DIFFERENTIAL FLOTATION OF A COMPLEX LEAD ORE

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"M.Sc. THESIS"

The Differential Flotation of a Complex Lead ore by the use of Single Cell, Laboratory Type Apparatus for Intermittent Mechanical agitation; and a comparison of these results with those obtained with an 8 Cell Continuous Agitation Machine.

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If the amount of literature published on the subject of flotation in the past few years be taken as a criterion, the increasing importance and economic value of the art will be realized. Numerous Flotation plants recently put into operation could be cited to further illustrate this statement.

In some cases of ores amenable to Flotation it has become an economic question to decide whether to use flotation or gravity means of concentration, while in others, although not a panacea, flotation has resulted in a tremendous saving of mineral in the finer sizes where ordinary means of separation by gravity processes failed.

As flotation is particularly adapted to treating fine sizes, its benefits are best seen in the treatment of finely disseminated ores of a complex character, which necessitate a great degree of crushing to liberate the various minerals contained in the ore.

Notable in this connection is the Sullivan ore, mined at Kimberly, B.C., which will be described in greater detail in the practical section of this paper. It is sufficient to remark here, that flotation proved the salvation of that particular ore which after years of more or less unsuccessful experimental treatment by other methods is now being successfully treated by the Consolidated Mining and Smelting Company at Trail, B.C.

Various other cases might be instanced of ores which have defied treatment by older methods, or of low grade ores of various characters such as copper-nickel ores, low grade silver, porphery copper, graphite, and many others.

Taking again the economic standpoint, formerly it was common practice to extract a relatively small part of the valuable constituent of an ore, as more complete recovery, involved excessively costly and therefore unprofitable operation.

Of late years the necessity has arisen to increase the extraction, particularly in the case of lead, as few new deposits have been discovered recently. With the advent of flotation many low grade ores and tailings dumps are being retreated profitably.

"FLOTATION IN PRACTICE DEFINED"

Flotation in present day practice consists in the formation of a froth in a suitable machine, continuously fed with a freely flowing pulp, to which have been added so called contaminants either to assist frothing to collect certain minerals in the froth, to produce such surface changes in the different minerals, to increase a variance in their flotable properties, such as enhancing the flotability of one mineral or decreasing that of another, or a combination of two or all three of these effects.

The froth containing the concentrates collects at the surface of the pulp and is skimmed, or allowed to overflow over a lip. The tailings containing that part of the ore which is non-flotable under the existing conditions are removed from the treated pulp, and either sent back for some retreatment or discarded as waste.

The types of machines used in practice can be divided into three classes, namely:-

1st. The Mineral Separators type, which depends on Mechanical agitation only for the aeration of the pulp. These machines consist of a series of cells or compartments. In the first cell is a fast revolving impeller or stirring paddle which not only gives thorough agitation of the pulp, but also introduces air into it. The pulp then overflows into a Spitz-kasten or relatively quiet settling box, where the mineral froth rises and the remainder of the ore settles to the bottom from whence it is drawn into the next agitation box by the action of its impeller.

Here it is again agitated with the introduction of more air, and again overflows to a settling box and so on through a succession of twelve to twenty cells, depending on the character of the ore and the mill requirements.

The impellers of a series of cells are driven by a shafting and belting usually from an electric motor.

2nd. (The Callow cell type). In machines of this class the ore is given its necessary agitation and treatment with oils or reagents prior to being admitted to the flotation machine.

The Machine is provided with a porous bottom beneath which is an air-tight compartment, and through which compressed air is introduced and released through the pulp. The mineral froth rises to the top and overflows into launders. The bottom is usually made sloping to assist in the movement of the unfloated portion of the ore to the discharge end where it is removed.

3rd. The Sub-aeration type. The machines in this class depend on both machine agitation and on compressed air for their agitation and aeration. The mineral separation machine of this type is composed of a series of agitation cells similar to those in class 1, except that they have a nozzle through which compressed air is introduced. The mineral froth is skimmed off as in class 1, and the unfloated portion removed.

Other machines of this class have different methods of introducing air, such as the admission of the air through a spray, or porous bottoms, or through the periphery of the impeller.

The usual practice is to introduce the pulp to an agitator, such as the Pachuca tank, wherein the reagents and oils are added, thus insuring a thorough mixing of pulp and reagents. The agitators are discharged into cones to provide a steady feed for the flotation machine. In some cases the reagents are added in the tube mills which form the final stage in the crushing or grinding plant, but this is not always practicable due to subsequent desliming or settling processes.

In other cases better results are obtained by adding reagents direct in the flotation machines themselves.

Practically all processes of flotation retreat their products to obtain either a cleaner concentrate or to increase the extraction. Satisfactory results rarely attend the first run of an ore through a machine. This retreatment may be carried on in the same machine as a closed circuit, or may be carried on in a different machine of the same or another type.

Some flow sheets are exceedingly complicated.

"HISTORICAL DEVELOPMENT"

In the introduction to the subject of this thesis it might be well to give a brief summary of the historical development of flotation without going into too great detail.

Although the affinity of oils and fatty substances for certain metallic minerals and metals was known to the ancients, the progress of flotation may be roughly divided into three parts.

In the first period, from 1860 to 1902, at least a dozen methods of causing sulphides to float on an ore pulp were developed in laboratories but never proved economically practicable.

These may be subdivided into two classes chiefly:-

1st. The selective action of oils and certain fatty substances entrapped the sulphides and due to the buoyancy of the oily substance, floated the sulphides.

2nd. The selection of a gas for sulphide particles buoyed them to the surface.

The second period from 1902 to 1907 wherein these two fundamental ideas were brought together.

Finally the third period, 1907 to the present in which the ideas were put to economical use, and suitable mechanical ideas brought forth.

It is seen from the above that the first two periods were those of the inventor, while the third is that of the Engineer.

In reading over the volumes of literature published on the development of flotation and the processes patented, one realizes the great diversity of ideas and their applications,

all based more or less on the fundamentals of the present day process, but in most cases the uneconomical results proved to be an overruling factor.

The following is a summary of the development:-

In 1860 William Haynes discovered a process in which he used an oily, gummy or bituminous substance to separate mineral sulphides. By mixing coal tar and resin, with crushed ore in the proportion of 5 to 9, he made a dough which would hold the sulphides while the gangue was washed away by water. This process had no commercial application.

In 1886 Hezekiah Bradford, an American, invented a process based on surface tension factors. In this process the flotation of sulphides on the surface of a liquid at rest was affected. Although this patent had no commercial application, it is important, in that it is probably the precedent of the De Bavay and Wood types.

During the same year Carrie J. Everson, an American, discovered the selective action of oily substances for sulphides, (Haynes) and also the flotation of sulphides on a liquid at rest, (Bradford) but further found that acid increased the action even when present in very small quantities, and finally that the oiled mineral could be separated from the gangue by a thorough agitation of the mass, skimming off the scum, and that the gangue could be drawn off the bottom .

The amounts of oil used were 6%, 12% and 20% of the weight of the ore; and the acid, less than 1%.

The amount of oil used points to the conclusion that it was used for its selective effect, as the buoyancy of the oil

alone could not float the sulphide, and this further proves that air must have been introduced in some way, probably during the thorough agitation specified.

This patent is important as it contained all the essentials of the modern practice, and probably it was just by chance that flotation at that time was wholly successful.

A capitalist named Crilly financed the undertaking of large scale tests at Baker City, Oregon, in 1889. The ore was crushed to 50 mesh, and roughly mixed with thick black oil. Boiling water and acid were then added and a flotation affected. The amount of oil used made the cost excessive.

In 1892 the Hebron-Everson process was patented. The ore was pulverized with a buoy-stock in a dry state then submitted to a stratifying apparatus into which air could be introduced to produce effervescence.

The failure of this process was due, to a great extent, to the fact that it was such a startling innovation that those who were skilled in the art of concentration looked at it askance, and no real serious investigations were made.

Another unsuccessful attempt was made by Robson and Crowder, two Englishmen, in 1894. In this process the ore was mixed with a little water, about 20 - 30%, and the pulp placed in a vessel with a suitable agitator and oil added at the bottom and allowed to overflow.

The next step was an improvement on the above process developed by Francis E. Elmore, another Englishman. He increased the amount of water to a freely flowing acid pulp, and used the

selective action of an equal or greater weight of oil than in the Robson patent.

After gentle mixing in a revolving drum to prevent emulsifying the oil, the pulp ran into a setting compartment. The oil was separated from the concentrates by a centrifugal apparatus.

This process was worked on carefully and the defects improved resulting in large scale commercial application. It was the first practical flotation process and was used up to 1905.

James W. Van Meter, and Martin P. Boss invented and installed a flotation plant at the Santa Barbara and Alpinina Mining Co., in Peru, in 1902. Although the apparatus was different the main principles were the same as the above, and the rights were taken over by the Elmore Company.

In 1902, Charles V. Potter invented a process in Australia, whereby flotation was accomplished in a 1 to 10% solution of acid with the application of heat.

About the same time Gullaume Delprat developed practically the same idea, but with the use of salt-cake, in place of sulphuric acid. Both of these men used small quantities of oil. They assumed the gas produced in the process to be sulphuretted hydrogen, generated by the action on the sulphides, whereas the greater volume of the gas was really carbon dioxide generated from the carbonates present as gangue minerals.

During this same year Alcide Froment showed the importance of gas bubbles in a freely flowing pulp, while working on the flotation of the ore at the Traversella Mine in Italy. He enunciated the important principle:- "The rapidity of the formation

of the spherules and their accension is in direct ratio of the quantity of gas produced in the pulp in a given time." In his process he deliberately added calcite to produce gas bubbles. The Minerals Separation Company bought his patent in November 1903.

The Cattermole process, invented in 1903, made use of 4% - 6% of oil added to a freely flowing pulp, and also 2% of soap to coagulate the slimes. The separation was affected by an upcast current of water, whereby the gangue was taken off the top, and granules of coagulated sulphides taken from the bottom. This was a commercial failure.

The "Agitation froth process" of the Minerals Separation Limited, developed in 1905, caused the tails from the first Spitz-Kasten to flow over an inclined surface, so that the oiled particles which had escaped coming in contact with air bubbles came into contact with air, and took up a proper air film, and floated in a second Spitz-Kasten. An extremely small amount of oil was used, the upper limit set by the decision of the Supreme Court being 1%.

Goyder and Laughton invented a machine in 1903, employing Potter's idea. They were the first to disclose the principle governing the Delprat - Potter acid flotation.

The difficulty in their process was that the bubbles were not persistent in reaching the surface.

The Elmore vacuum process, 1904, made use of small quantities of oil and the liberation of finely divided air in the pulp. This liberation of air was accomplished by a vacuum and by heating; the air released amounting to 2.2% of the volume.

This process is abandoned at the present time.

In this same year Auguste J.F. De Bavay, an Australian, floated the sulphide minerals by a straight surface tension method, by bringing a thin film of pulp to the surface, where the sulphides floated. The slimes had to be removed, and any carbonate film due to weathering was removed by a solution Carbonate of Ammonia or Carbonic acid gas prior to flotation.

The MacQuisten tube also made use of the surface tension of liquids for separating minerals, but all these processes had difficulty in the treatment of slimes.

Lockwood and Samuel in 1908 effected a separation of minerals by a method of increasing the selectiveness of minerals for oils by treatment with various salts, then effected a magnetic separation, sometimes by the addition of magnetic substances.

The first large scale attempts at flotation made in the U.S. used the process of James D. Hyde in 1911.

The process consisted in the addition of small quantities of Sulphuric acid with or without iron sulphate, to coagulate slimes in a freely flowing pulp. The pulp was taken off rapidly and retreated in a second machine with no freely flowing water.

At the present time the foregoing processes have been practically eliminated with the exception of the Minerals Separation and the Potter-Delprat processes, which have been developed and improved upon continuously, particularly that of the Minerals Separation, Limited.

The greatest problem today is not that of a separation by simple flotation of sulphides from a worthless gangue, but a differential flotation of one valuable mineral from another, particularly illustrated by a complex sulphide ore. The first idea of differential flotation was put forth by Sulman, Picard and Ballow in 1905. They discovered that by immersing a mixture of sulphides and gangue, then exposing the mixture in air and again immersing, that the sulphides floated, and further that the time of exposure necessary was different for different sulphides. Although their practical application at the time failed, they developed the principle of differential flotation. Further strides were made in 1909 by Henry Azor Wentworth who rendered certain sulphides present in an ore non-flotable by a slight preliminary roast.

Great advances in mechanical details were submitted by T.J. Hoover in 1909.

The Mineral Separation, Limited, further improved their process in 1910 by details in handling the pulp, aeration, oils and time of treatment for the differential flotation of ores.

In summarizing the history of the development of flotation it may be said that the success of the art is due to the untiring efforts of many men and their belief in its initial success, although the theory was little if at all understood. It has developed slowly and wholly empirically along many diversified channels, and is still open to intense investigation, in fact, the greatest advances have been made in just the last few years. The essentials in present day practice of flotation are:-

1st. That the ore be crushed sufficiently to separate the various composite minerals, producing as little slime or colloidal matter as possible, and as the upper extreme the limiting size upon which flotation processes will work.

2nd. That the aqueous be at least four parts by weight of water.

3rd. That the pulp should be agitated for a definite time with certain reagents; namely, a froth producer, a froth sterilizer and gangue modifier. (The effect of each of the above will be gone into in detail in a later chapter.)

The agitation brings about a uniform suspense in the pulp, to produce maximum wetting and to disseminate the frothing agent and the immiscible oil. It further allows the modifying agent to deflóculate agglomerates or promotes flocculation as the case may be, and finally agitation introduces air.

The other processes as given above may be classified as follows:-

1st. Those which utilize the surface effects at a water surface. These are the filming processes, such as the DeBavay, Bradford and MacQuisten.

2nd Those in which oil is employed both as the adhesive and buoyant medium, called the oil -buoyancy processes, illustrated by the mass oil Elmore process.

3rd Adhesion of oil or grease for particles without the actual recovery by flotation, illustrated by the Murex Cattermole grease-plate process.

4th Those dependent on froths produced by gases generated chemically, such as in the Potter-Delprat and Froment process.

5th The Elmore vacum and "plus" pressure methods.

"THEORY"

In giving the theory of flotation there will be an unavoidable repetition of the previous theses on this subject, but the author of the present thesis feels that no report is complete unless it is self-contained, hence the following will be a concise statement of the theory of flotation including any new points which have come out in recent literature.

It appears from the many papers and articles prepared by those men who are considered authorities on the subject, that the fundamental principles underlying flotation is that of surface energies and surface tension. The success or faliure of operation depends upon whether or not the desired results are brought about by such changes that can be obtained in surface energies or their resultants.

"SURFACE TENSION AND MOLECULAR CONSIDERATIONS"

Surface tension is that condition of stress existing at the surface of all liquids, and assumed to exist at solid surfaces.

That surface tension exists on all liquid surfaces is manifested by many experiments. The surface appears to act as an elastic skin, shown by the fact that certain metals and metallic substances may be supported there. There is one great difference, however, which will be explained in this discussion, and which should be born in mind. In the case of the elastic skin, the point directly subjected to a weight is in greater tension than the remander whereas the surface tension of the liquid is equal at all points.

The conception of surface tension is based on the molecular theory. This theory states that "gases, liquids and solids are composed of finite, physically indivisible particles called molecules. These molecules are separated from each other by distances which are comparatively small in solids, somewhat greater in liquids, and very large in gases, depending upon the conditions under which they exist. All are in rapid motion, increasing and decreasing with a rise or fall in temperature.

The molecules have an intense attraction for one another, but it is manifested over a very small distance. This accounts for the different characteristics of gases, liquids and solids.

In the case of the gas, the molecules are so far apart that little if any influence is felt by one molecule for another, and for this reason the molecules are free to move around in any direction, and a gas will occupy homogeneously any container into which it is put. The free mean path of a molecular of a liquid is much less, probably not more than the diameter of the molecular, but the molecules are still able to move freely amongst each other. Due to this fact liquids are mobile, and will conform to the shape of its container with one plane surface at the top. With solids the arrangement of the molecules is much closer, so that while the molecules are in motion they are not free to move about amongst each other.

The point to be brought out by this understanding is that the three classes of substances grade from one into the other, and while surface tension can be proven to

exist in liquids, it can be inferred by analogy to exist in solids to a greater degree.

It would seem unreasonable to believe that by lowering the temperature to a point beyond the limits of the liquid state of a substance that surface tension should suddenly disappear. Mathematical considerations also prove the surface tension of solids to be of higher order than that of liquids. These liquid surface tensions will be confined in the discussions to liquids, the conclusions applying solids to a greater degree.

With the molecular consideration then surface tension may be defined as the resultant of molecular activity within the body of the liquid, acting at the surface and parallel to it.

W.R.Ingalls states, "A body of water, or of any liquid, has greater cohesion at its free surface than elsewhere in its interior, because whereas the particles are actually attracted by the adjacent particles in all directions, those which are at the surface have no attraction for outside, to conteract the pull from those at the interior."

The effect of this is to reduce the mobility of the particles on the surface, and figuratively speaking exerts a pressure on the interior. The production of the surface tension represents energy, i.e. molecular energy which may be measured. Surface tension is expressed in dynes per centimeter and thesis.

Surface energy = Surface tension X area

This phenomena of surface tension may be more clearly demonstrated with the aid of a diagram -

Suppose xy to represent the surface of a body of a liquid xaby. Then let z represent a molecule near the surface and acbd be the limiting sphere of its attraction. It is seen that provided the limiting shere of attraction of a molecule does not cut the surface of the liquid that the attractive forces will be totally compensated. In the case of the molecule z however, that segment represented by abd is not balanced by any force above and there is a resultant pull on the molecule towards the centre. This partially explains the phenomena of the tendency of a drop to assume a spherical shape , further since total energy surface tension x area, and since the sphere has the smallest surface of any form for the same volume, this shows the tendency of surface energies to assume a minimum.

Further, taking the surface layer of molecules, (diag. 2)

fig 1.

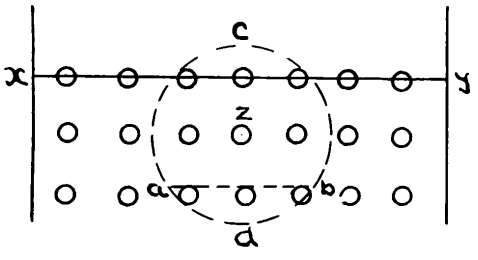
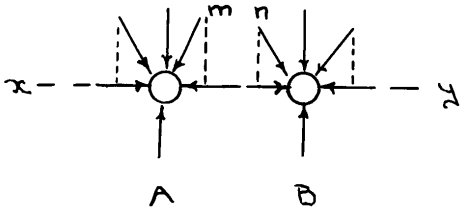


fig 2.



the forces acting on any molecules A & B may be resolved into vertical and horizontal components. The horizontal components of any unbalanced forces such as m and n attract one another and set up an incresed strain at the surface, effecting as it were a closer interlinking of the surface molecules.

From both diagrams 1 and 2 it must be understood that these effects grade from a maximum at the very surface layer into the body of the liquid.

Surface tension is therefore due to unbalanced molecular forces, and is a function of the strength of attraction between the molecules. That attractions between like molecules of one liquid differ from attractions of like molecules of another, is shown by differences in their respective boiling points. The boiling point of a liquid is the point at which the molecules in motion overcome the attraction of the other molecules in the body of the liquid, and pass off, forming vapor. In reality they are overcoming the surface tension effects for the liquid.

Another point to be brought out here is that if a depression is made in the surface of a liquid, the tension is not increased, but due to the mobility of the liquid, new molecules move up to form new surface, and the surface tension is constant in the molecules and retain their original spacing. This explains the difference between an elastic skin and the surface of a liquid.

If a molecule be raised against these unbalanced forces it continually gains in potential energy till it reaches a maximum for that system at the surface. This potential energy is the cause of the surface energy. To make this a minimum, the surface tends to contract to a minimum, i.e., a sphere.

If a plane be taken through the body of the liquid at one point, there would be forces exerted by the molecules on either side of the plane, equally and in opposite directions. This is cohesion, and the force varies with the square of the density of the liquid.

If no other force existed and the molecules were at rest, they would finally draw up together, total incompressibility resulting from cohesion.

Experiments show that all substances are compressible and distensible, thus there must be some force responsible for the maintenance of molecular distances, and this force has been termed intrinsic pressure. Intrinsic pressure then must be equal and opposite to cohesive force.

Cohesion is dependent on molecular attraction and thus varies as the square of the density of substance. It is evident that the cohesion of a solid is greater than that of a liquid.

"INTERFACIAL TENSION"

The surface tension is theoretically measured at the surface of a liquid in vacuo. In practice this is never obtainable, as the surface is always in contact with another substance, whether the vapor of the liquid, another gas, liquid or solid. This brings in another phase of the subject, namely "Interfacial tension", which is the factor always encountered in practice.

Again referring to the molecular theory, all substances and particularly their surfaces, are porous, due to intermolecular spaces. When two seats of energy (i.e. Two surfaces)

come together, these spaces permit an inter-penetration to some extent making only one seat of energy. This is interfacial tension.

Interpenetration can be shown for two solids such as gold and lead, for two liquids by diffusion, for a liquid and solid by permeability, for a gas and solid by occlusion, and numerous other examples.

The resultant interfacial tension depends whether the forces coming together tend to attract or repel one another. If there is attraction the resultant interfacial tension will be less than the tension of either, and if they mutually repel one another, a strain greater than either one will be set up.

Where there is no adhesion, there is no attraction and the interfacial tension is a maximum, and equal to the sum of the two tensions of the substances in contact.

Interfacial tension may be varied by:-

(1) Contaminants (any substance capable of being adsorbed). The effect of these substances will be taken up in a subsequent chapter.

(2) Heat applied to:-

(a) the solid phase

(b) applied to the liquid phase.

(3) Electrical energy.

"DIFFERENTIAL WETTING".

The effect of interfacial tension is the phenomenon of differential wetting. A common manifestation of it is the meniscus of a liquid in a glass tube.

"DIAGRAM"

3. 4

Figure 3 shows the appearance of a water surface in a glass tube, while figure 4 represents mercury in a glass tube. In the former case the water seems to be attracted by the glass, and tends to wet it to as great a degree as possible, while in the latter case the mercury is repelled from the surface of the glass and tends to draw away to make the minimum contact possible.

A difference in the action of a drop of water on a sulphide mineral, and on a gangue mineral, such as quartz, or feldspar, was noted many years ago. An experiment was tried in our own laboratory with crystals of pyrite quartz, and orthoclase feldspar. When a drop of water was placed on the pyrite, it appeared to stand up from the face of the crystal, and draw itself into a shape approaching a sphere. This drop could be moved readily around the face of the crystal with a glass rod, leaving the pyrite apparently dry.

This was not the case with the quartz or feldspar, but the drop tended to flatten out, and could only be dislodged with difficulty, leaving behind droplets of water on the surface of the crystal.

The effect is due to the interfacial tension which tends to prevent lateral extension, this being opposed to some

extent by gravity. The degree of adhesion of a liquid to a solid is determined by the liquid - solid interfacial tension, where one is a maximum, the other is a minimum.

Referring back to the porous structure of the surface of minerals, there is always an impenetration of water molecules to a greater or lesser degree, and these act as nucleii for condensation of like molecules. This enhances the wetting of the mineral by water, and may even destroy its flotable properties. Here is the probable explanation of the fact that heated minerals are more readily floated.

Many experiments have been made to measure the contact angle between liquids and solids. When accurate measurements were made, it was found that the contact angle for a definite liquid and solid was not consistant, as formerly supposed, but varied between certain definite limits. The variation is known as hysteresis of the contact angle, and is dependent on surface conditions of the solid such as porosity, and changes due to skin friction. The maximum and minimum angles for a given liquid and solid are always found to be the same. The effect of hysteries of contact angles is to give a wider range of equilibrium to a particle floating by surface tension.

Contact angles, then, may be taken as a measure of the floatability of a mineral under definite conditions. Due to the complexity of conditions and systems, it is of little practical value.

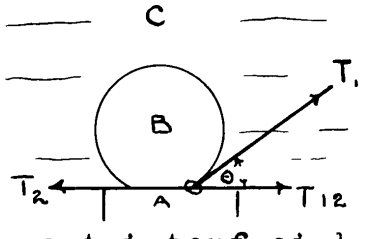
An interesting point to note is that cleavage planes show less energy than fractured surfaces, and thus cleavable

minerals tend to float more readily than non-cleavable minerals, particularly when freshly cleaved.

In practical considerations, three phases enter into equilibrium of the interfacial tension system, namely the gas, usually air, the liquid, and the solid phase, the latter being the mineral particle. It is possible that the gas molecules, let us say air, relieve the surface strain on the solid particle to a greater extent than does water, the liquid phase. In this case, due to that inherent property of interfacial tension to become a minimum, the air will tend to exclude the water from the surface of the mineral particle. This is what really happens in the case of a sulphide particle in contact with air and water. With a gangue particle the reverse happens, ie. the water tends to exclude the air.

To express these qualities mathematically, take the figure of a bubble "B" attached to a solid particle "A" immersed in a liquid "C". For three substances observed, the bubble will always assume definite shape.

"DIAGRAM"



Let T_1 represent interfacial tension of liquid in contact with gas.

Let T_2 " " " " solid "

" " "

$$T_2 = T_1 \cos \phi \times T_{12}$$

$$\therefore \text{Cos}\theta = \frac{T_2 - T_{12}}{T_1}$$

The above equation propounded by H.L. Sulman expresses the extent to which the surface tension of a solid is reduced by contact with a liquid at the interface between them, and will determine the angle of contact between the air-liquid and liquid - solid interface.

Another system to consider is that of two immiscible liquids in contact with a mineral particle. Here again we have an equilibrium of interfacial tensions, which tends to become a minimum. If T_1 be the surface tension of one of the immiscible liquids, and T_2 be the surface tension of the other immiscible liquid, and T_s be the surface tension of the solid,

Then if $T_{2s} > T_{1s} \times T_{12}$ the solid will remain unchanged in T.

" " $T_{1s} > T_{2s} \times T_{12}$ " " " go into liquid 2.

" " $T_{12} > T_{2s} \times T_{12}$ " " " collect at the liquid-interface and tend to separate the liquids.

"ADSORPTION"

The greatest factor available in practice for the variation of interfacial tension is adsorption. It is another name for surface concentration, and is defined by Mr. Taggart as "The process of rearrangement of a system which results in establishing a difference in concentration, as between the interfacial layers, and the bulk of the phase of a substance initially uniformly dispersed."

Thus a change in surface energy of a liquid is brought about by dissolving in it some substance which will cause an

excess or deficiency of the dissolved material in the surface of the liquid, compared to the concentration in the bulk of the liquid. An excess in surface concentration is termed positive adsorption and a deficiency - negative adsorption.

Adsorption in its action is opposed by the tendency to go into solution, i.e. to equalize the concentration at all points, to be homogeneous.

It is not necessary for the contaminant to be soluble, provided it is in a fine enough state of diversion, but the greatest effect is obtained from the soluble class, probably because the soluble contaminant is in molecular dispersion.

To determine the effects of positive and negative adsorption, consider a system, containing water and a contaminant. According to Sulman if the attraction between the foreigh particles or molecules and the water is less than the attraction of water for water, they will be pushed to the surface. In this case the work required to send the foreign particles and molecules to the surface is less than that required to bring the water to the interior, therefore the surface possesses less energy. This is positive adsorption.

If on the other hand the particles or molecules have a greater attraction for water molecules than water has for water, they will tend to move to the interior, and only a few remain at the surface, and due to their greater energy increase the surface tension. The surface tension can only be slightly raised since so few foreign particles or molecules remain at the surface, whereas it can be greatly decreased by positive adsorption.

"ELECTRICAL ENERGY"

An electric field can be made to reduce the surface tension of water by opposing the molecular forces, but there are no practical applications of it.

"CONTAMINANTS"

Contaminants have been classified as follows:-

1. Oils and their fractions
2. Acids and Alkalies
3. Salts
4. Colloids
5. Gases.

These classes shall be dealt with separately.

"OILS"

The oils used in flotation are composed of two fractions, the immiscible part, and the miscible part.

Both are necessary according to Taggart, who made a thorough research with varying proportions of an insoluble oil, such as Nujol, and a very soluble oil such as phenol and cresol. In this series of tests he claimed that the maximum frothing was obtained when the ratio of insoluble oil to soluble was 2 : 1.

The immiscible oil is adsorbed and tends to coat the sulphide particles to the exclusion of the water. It further tends to coat the air bubbles and assist in bringing about the correct balance between air and water and solids. The air bubbles then attach themselves to the oil film surrounding the sulphide particles and buoy them to the surface. The condition most desired is that the sulphide goes into the water-oil interface.

Mr. Taggart pointed out that the molecules of oil

exhibited polarity. The polar ends of the molecules of oil turned to the sulphide particle, leaving the non-polar ends out towards the water interface, which is the condition required for the precipitation of air bubbles.

The presence of immiscible oil stabilizes the froth by increasing the hysteresis of the contact angle, importing a wider range of equilibrium in the mineral froth. It makes the films more viscous, the mineral particles present having the same effect.

The insoluble oil does not affect the surface tension, or does not cause frothing. It may act even as a reservoir for the soluble portion of the complex oil, particularly if it is adsorbed at the interface.

The function of the miscible oil is to decrease the surface tension of water and to produce frothing. The presence of the soluble oil increases the viscosity of the surface film.

The oil in solution is capable of adjusting itself in concentration, so that the surface tension developed at any particular portion of a bubble will be just sufficient to balance the strain put upon it. It is a well known fact that pure water will not froth, and persistence of froth is dependent upon the variable surface tensions.

Thus the soluble fraction of an oil may be termed the "Frother".

Over oiling has the effect of making a touch froth, which is harmful in that it brings up too much gangue, producing

a dirty froth and concentrate. This effect is more pronounced in frothing oils than in collecting oils.

Another deleterious effect sometimes encountered in flotation is that of "raw" oil. If a few drops of oil be placed in the spitz-kasten of an M.S. machine, the froth is immediately killed, nor will it reform till the oil has been thoroughly mixed with the pulp. This is caused by a skin of oil forming over the water, i.e. in the air water interface. The amount of oil necessary is governed by:

1st. The surface of the sulphides.

Collecter - a large amount necessary for slimes.

Frother - a small " " " "

2nd. Amount of water.

Governing the frother only.

3rd. Air bubbles.

Increased air lessens the amount of oil required.

"OTHER REAGENTS"

The addition of other reagents to a flotation pulp may be to further stabilize the froth by adsorption of the foreign matter. To float a mineral and yet have a stable froth, it is necessary to add a reagent which will not be so strongly adsorbed as to displace the mineral, but a joint adsorption effected. This condition is partly filled by the soluble portion of the oil and partly by the modifying agent.

These modifying agents further differentiate the adsorption by the various minerals present, giving a cleaner

separation by enhancing the floatability of one mineral, and depreciating that of another.

This is what actually happens in the case of a gangue mineral. Quartz, for example, adsorbs oil to a certain degree. By the addition of certain modifying reagents that lower the liquid - solid interface, the quartz is more certain to be wetted by water.

When a number of homologous reagents are added together, the resultant depression in surface tension is found to be equal to the sum of each independent depression.

Acids, Alkalies, sodium silicate and fluosilicate reduce the interfacial tension, water-mineral exceedingly.

"ACIDS"

Acids when added to an aqueous pulp appear to lower the solid-liquid interface, particularly that of the gangue-water.

In some cases acids "cut" the oil, forming emulsions. Probably one of the chief factors in the use of acids is their properties as flocculators. Flocculators help the flotation of the large particles.

"ALKALIES"

Alkalies on the other hand are deflocculators, breaking up floccules and permitting a better differential action.

This class of reagents usually causes the best dissemination of the oil through the pulp, and lastly in some cases form soap, when used in conjunction with certain oils.

It is desirable to flocculate the sulphides, but to

deflocculate the gangue, therefore a balance must be struck between the two.

"SALTS"

Salts, as well as acids and alkilies may act in two ways.

(1) To modify existing physical conditions.

(2) To produce some chemical change on the surface of the minerals.

It has been determined that the salts of the metals of the higher valences have greater effects on surface energies than those of the lower valences, but in an enormously increasing ratio.

With all modifying agents, it is found that the best results are obtained by using an amount well below that required for saturation.

"COLLOIDS"

The presence or absence of colloids in an ore has always been an elusive question, and has been the subject of much theorizing.

In the light of the molecular theory and that of interfacial tension, the difficulty presented by colloids lies in their immense specific surface. It was shown previously that surface energy = Area x Surface tension. Colloids therefore possess enormous surface energy, and are capable of being adsorbed, and of adsorbing reagents and oil. Furthermore, it is practically impossible to float them.

That colloids adsorb ions is shown by their tendency to migrate in an electric field.

Consequently, where colloids are very troublesome in an ore, precautions should be taken to remove them before going to the flotation machine.

There are two types of colloids, namely

(1) Reversible colloids - those which can be coagulated or precipitated and redissolved.

To this type belong aqueous solutions of glue, gelatine, etc. These are less susceptible to electrolytes, but tend to wander to the negative pole under the influence of an electric field.

(2) Irreversible colloids - those which cannot be redissolved on precipitation. To this type belong stannic acid, ferric oxide, alumina, etc. For this reason it is said that the presence of soluble compounds of the heavy metals is deleterious to flotation.

These colloids wander, usually, towards the positive pole of an electric field, and are more susceptible to electrolytes.

Most colloids in ores are of the irreversible type, and may explain the benefits of $CuSO_4$ & etc. Further, heat precipitates irreversible colloids, hence the benefit of heat flotation.

There are certain organic colloids called protective colloids, on account of an inherent property of being capable to convert colloids of the irreversible to the reversible type, and thus stabilize them. In practice these can usually be overcome with potassium permanganate.

"GAS"

The gas most commonly used in flotation is air, although carbon dioxide, sulphur dioxide and sulphuretted

hydrogen are used in some localities.

The function of the gas is to form bubbles in the pulp, thereby greatly increasing the liquid - gas interface in which the sulphide mineral collects by the various phenomena previously mentioned, and is brought to the surface by the buoyancy of the gas bubbles. A mineral froth is formed at the surface in this way.

The action of the gas was taken up to some extent in differential wetting. Films of gases are attracted to the surface of certain solid particles and adhere strongly in some instances, and are only displaced by the liquid with considerable difficulty. This explains the difficulty in wetting sulphides.

The surface tension of a bubble decreases as the curvature of the surface increases, but it is only when the radius of curvature is very small that the surface tension diminishes perceptibly. As the liquid surface tends to contract, the pressure on the gas is increased and is therefore always higher than atmosphere pressure.

Apart from the interfacial equilibrium and buoyant effect, some gases have probably a chemical effect on the surface of certain minerals. Probably the use of H_2S gas has an effect of providing a thin sulphide film on the surface of certain minerals by which it is preferentially adsorbed.

"EFFECT OF SIZE"

It can readily be understood that the size of the particles has an immense influence on flotation. It has been

pointed out that substances which are colloidal or approaching the colloidal state are extremely troublesome, as the subdivision of minerals is continued, the effect of surface energies and molecular forces are greatly increased, while that of gravity is continuously decreased. On the other hand experiments show that particles of galena larger than 1.77 mm. will not float on the surface of pure water.

To equalize conditions for several minerals present in a pulp it would be necessary to have all mineral particles the same size. The result would be a sharper differential action and a cleaner separation. This, however, is impractical.

On the other hand, water classification would be best for the differential flotation of minerals of nearly the same specific gravity.

With an understanding of the surface energy effect it may be stated that of two particles of the same mineral, the smaller has the greatest flotative intensity. Of two particles of different minerals, the widest difference in total flotative intensity would result, if particles of the lighter mineral were smaller, and had higher unit flotative intensity, because the difference in weight is greatest, and the specific surface increases as the size decreases. Unfortunately this association cannot be realized by classification, and the amount of crushing must be determined independently for each ore. There is a certain size, the surface energy of which will more nearly satisfy conditions demanded by certain frother, than other sizes do.

(1) The finer the ore the greater recovery for a given quantity of oil.

(2) The greater the depression in surface tension the greater the recovery of ore, the lower the grade.

(3) For a given depression the finer the ore the greater the recovery.

(4) Depression must be greater for coarse material.

"WET AND DRY CRUSHING"

The difference in the surface of a freshly crushed mineral has been noted. There seems to be a rearrangement of the molecules at the new surface necessary to restore it to its original properties, and this takes time in solids. The surface is more permeable and is therefore usually wetted to a major degree with gangue minerals which have a good cleavage. It will prove advantageous to crush wet, insuring a maximum wetting, and destroy their tendency to float.

H.L. Sulman has shown the surface alternation which takes place after fracture by the use of polarized light.

Other crushing effects are changes in the surface due to attrition (such as solid "flow" this surface being more soluble); and that sulphide particles may be made to impregnate the surface of gangue particles. The latter effect is important in that it may account for the presence of some gangue in the flotation concentrates.

"PULPRATIOS"

A more dilute pulp gives a cleaner froth, because the particles of ore are more widely disseminated in the pulp, and each acts according to its own properties, or flotative ability. With a thicker pulp the larger particles are probably buoyed up by the smaller ones particularly by floccules when a flocculating agent is present. Thus a more concentrated pulp gives a higher total extraction. The dilute pulps require more oil due to the greater dispersion.

A conclusion to be drawn from the above is that probably for roughing work, it is better to use a thick pulp, while a more dilute pulp is better for cleaning work.

"EMULSIONS"

Emulsions in connection with flotation are the suspensions of droplets of one liquid in another immiscible, but not necessarily insoluble, liquid. These droplets are usually oil in a water phase, and are larger than colloidal sizes, and hence more subject to gravity and less to molecular forces. Emulsions are therefore more sluggish in adsorption than solutions.

These droplets tend to coalesce, i.e., to lessen the interfacial tension, and require a third substance to stabilize them by lowering the potential energy of the system.

True emulsions, however, are incapable of being adsorbed and hence are not active in flotation. For this reason it is essential that the oil be only temporarily in suspension throughout the water of a pulp and not truly emulsified.

"DIFFERENTIAL FLOTATION"

C.W. Fahrenwald defines differential flotation as the separation of two floative minerals by altering physical properties, whereas preferential flotation implies that one mineral undergoes some chemical alteration of surface.

As many gangue minerals,noticeably those with good cleavage, and to some extent quartz, show a tendency to float, all flotation operations are a differential action. For this reason the term "Differential Flotation" has come to be applied more strictly to the separation of several sulphides present in an ore.

Differential flotation may be brought about by:-

(1) Accentuating flocculation or deflocculation.
(2) Limitation of film stability.
(3) Modification of mineral surface properties.
(4) Limitation or control of bubble surface.
(5) Variation in particle size.

All the above methods are purely physical.

Preferential action as defined above may be brought about by:-

(1) Fractional roasting (i.e.) Galena may be oxidized at a temperature which will not affect sphalerite and the galena rendered non-floatable.

(2) By treatment with chemicals which affect the soluble sulphides.

(3) By the use of oxidizing or reducing gases.

- - - - - - - - - - - - - - - - -

The problem in the differential treatment of a galena-sphalerite ore is to decrease the galena-oil and

sphalerite-water interfaces, and increase those of galena-water and sphalerite-oil.

Due to the many variables encountered in flotation, particularly that of the assortment of sizes, a sharp differentiation cannot be hoped for, and the separation is governed usually by the grade of concentrate required by the smelter, together with the extraction obtained.

Each ore must be tested empirically.

"SUMMARY"

For the floatation of an ore there must be present a liquid, usually water, a gas, in most cases air, and a contaminant, either oil or a modifying agent or both. There must be some device to admit the gas in a finely divided state, either produced by mechanical agitation or by compressed gas.

(1) Interfacial tension is the controlling factor. The tendency of a system to reach a minimum of surface energy manifests itself in flotation. For an ore particle to float, it must go into the oil-water interface or totally into the oil-phase. If no oil is used, it must go into the air-water interface. Otherwise it would be wetted and sink.

(2) Bubbles of gas act not only as a buoyant agent, but give an enormously increased surface or interface.

(3) Both insoluble and soluble oils must be present or an oil containing fractions of both. The insoluble portion adheres selectively to the mineral particles, while the soluble portion stabilizes the froth by adsorption.

(4) Modifying agents do not produce new effects but are used rather to increase or decrease effects already present.

(5) Mineral adsorption stabilizes the froth, more so if flocculated.

(6) Oils should not be so well emulsified that they will not be given up to the bubble-surfaces, but should be thoroughly disseminated through the pulp.

(7) Colloids are generally harmful in that they stabilize an emulsion of oil, or they are more strongly adsorbed at the bubble surface than the mineral, and prevent mineral attachment.

As H.L. Sulman states, "Flotation depends on the most advantageous selective adhesion, selective adsorption, and selective flocculation, between complex particles in an ore pulp.

"LABORATORY WORK"

The course of investigation and the subdivision of the work in the laboratory was arranged by Dr.J.B.Porter. The experimental work was carried out in the ore - dressing laboratory of McGill.University, which is now so well equipped with apparatus that the research students were able to carry on their investigations wholly independent of each other.

It was the intention of the writer at the beginning of the session, to run a comparative set of tests on the continuous mechanical agitation apparatus, but this was abandoned due to an insufficient supply of ore and a lack of time.

Frequent conferences with Professor J.W. Bell and Mr.Erlenborn afforded much valuable techinical advice.

"SULLIVAN ORE"

It was decided to choose an ore for the investigation which was being treated in practice by flotation, and which offered a large field for intense research work. Such consideration suggested a complex sulphide ore amenable to differential flotation.

The Sullivan ore, mined at Kimberly, B.C. and treated at Trail, is just such an ore, and although the results of the Trail practice are not common knowledge it is quite probable that they are open to improvement.

While it is almost impossible to draw a comparison between work carried out on a large scale, with numerous closed circuits and retreatment processes,

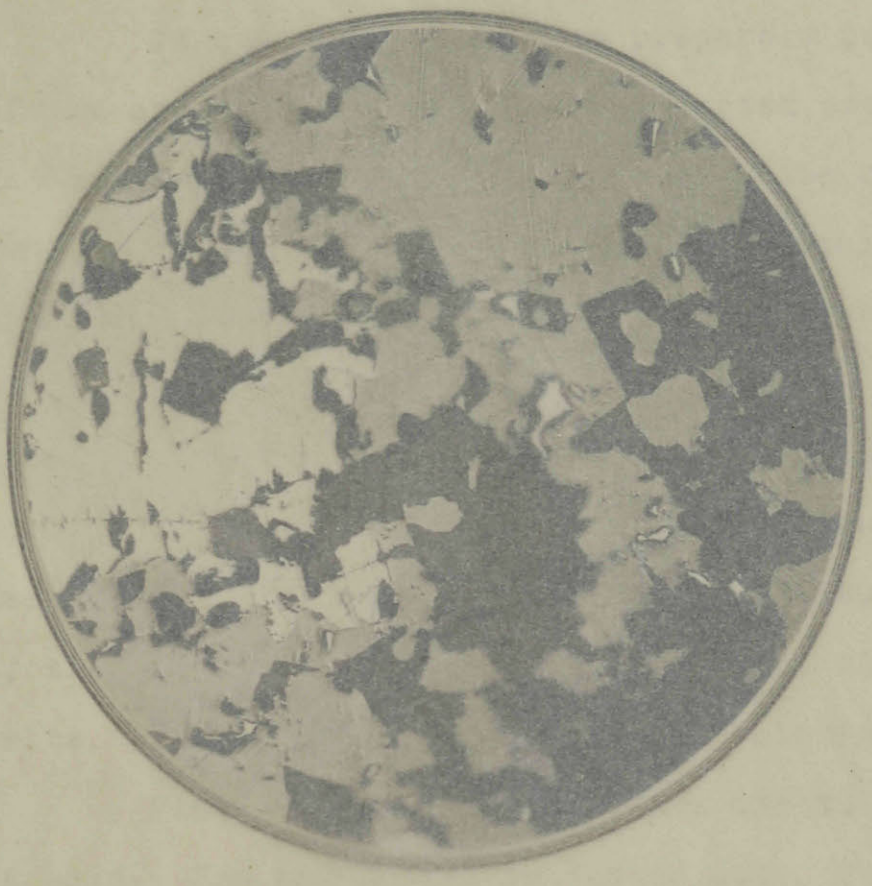
and that of testing apparatus, it is possible, and in fact profitable, to investigate the influences of reagents , used in flotation, and those of physical and mechanical details, as obtained in laboratory tests. These influences the writer has endeavored to determine.

The Sullivan ore, laboratory no.177, is a complex lead - zinc-iron sulphide ore with a small amount of gangue minerals.

Without going into the geology of the ore body at Kimberly, it is enough to say that it is not a true fissure vein, but occurs as a replacement of a fine-grained quartzite. The ore is a heterogeneous conglomeration of compact sulphides with very little gangue, and composed of blende marmatite, galena, pyrrhotite and pyrite, any one of which is liable to predominate, although in some places towards the centre of the ore body there are cleaner patches of galena. Outwards the ore body grades into a mixture of sulphide with garnets and actinolite and finally chert, and fine-grained quartzites, in alternating beds.

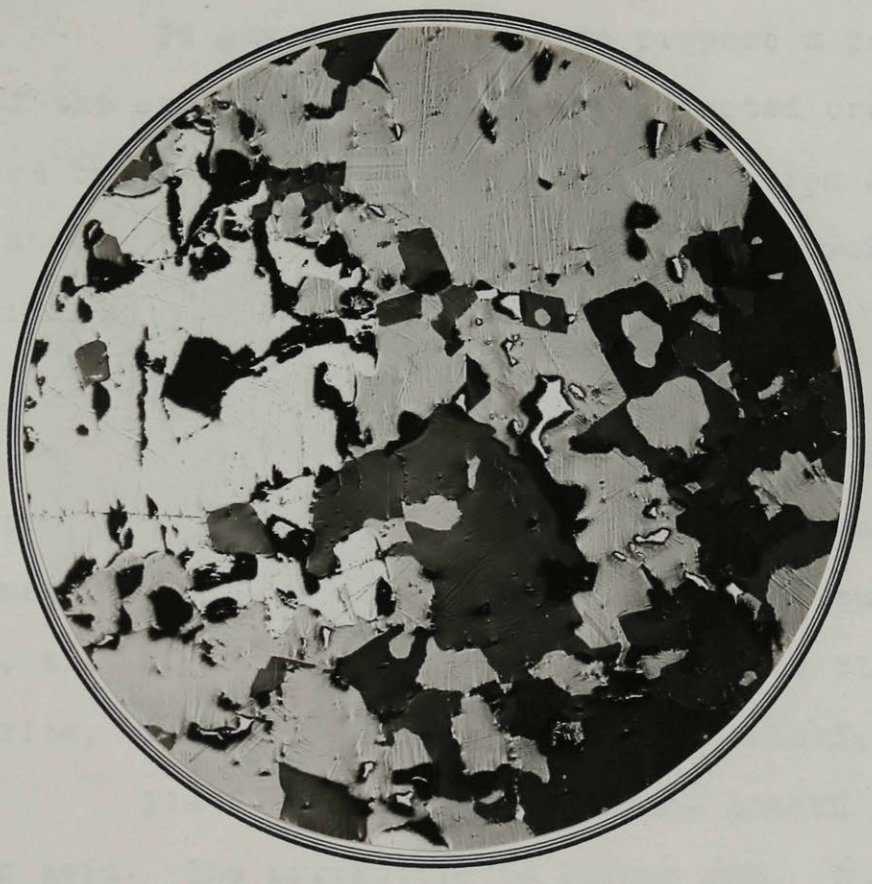
"MICROSCOPIC WORK"

A sample of the ore was ground to - 200 mesh and examined under the microscope. The great dissemination of the sulphides present was immediately recognized, particles even under this state of sub-division being complex in composition. Very little gangue was recognizable, occasional particles of pink garnets were seen. No thin section was made of the ore since the high percentage of sulphides present would make it practically opaque, and would hence be of little value.

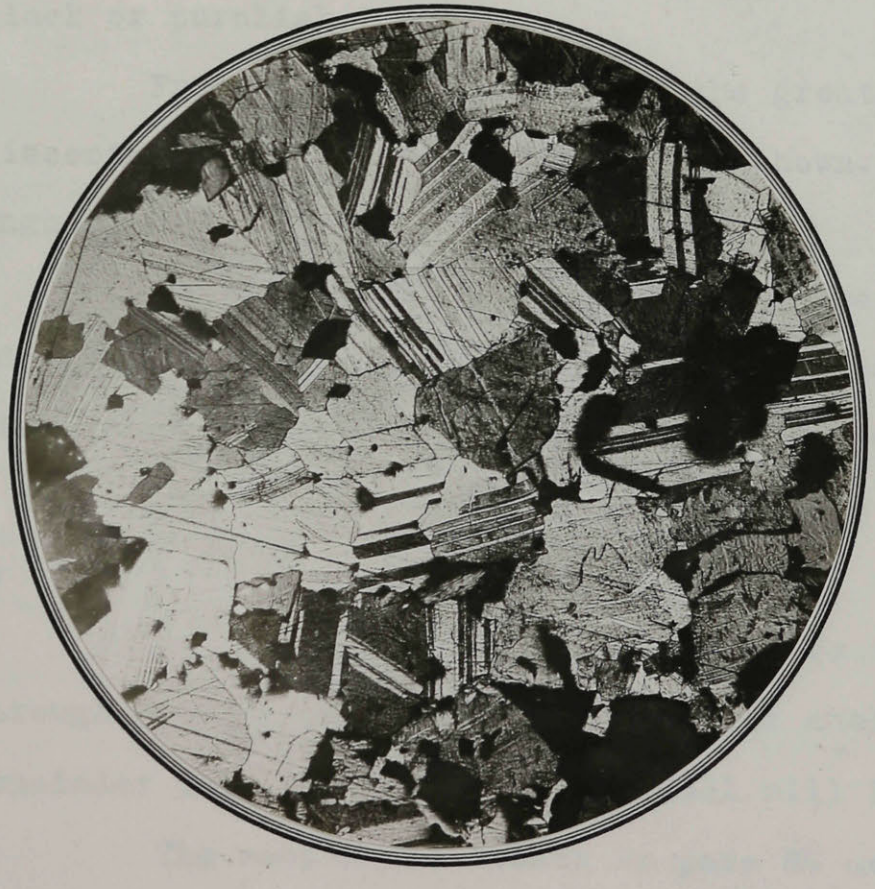


POLISHED SECTION (not etched) 90 x

POLISHED SECTION (etched) 90 x



POLISHED SECTION (not etched) 90 x



POLISHED SECTION (etched) 90 x

It was decided then to prepare a polished surface of the ore for examination by reflected ore for examination by reflected light. The preparation of the specimen and the taking of the accompanying photomicrographs were kindly performed by Mr.Pascoe of the metallography department.

Plate (1) shows the specimen examined through the miscroscope using reflected light and at a magnification of 90 diameters. The black mineral with a plane surface is galena, the brown mineral with striations and cleavage is sphalerite, while the pyrrhotite appears colorless.

Plate (2) shows the surface etched with 1:1 nitric acid. The pyrrhotite is burned out. The cleavage of the sphalerite is well brought out. The galena still appears black or purplish.

From both of these plates the great interlocking and dissemination of minerals is clearly shown. Very little gangue can be discerned.

Three bags of the ore, which had been crushed in the Dodge Crusher to about 1" pieces, were crushed in the rolls in two stages to pass the 1/8" screen. This ore is soft and tends to cake in the rolls, and therefore had to be fed carefully.

The 1/8" product was coned and quartered to ensure thorough mixing, and a sample cut out for analysis, and the remainder put in boxes labelled "Ball mill Feed"

The sample was bucked to pass 80 mesh and rolled and an essay sample cut from this.

The average of several assays gave:-

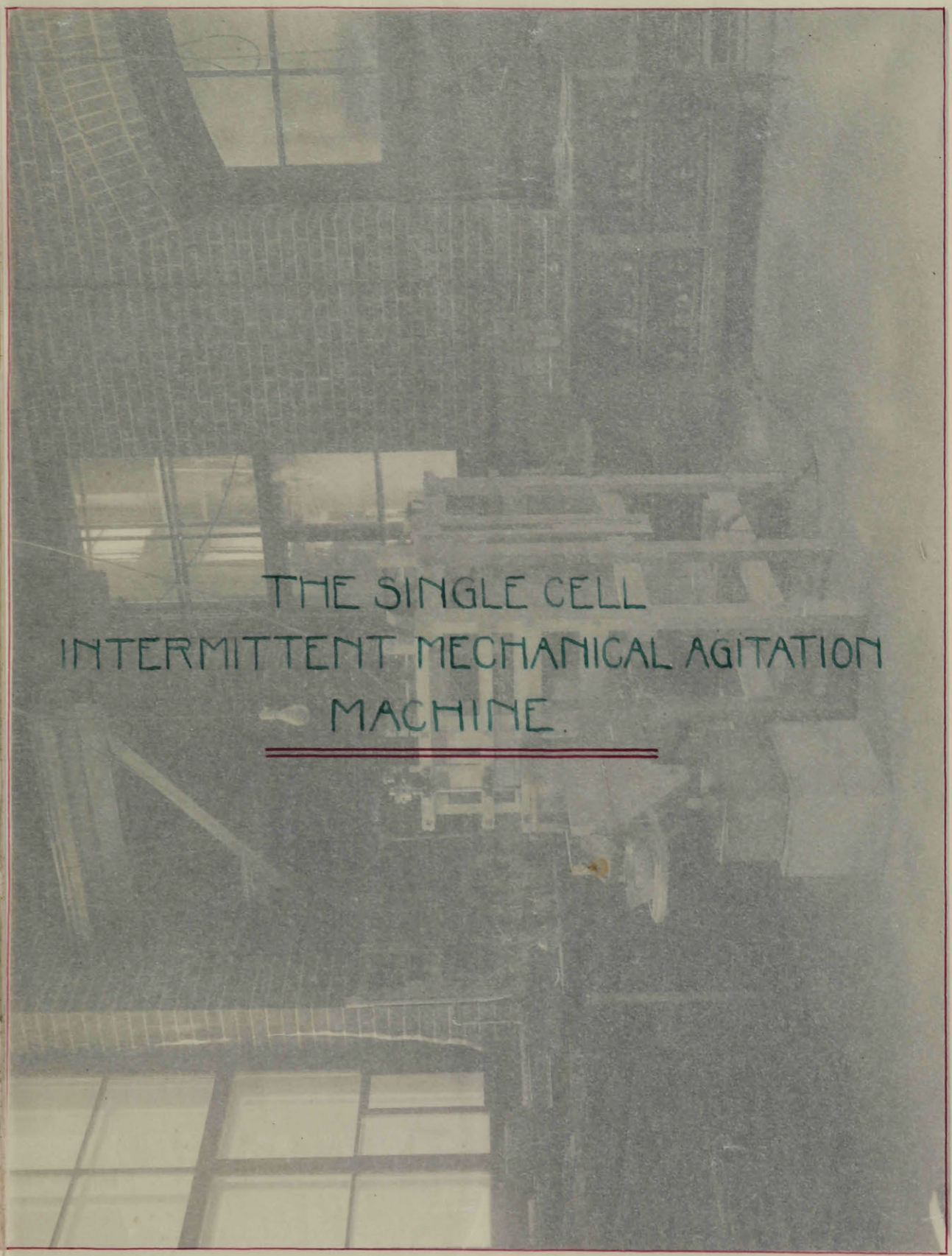
Lead	=	11.9 %
Zinc	=	20.1
Iron	=	28.2
Insoluble	=	7.1
Silver	=	2.48 oz.per ton
By calculation	=	
Galena	=	13.8
Sphalerite	=	89.9
Pyrrhotite	=	46.8
Insoluble	=	7.1
Undetermined	=	2.4
		100.0

"APPARATUS & METHOD OF PROCEDURE"

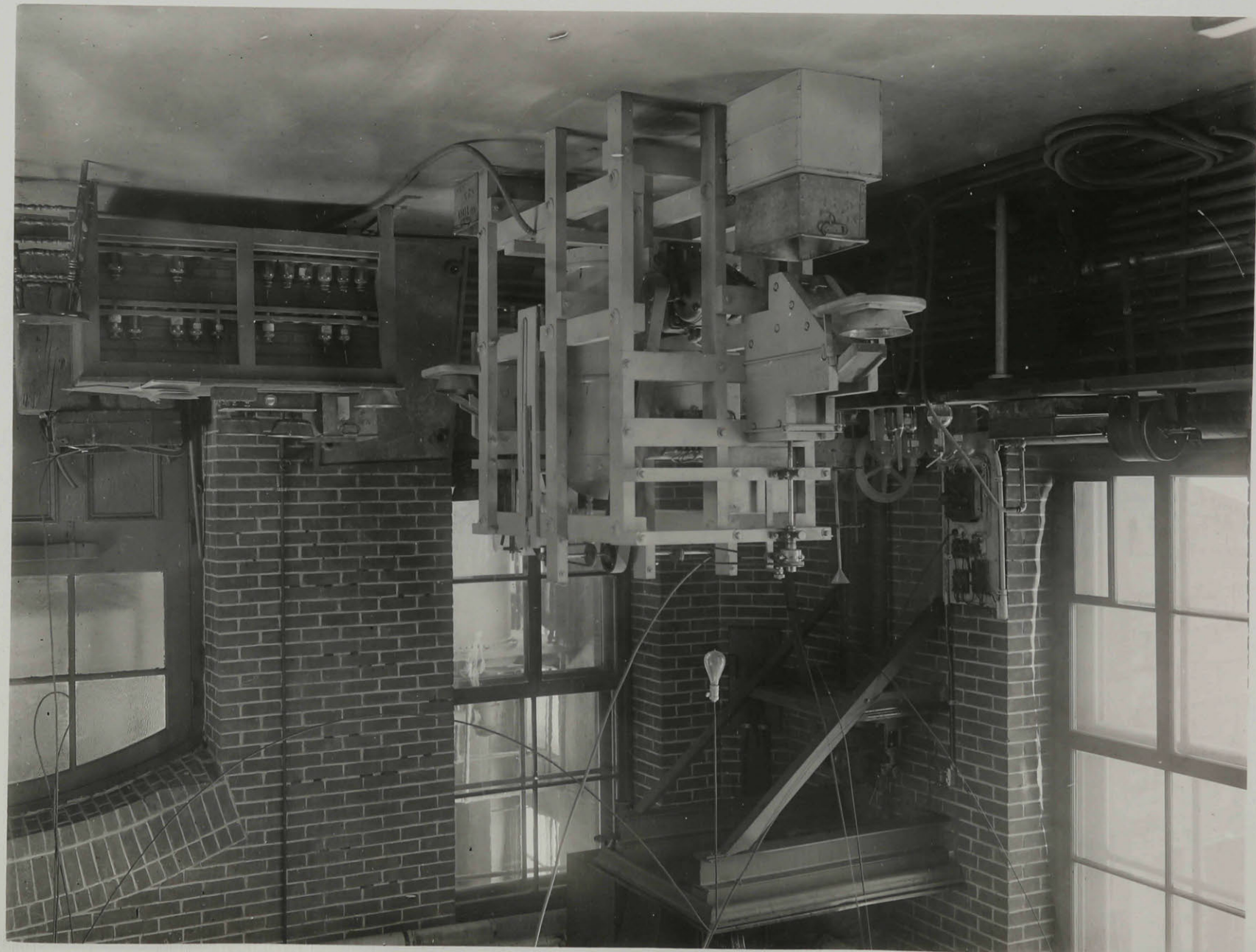
The flotation machine used was a test machine of the single-cell Mineral Separation Type. The dimensions and construction are shown on the accompaning blue print.

The samples were ground in a 7½" ball mill working on a 1:1 pulp ratio. The samples after grinding were washed into a pan provided with a screen to remove the balls. From the pan it was washed directly into the flotation machine, when no previous agitation was required. Samples to be agitated were filtered on a vacuum filter and the moisture content determined. They were then placed into a jar, and water and the reagents desired added bringing the pulp ratio up to 1.1.

PLATE Nº 1.



THE SINGLE CELL
INTERMITTENT MECHANICAL AGITATION
MACHINE.



The jar was then fastened to a shaking screen, the motion giving satisfactory agitation. The contents of the jar could easily be washed into the machine.

In all cases, the impeller of the M.S. Machine was started before adding the sample and the charge agitated for five minutes before the addition of oil.

The oil was added, by means of a calibrated dropper into the agitation chamber.

The froths were skimmed by hand, into pans, and at the end of the test, the tailings were removed by a spigot discharge in the bottom of the machine. All samples were then filtered, tagged and dried in a steam cabinet.

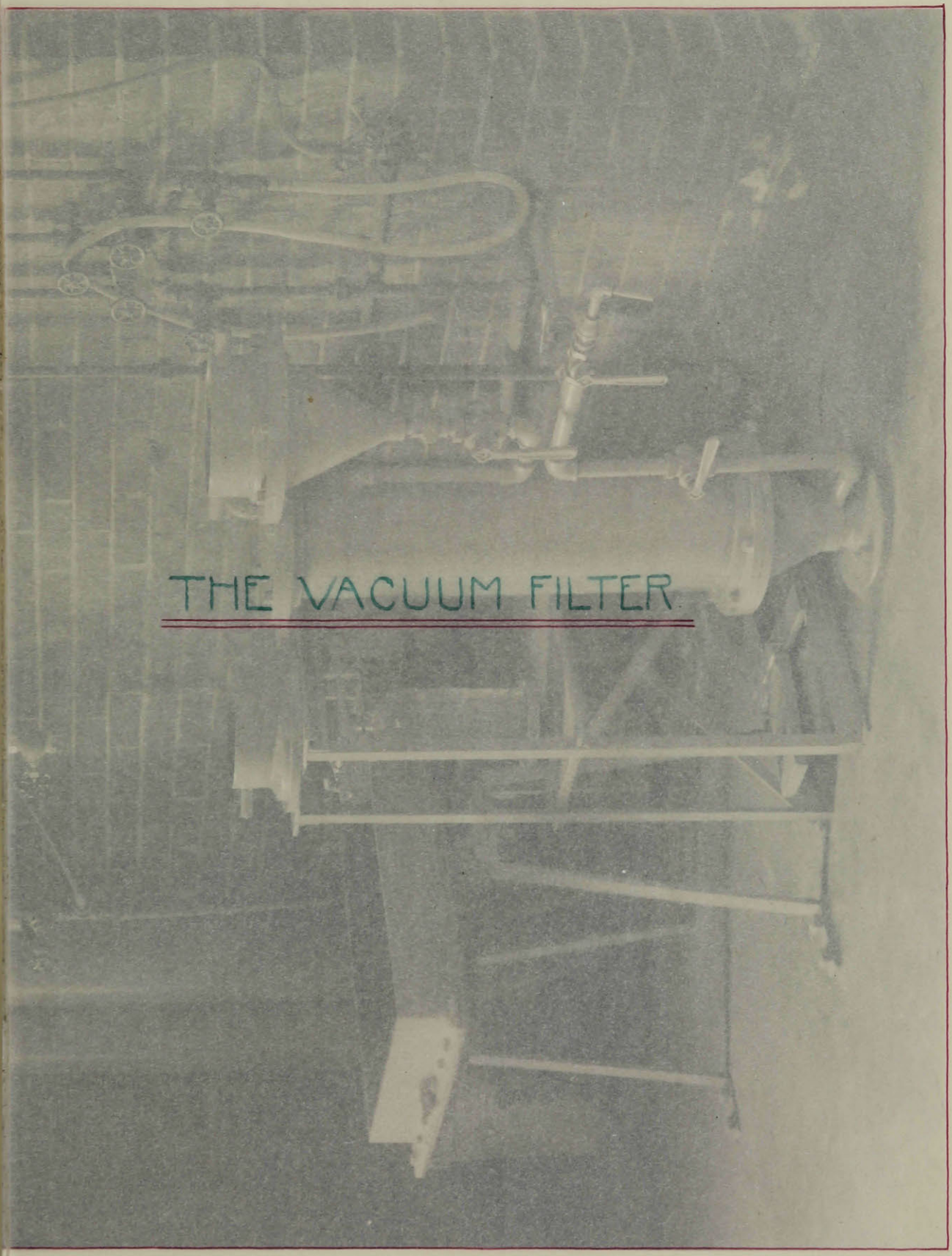
"PREPARATION OF SAMPLES"

Bags were numbered in duplicate to correspond with the sample numbers, one being marked "original sample" the other - 80 mesh.

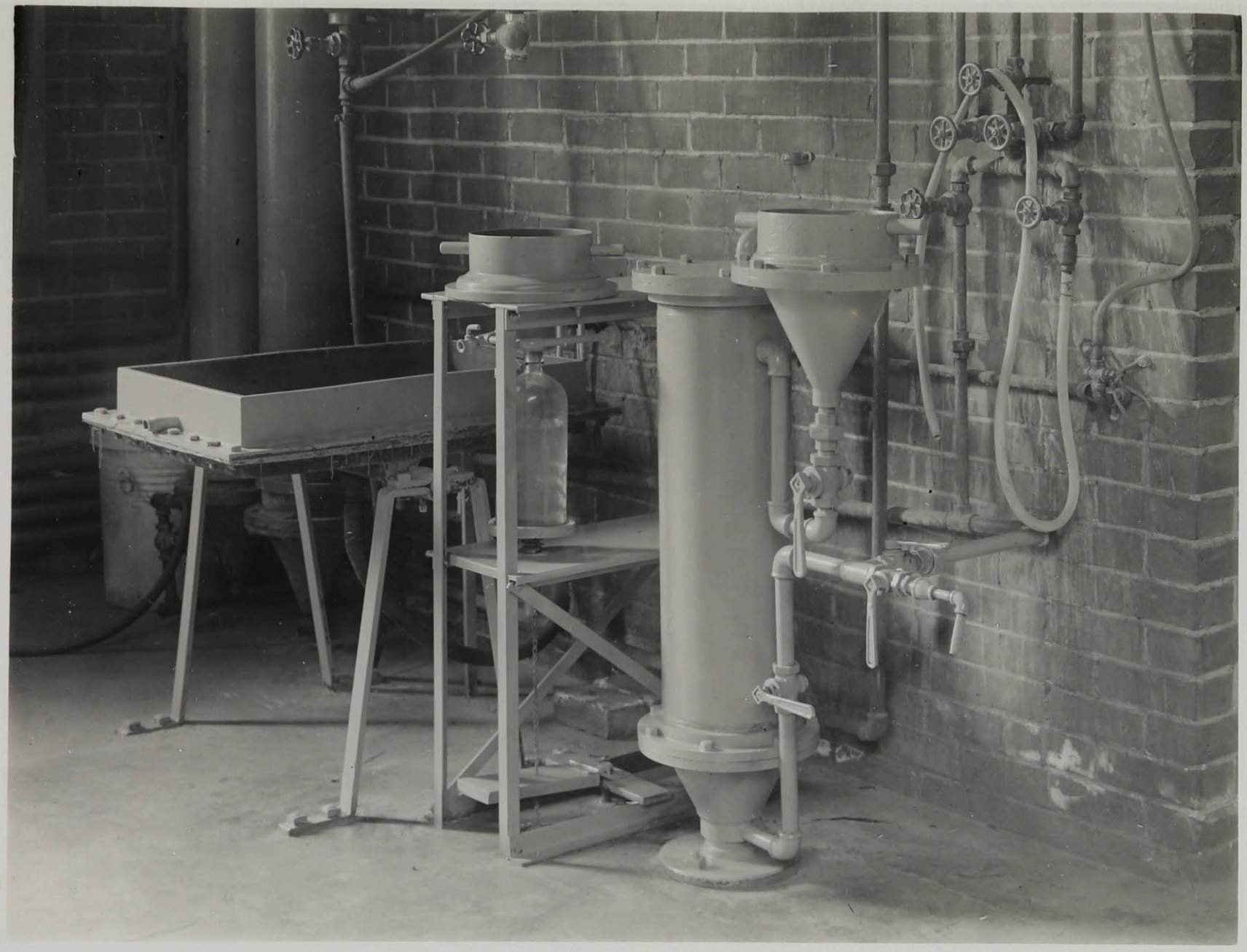
The samples were weighed, and the weights recorded both on the test sheets and sample tags. They were then passed through a 40 mesh screen to break up cakes, and rolled to insure mixing.

The sample was cut in half, one part being placed in the bag marked "original" and the other half was bucked to pass 80 mesh. An assay sample of about 20 grans was cut from this and placed in a small dish to be taken to the assay laboratory and the remainder placed in the bag marked - 80. The dishes were numbered by a duplicate number torn from the sample tag. The sample dishes were covered with watch glasses to prevent contamination.

PLATE N° 2.



THE VACUUM FILTER



"CHEMICAL ANALYSIS"

A short method of analysis for the Sullivan ore was supplied by Mr. Erlenborn. This method given on the following pages, is good for lead-zinc-iron sulphide ores, which are particularly low in copper, containing arsenic and bismuth.

When the stock of chemicals and standard solutions was complete, as many as 30 samples were analysed in a day for lead, zinc and iron.

Due to the large consumption of chemicals this term, it was difficult to keep a supply on hand, and considerable delay was thereby caused.

"METHOD OF ANALYSIS"

The process for the determination of lead depends on the following reactions.

In dissolving the ore in Nitric and Hydrochloric acids, the lead sulphide is converted into PbCl2 and $Pb(NO_3)_2$, which are soluble in the strong acid solutions.

$PbCl_2 + Pb(NO3)_2 + 2H_2 SO_4 = 2PbSO4 + 2HCl + 2HNO_3$

and by fuming the H_2SO_4, the HCL and HNO_3 are driven off. $PbSO_4$ is very insoluble while iron sulphate remains in solution.

The lead sulphate is then treated with ammonium acetate $PbSO4 + (MH4)_2 (C_2H_3O_2) \cdot 3H_2O = Pb(C_2H_3O_2)_2 \cdot 3H_2O +$ $(NH4)_2SO4$ lead acetate being soluble in water particularly when alkaline.

In titration with ammonium molybdate:-

$Pb(C_2H_3O_2)_2 \cdot 3H_2O + (NH_4)_2 Mo\ O4 = PbMoO4 + (NH4)2\ (C_2H_3O_2)_2 + 3\ H2O$

the lead molybdate being a white precipitate.

Any free ammonium molydate gives a yellow color with tanic acid.

"IRON" The iron now is present as the soluble ferric sulphate, and ferrous sulphate. The ferric sulphate is reduced by boiling with aluminum strips.

$Al + Fe_2\ (SO4)_3 = Al\ SO_4 + Fe\ SO_4.$

In the titration with potassium permanganate:-

$2\ KMNO_4 + 10\ FeSO_4 + 8\ H_2SO_4 = K_2SO_4 + 2\ MnSO_4 + 5\ Fe_2(SO4)_3 + 8\ H_2O$

Thus it is seen that the presence of H_2SO_4 is essential and care must be taken in fuming the samples with H_2SO_4 so that it will not all be driven off, i.e., do not allow the samples to come down to dryness.

A drop or two of free permanganate turns the solution pink.

"ZINC" This process depends on the fact that solution of zinc in hydrochloric acid are completely precipitated by potassium ferrocyanide, zinc ferrocyanide being white. The zinc sulphide is dissolved in the nitric acid solution saturated with $KClO_3$.

The $KClO_3$ precipitates any manganese present. The zinc and copper are brought into solution by NH4Cl NH4OH while any arsenic or antimony is precipitated by bromine.

The retreatment is to insure the solution of all the zinc.

The solution is made slightly acid to insure total precipitation of the zinc with the ferrocyanide.

The test lead removes any copper present in solution.

$$2ZnCl_2 + K_4 Fe(CN)_6 = 4KCl + Zn_2Fe(CN)_6$$

Any free potassium ferrocyanide gives a yellow color with ammonium molybdate.

Care must be taken in this analysis to keep the concentration of HCl low and constant, as any free chlorine decomposes the ferrocyanide producing a green precipitate, and making the results high.

Further the solutions must be titrated hot, and the ferrocyanide run in slowly to allow time for proper precipitation, or an end-point reaction will be obtained by zinc-potassium cyanide before the real end-point is reached.

"STANDARD SOLUTIONS REQUIRED"

The ammonium molybdate solution is made by dissolving 17 grams of ammonium molybdate in water and bringing the solution up to 2 litres. 1 cc. of this solution will be equivalent approximately to .01 gr. of lead. To standardize the solution, dissolve 0.5 grams of $PbSO_4$ in ammonium acetate and dilute to about 250 cc. and boil. Titrate with ammonium molybdate, using tannic acid as an indicator, a yellow color being obtained at the end point. As 1 gr. PbSO contains 0.3415 grams of lead, the value of the solution is determined per cc.

For the iron titrations dissolve 5.7 gr. potassium permanganate in water and dilute to one litre. Filter and add caustic potash to preserve the KMNO4, leave the solution to age.

To standardize, dissolve 1.405 grams of ferrous-ammonium sulphate in about 10 cc. of H_2SO_4, and dilute and boil. Titrate with permanganate, the solution turning pink when the end point is reached. The amount of ferrous ammonium sulphate taken contains 0.2 grams of iron, and from this the value of the standard solution is obtained. 1 cc. of $KMnO_4$ will approximately = 0.01 gr. of iron.

For the zinc titrations, 42 grams of potassium ferrocyanide are dissolved in water and diluted to 1 litre. One cc. of this solution equals approximat_ely 0.01 gr. of zinc.

To standardize, dissolve 0.2 gr. of C.P. Zinc in 10 cc. of HCl & 20 cc. of water, add 10 gr. of nH_4cl, dilute to 250 cc. and heat to about 70° and titrate, using ammonium molybdate solution as an indicator. A yellow color is obtained at the end point. The value of 1 cc. of the solution can now be determined.

"OTHER SOLUTIONS"

A bottle of Nitric acid solution is made up by merely saturating the acid with potassium chlorate.

The ammonium chloride solution is made up by placing in a bottle 400 gr. of NH_4Cl, 700 cc. of NH_4CH and adding water to bring the solution up to 2 litres.

An aqueous solution of bromine is used in the zinc analysis.

Tannic acid solution is made up as required as it does not keep.

"CHEMICAL ANALYSIS OF SAMPLES"

In the following process of analysis, the lead and iron content is determined from one sample while the zinc is determined separately from another, and in those cases where the ore was tested for insoluble content a third sample was taken. In every case one gram samples were used.

PROCEDURE FOR LEAD ZINC AND IRON ANALYSIS:-

For lead,

Weigh one gram of the sample, put it in a 250cc. beaker and add HCL and HNO_3 , 10 cc. of each. Heat at a low temperature till the ore is decomposed. This point is recognized by the brownish color of the liquid, and the light colored sediment which remains, boil vigorously to expel all chlorine. Now add 15-20 cc. of 1:1 sulphuric acid and boil till heavy fumes of the sulphuric come off. Cool and add about 50cc. of water. (care must be taken not to add water to the hot sulphuric acid, or due to the affinity of the latter for water spitting will occur, or the beaker crack. Bring up to a boil and cool slightly. Filter and wash, saving the filtrate for the determination of iron .....(1)

Dissolve the precipitate in 20-25 cc. of ammonium acetate solution. Dilute to about 150cc. and boil. The solution is now ready for titration.

The solution is titrated with ammonium molybdate solution, and tannic acid is used as an outside indicator. Titration is complete when a drop of the solution turns the tannic yellow.

For iron:-

IRON

The filtrate (1) from the lead analysis is diluted to 250 cc. Add a strip of aluminum and boil till the solution is absolutely colorless. It will be noticed that a persistant white froth will appear on the surface of the liquid.

Now titrate the solution with the standard potassium permanganate solution. The solution first turns green in colour and will suddenly turn pink when the end-point is reached.

ZINC

For zinc:-

Dissolve one gram of the sample in 30-40 cc. of HNO_3 (saturated with $KClO_3$.) Heat to dryness at a low heat. The low heat is essential or spitting will occur, and cause loses. If the samples commence to spit, cover with watch glasses. Bake for 5 or 10 minutes. Take up with ammonium chloride solution. (about 50 cc.) Add 10 cc. of bromine water and boil for 10 minutes. Filter hot and wash with hot water. Dissolve the precipitate in HCl and add the ammonium chloride solution till precipitate comes down. Add 5cc. of bromine then boil to expel all excess bromine. Filter hot and wash with hot water, adding this filtrate and wash water to the previous filtrate. Make the solution acid with HCl, taking care to have no excess. Boil to expel any bromine or chlorine and add test lead. Cool to about 70 deg. and add exactly 2 cc. of HCl,

Titrate of this temperature with the standard potassium ferrocyanide solution, using a ammonium molybdate as an outside indicator. The end point is reached when a drop of the solution turns the molybdate yellow.

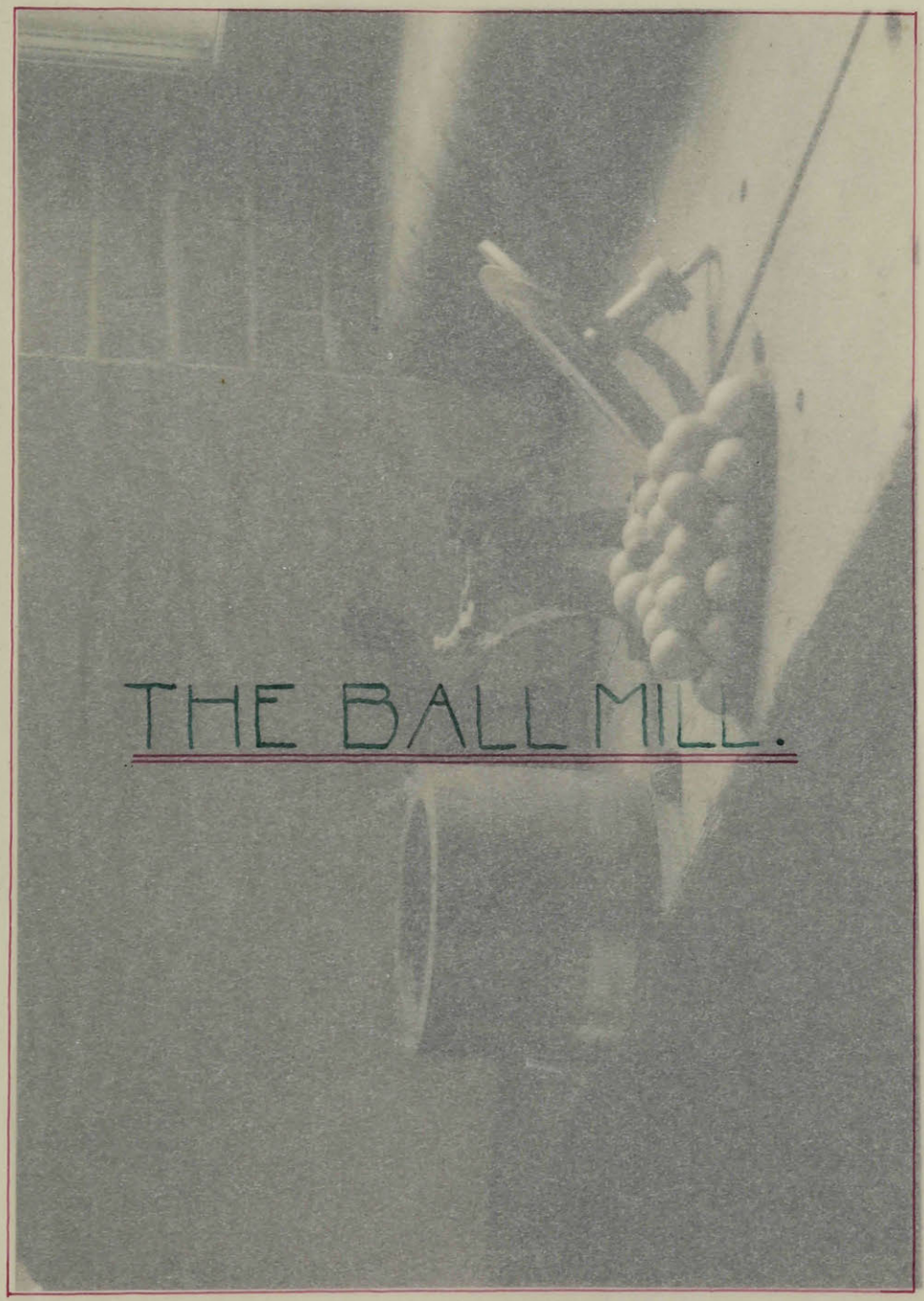
INSOLUBLES

Insolubles are determined by running a sample as for lead, and filter the ammonium acetate solution. Incinerate the filter paper containing the insolubles and weigh the residue, From this the percentage of insolubles in the sample is determined.

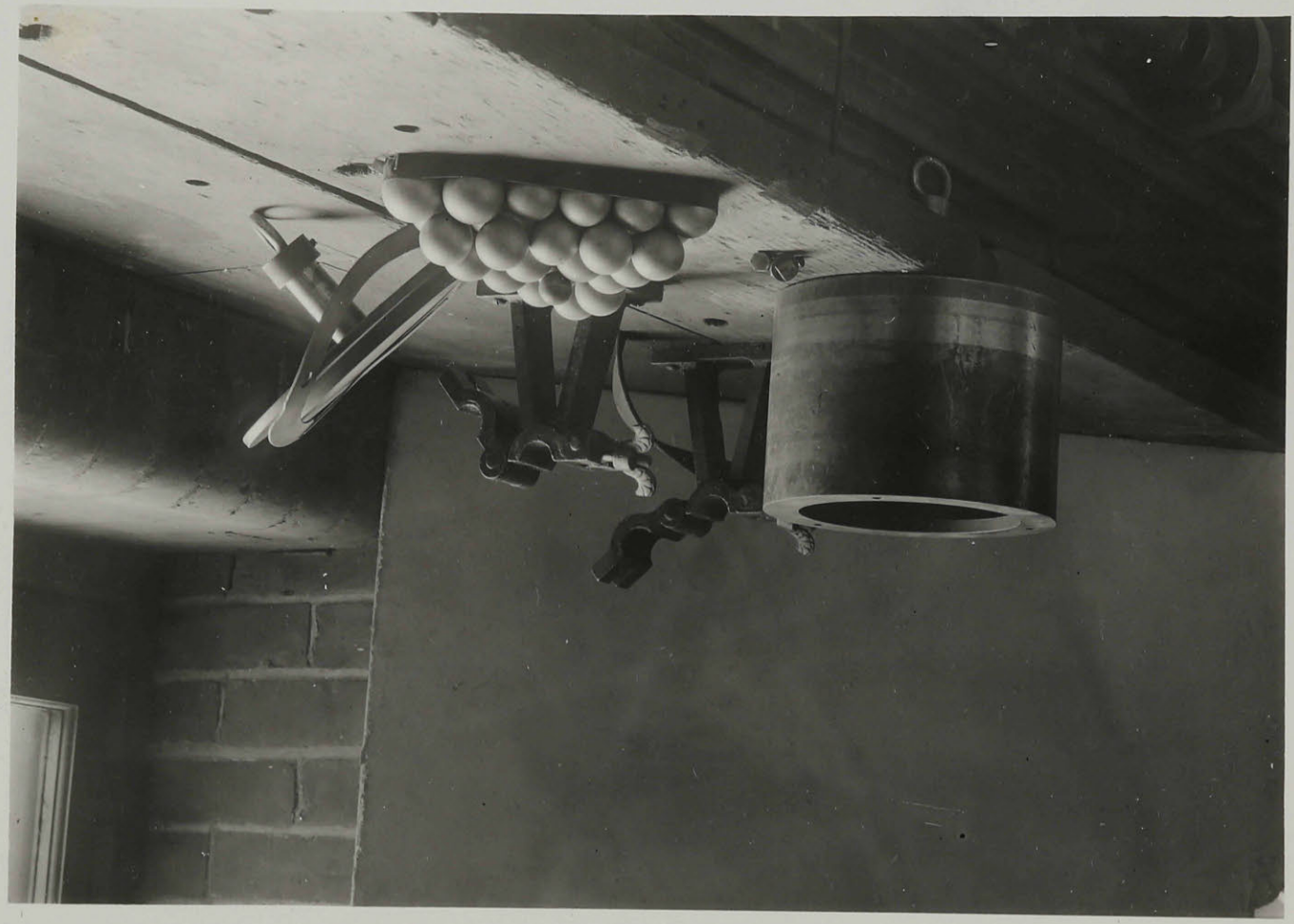
"DISCUSSION OF TESTS"

In the following discussion, those tests which are comparable will be grouped together, regardless of the test number. The tests were run in order as numbered to take full advantage of the time at our disposal, and in some cases, it was desired to obtain assay results of a test before continuing that particular series of tests.

PLATE Nº 3.



THE BALL MILL.



GRINDING TESTS

The ball mill.

All samples for flotation tests were given their final grinding in a 9½" x 6 7/8" ball mill, grinding in a 1 : 1 ratio. (See plate)

The ball charge used was 19.75 lbs., or 8.94 Kg. of ¾" steel balls. The mill made 72 r.p.m.

The discharge from the rolls was screen analyzed, giving as a feed to the ball mill the product:-

Size	Wgt.	% Wgt.	Acc. %.
5	0.660	0.46	0.46
8	29.990	20.82	21.28
"10	0.215	0.15	21.43
"14	25.450	17.70	39.13
"20	16.030	11.15	50.28
"28	11.740	8.20	58.48
"35	8.910	6.19	64.67
"48	6.070	4.22	68.89
"65	5.620	3.90	72.79
"100	5.390	3.75	76.54
"150	6.490	4.50	81.04
"200	3.970	2.76	83.80
"200	23.370	16.20	100.00
Total -	143.905	100.00	

GRINDING TESTS

A series of grinding tests was made on 500 and 1000 gr. samples, and the resultant screen analysis of the products shown on the accompanying charts, 1 and 2.

It was then decided to grind for twenty minutes for 500 gr. samples in the majority of the tests, this amount of grinding giving 95.8% - 200 mesh.

No. 1.

GRINDING TEST SHEET.

For 500 gr. samples.

Size	5 min. grind		10 min. grind		15 min. grind		20 min. grind		30 min	40 min.
10	grams	%	grams	%	grams	%	grams	%	%	%
10	0.065	o.21								
14	01010	0.04	0.015	0.06	0.001	---				
20	0.025	0.10	0.007	0.03	0.001	---	0.008	0.03		
28	0.026	0.10	0.019	0.07	0.009	0.04	0.040	0.13		
35	0.050	0.20	0.015	0.06	0.021	0.08	0.055	0.17		
48	0.115	0.47	0.023	0.09	0.021	0.08	0.040	0.13	0.10	
65	0.365	1.49	0.065	0.26	0.031	0.13	0.030	0.95	0.12	0.23
100	1.195	4.89	0.250	1.01	0.111	0.46	0.130	0.41	0.20	0.18
150	3.016	12.54	1.241	5.02	0.498	2.06	0.360	1.14	0.85	0.40
200	2.620	10.74	1.781	7.20	0.890	3.68	0.661	2.09	1.38	0.78
-200	16.920	69.40	21.280	86.10	22.610	93.50	30.370	95.80	97.35	98.45
Total	24.407	100.0	24.696	100.0	24.193	100.0	31.694	100.0	100.0	100.0

No.2.

GRINDING TEST SHEET.

For 1000 gr. samples.

Size.	10 min. grind		20 min. grind		25 min. grind		30 min. grind		35 min. grind	
	grams	%	grams	%	grams	%	grams	%	grams	%
10										
14	0.009	0.01								
20	0.007	0.01	0.030	0.04						
28	0.030	0.05	0.035	0.119	0.035	0.05	0.060	0.19	0.055	0.09
35	0.086	0.13	0.155	0.22	0.126	0.19	0.110	0.19	0.060	0.10
48	0.150	0.22	0.110	0.16	0.095	0.14	0.090	0.15	0.035	0.06
65	0.580	0.86	0.125	0.18	0.089	0.14	0.850	0.14	0.040	0.067
100	2.680	3.98	0.495	0.70	0.240	0.37	0.170	0.29	0.105	0.176
150	8.545	12.79	3.200	4.50	1.400	2.14	0.980	1.64	0.620	1.04
200	7.865	11.67	5.820	8.19	3.817	5.83	2.527	4.25	1.945	3.28
-200	47.415	70.50	61.130	86.20	59.720	91.25	55.435	93.10	56.620	95.20
Total	67.367	100.00	71.150	100.00	65.522	100.00	59.557	100.00	59.480	100.00

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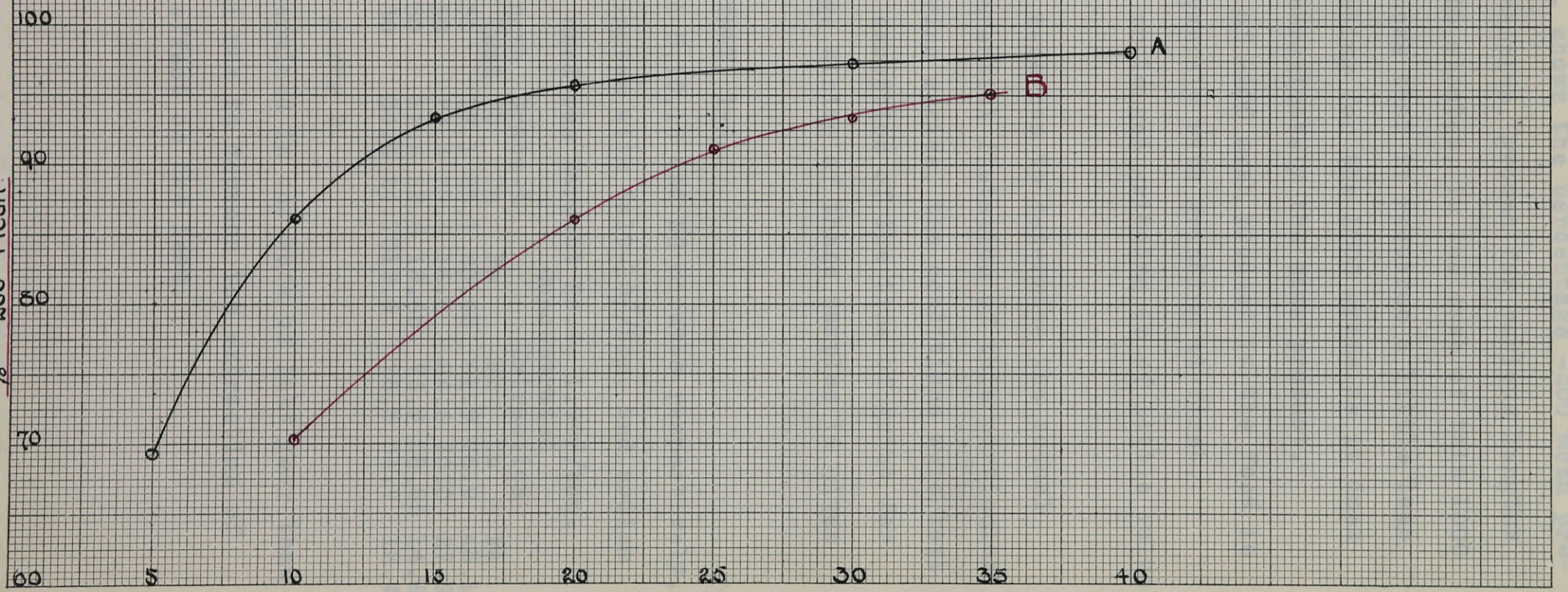
Curve 1.

GRINDING TESTS.

Curves showing percentage -200 mesh for:-

A - 500 Gram samples

B - 1000 " "



Curve No.1. shows the percentage -200 mesh product in 500 and 1000 gram samples, ground for various lengths of time from 5 minutes to 35 minutes, in the case of this 1000 gram sample. This curve shows that it requires a little less than twice the time of grinding for the 1000 grams as it does the 500 grams to produce approximately the same product.

The amount of -200 mesh product in the feed is 16.2%, and this increases rapidly with grinding at first, gradually falling off till prolonged grinding is of little value.

Tests 1-17 were run to determine the actual effect of size on the differential flotation of this particular ore. In each of the following series, the conditions were kept exactly the same, with the exception of the time of grind for each sample. The percentage sizing of these samples is given on chart 1.

TEST. 1-4.

500 gr. samples were ground 5,10,15 and 20 minutes respectively, and each agitated for 30 minutes with Salt-10#/ton, and sodium hydroxide-4#/ton. The oil used was Barrett No.4, 1.98#/ton.

Test	Time of Grind	Length of Test	Grade-%			Concentrated Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
1	5	30	17.1	25.1	20.45	81.9	76.9	45.1
2	10	30	23.4	29.8	16.6	84.6	70.0	27.9
3	15	30	31.6	25.6	13.65	76.9	38.85	14.9
4	20	30	34.6	24.1	12.6	76.5	34.7	12.45

The results are plotted on curve 2.

It was determined in our work of last year that the effect of NaOH and NaCl was to depress the extraction of zinc and iron with little effect on the lead.

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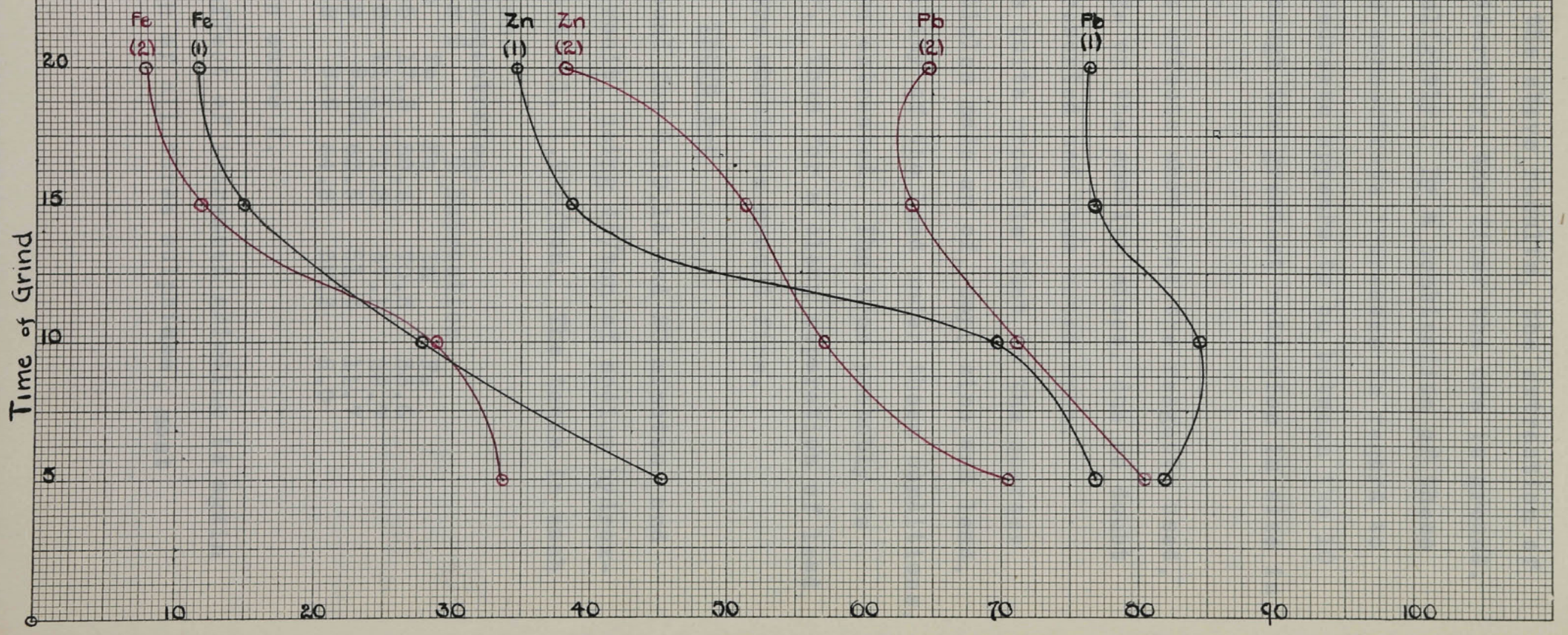
Curve 2.

GRINDING TESTS

No 1-8

(1) Series 1-4 inc.
(2) Series 5-8 "



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From the above results, the extraction of Zn and Fe falls off considerably, the finer the ore is ground. The lead only falls off slightly. By a combination of these results, the grade of the concentrate increases in regard to the lead. The greatest decrease appears to be between the 10 and 15 minute grind, although the greatest reduction in size is between 5 and 10 minutes.

These effects show that the reagents used, work to a better advantage on the smaller sizes, due no doubt to the greater surface presented and thus acted upon.

It is quite probable that in the coarser sizes some composite particles made up of, say, zinc and lead, float due to the floatability of the lead under these conditions, and thus increase the zinc extracted. The iron probably is extracted in the same way. Thus for a clean separation of lead from zinc and iron, the ore should be ground fine.

TESTS 5-8

500 gram samples were ground for 5,10,15 and 20 minutes, and floated in an alkaline circuit, using 4#/ton of sodium hydroxide, and using Barrett No.4 oil, 1.98#/ton. The tests in each were of 30 minutes duration.

Test No.	Time of Grind	Concentrates. Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
5	5	22.7	26.5	17.3	80.6	70.5	33.6
6	10	26.1	31.0	11.1	71.3	57.1	28.7
7	15	28.2	30.9	9.55	63.5	51.4	11.7
8	20	33.7	30.8	8.6	64.8	38.3	8.0

The results are plotted on curve 2.

The effect of increased grinding is again to decrease the extraction of all three sulphides, most

noticeably the zinc. As before, the grade of the concentrate increases in lead, and falls off considerably in iron, while the percentage in zinc is fairly constant.

Comparing this series with tests 1-4, (also see curve 2), the use of NaCl increases the extraction of lead throughout, and, in the coarser sizes, the zinc and iron, while in the fine sizes the use of NaCl keeps down more zinc and iron. Thus to obtain a clean separation of lead from zinc and iron, grinding very fine and use of NaCl in conjunction with NaOH. This will, however, slightly lower the extraction of lead.

TESTS 9-12

500 gram samples were ground 5,10,15 and 20 minutes, and floated in an alkaline circuit, using 4#/ton of NaOH, the oil used being Cobalt mixture No.1 2.67#/ton. The duration of the tests was 30 minutes.

Test No.	Time of Grind	Concentrates Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
9	5	20.8	14.9	30.9	41.4	16.3	23.8
10	10	14.2	24.7	24.1	91.8	86.5	65.8
11	15	14.6	23.8	24.4	91.1	87.0	68.6
12	20	13.8	21.6	24.6	90.9	85.1	74.1

See curve 3.

The sizing was evidently too coarse for flotation conditions in test No.9. Otherwise, the extractions of lead and zinc are apparently little effected by size, between these limits, while the extraction of iron increases with diminution in size. Omitting test 9, there is very little change in grade of concentrate.

By a comparison with tests 5-8, the effect of

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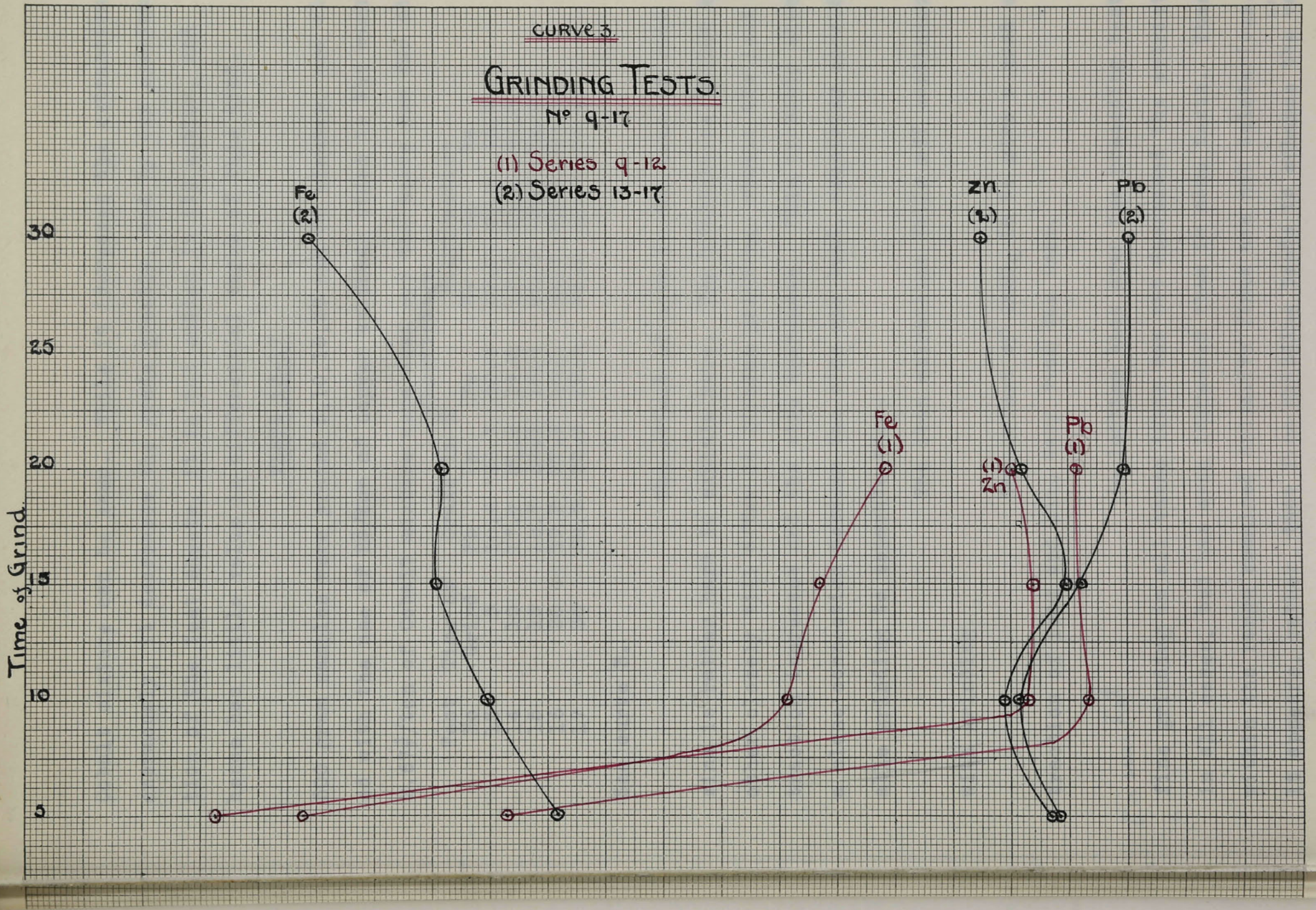
CURVE 3.

GRINDING TESTS.

N° 9-17.

(1) Series 9-12.

(2) Series 13-17.



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Cobalt mixture can be seen. While it increases the extraction enormously, it decreases the grade greatly, and by our examination of the test sheets, it is too sudden in its action, and hence has little value in differential works of this kind.

TESTS 13-17

500 gram samples were ground 5,10,15,20 and 30 minutes, and floated with the use of 2#/ton of Copper sulphate added in the machine. 2.67#/ton of Cobalt mixture were used and the tests run for 40 min.

Test No	Time of Grind	Concentrates Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
13	5	15.6	26.7	20.9	89.2	89.0	45.7
14	10	17.1	31.6	19.6	85.9	84.6	39.8
15	15	18.7	29.5	16.4	90.0	89.9	35.2
16	20	19.3	27.6	18.1	94.9	85.9	35.9
17	30	20.9	32.3	12.0	95.3	82.5	24.4

See curve 3.

The effect of size in the case of lead and zinc is rather hard to explain here. The extractions follow each other closely till after 15 minutes grinding, whence the lead extraction increases and the zinc decreases. This probably shows a close connection between the zinc and lead, requiring considerable grinding to separate them.

The iron extraction falls off continuously with grinding.

The effect of $CnSO_4$ is to give a good extraction of lead and zinc away from the iron.

It is seen that In looking back over the preceding tests, fine grinding in all these tests has not decreased the extractions in all cases, but has even increased them in some tests. Thus within the range examined excessive fines are not deleterious. It appears, rather, that fine grinding tends to enhance the value

of the reagent, whether it be to increase or decrease the extraction of a mineral. This is due to the greater amount of surface produced for the surface reactions to affect (i.e. the specific surface is increased.) Further, fine grinding is essential for the final separation of the minerals contained in this ore, due to their great dissemination.

PULP RATIO TESTS

The pulp ratio in the agitation bore of a M.S. machine is quite evidently different from the ratio of the total amount of water to the amount of the ore in the machine. As it is in this compartment that the ore meets with the oil, and also any reagents which might be added to produce surface alterations, and finally since it produces a thorough mixing of the pulp, reagents, air and oil, it was deemed advisable to determine accurately the pulp ratios in the agitation chamber.

This was tried in several ways till finally a good check was obtained. The best method was found to be that of syphoning a quantity of the pulp from the agitation chamber into a weighed evaporating dish while the machine was running. The weight of the sample was determined immediately, and the water slowly evaporated from it. The weight of the ore present was then determined, and the pulp ratio for the given charge calculated.

These determinations were made for 250, 500, 750, 1000, 1250, and 1500 gram charges. In all cases the ore was ground in 500 gram lots to insure the same amount of grinding for each charge.

The pulp ratios for the total charge in the machine were also determined, and the results of the two series of tests tabulated and curves drawn. (see sheets5)

From the curve 5 it is seen that for a 250 gram sample the pulp ratio for the agitation bore and that for the total machine are almost equal. As the weight of the sample increases, however, the pulp ratio in the agitation bore increases much more rapidly than that for the total charge.

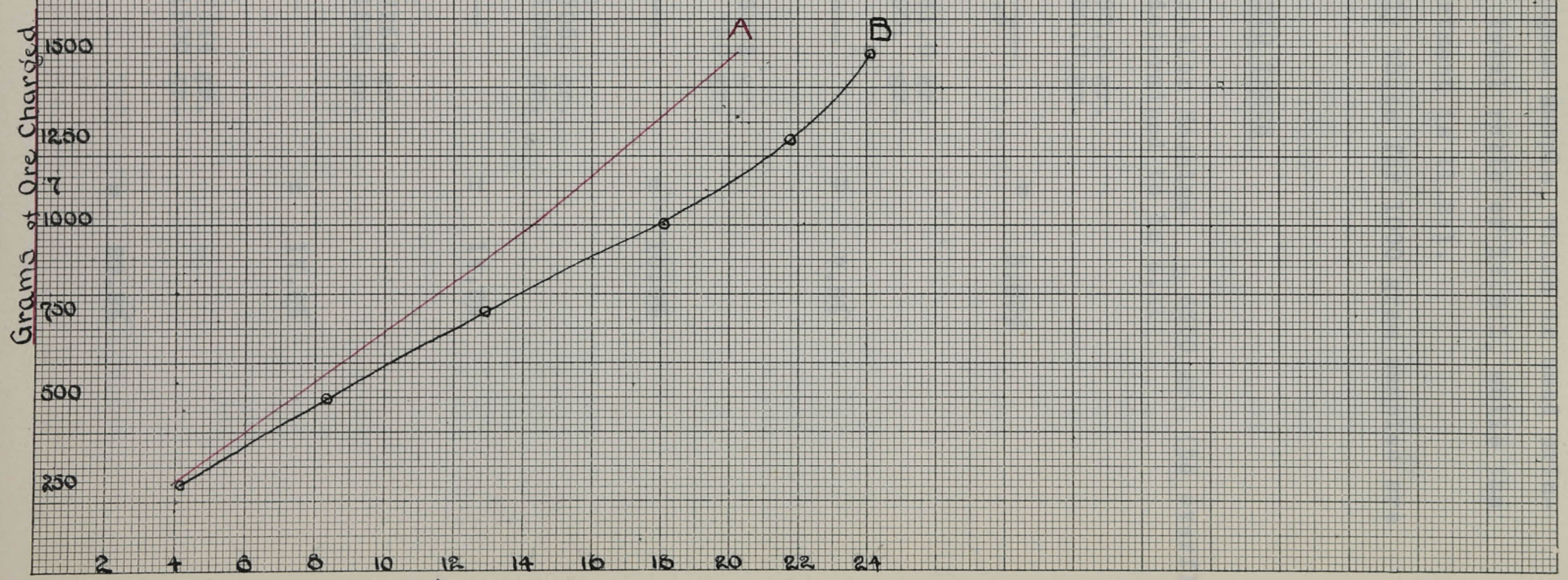
Curve 5

PULP RATIO TESTS in the M.S. MACHINE

Curve :-

A - Percentage Solids in Total Charge.

B - " " " Agitation Box



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The 500 gram sample, which is used principally in the tests gives a total ratio of 12.3:1, while the ratio in the agitation compartment is 11.2:1.

Similarly those for 1000 gram samples are 6:1 and 4.5:1, respectively.

PULP RATIO TESTS

For the total machine:
Capacity of the Mineral Separation Machine ± 6300 gr. (to overflow)
Specific gravity of the ore determined to be 4.21

For 250 gr. sample:
weight of pulp - 6490.6 gr.
" " Ore - 250.0 gr.

$$\text{Ratio} - \frac{250}{6490.6} = 3.85\%$$

For 500 gr. sample:
weight of pulp-6681.0 gr.
" " Ore- 500. gr.

$$\text{Ratio} - \frac{500}{6681} = 7.5\%$$

For 750 gr. sample:
weight of pulp - 6872 gr.
" " Ore - 750 gr.

$$\text{Ratio} - \frac{750}{6872} = 10.9\%$$

For 1000 gr. sample:
weight of pulp - 7052 gr.
" " Ore - 1000 gr.

$$\text{Ratio} - \frac{1000}{7052} = 14.2\%$$

For 1250 gr. sample:
weight of pulp - 7253 gr.
" " Ore - 1250 gr.

$$\text{Ratio} - \frac{1250}{7253} = 17.2\%$$

For 1500 gr. sample:
weight of pulp - 7444 gr.
" " Ore - 1500 gr.

$$\text{Ratio} - \frac{1500}{7444} = 20.2\%$$

PULP RATIO TESTS

Pulp ratios determined in the agitation box only.

	A		B
For 250 gr. sample:			
Weight of dish and pulp -	197.3 gr.		224.205 gr.
" " " "solids -	98.442		106.0
" " " only -	94.3		100.985
" " pulp " -	103.0		123.22
" " solids " -	4.142		5.015
Percentage of solids -	4.2%		4.07%
mean -		4.135%	
For 500 gr. sample:			
Weight of dish and pulp -	223.470		178.180
" " " "solids -	109.469		91.400
" " " only -	99.122		83.540
" " pulp " -	124.348		94.640
" " solids " -	10.348		7.660
Percentage of solids -	8.31%		8.10%
mean -		8.205%	
For 750 gr. sample:			
Weight of dish and pulp -	175.055		156.770
" " " "solids -	99.544		91.512
" " " only -	88.365		81.619
" " pulp " -	88.690		75.151
" " solids " -	11.189		9.893
Percentage of solids -	12.6%		13.1%
mean -		12.85%	
For 1000 gr. sample:			
Weight of dish and pulp -	164.120		143.080
" " " "solids -	85.955		82.556
" " " only -	68.435		69.439
" " pulp " -	95.685		73.631
" " solids " -	17.520		13.205
Percentage of solids	18.3%		17.95%
mean -		18.125%	
For 1250 gr. sample:			
Weight of dish and pulp -	198.600		184.975
" " " "solids -	117.150		119.215
" " " only -	94.300		100.985
" " pulp " -	104.300		83.990
" " solids " -	22.850		18.230
Percentage of solids -	18.3%		17.95%
mean -		21.8%	
For 1500 gr. sample			
Weight of dish and pulp -	210.122		168.140

PULP RATIO TESTS (continued)

For 1500 gr. sample:

Weight of dish and pulp	-	210.122	168.140
" " " "solids	-	126.075	103.798
" " " only	-	99.122	83.540
" " pulp "	-	121.000	84.600
" " solids "	-	26.953	20.258
Percentage of solids	-	24.25	23.95
mean	-	24.1%	

TESTS 18-21

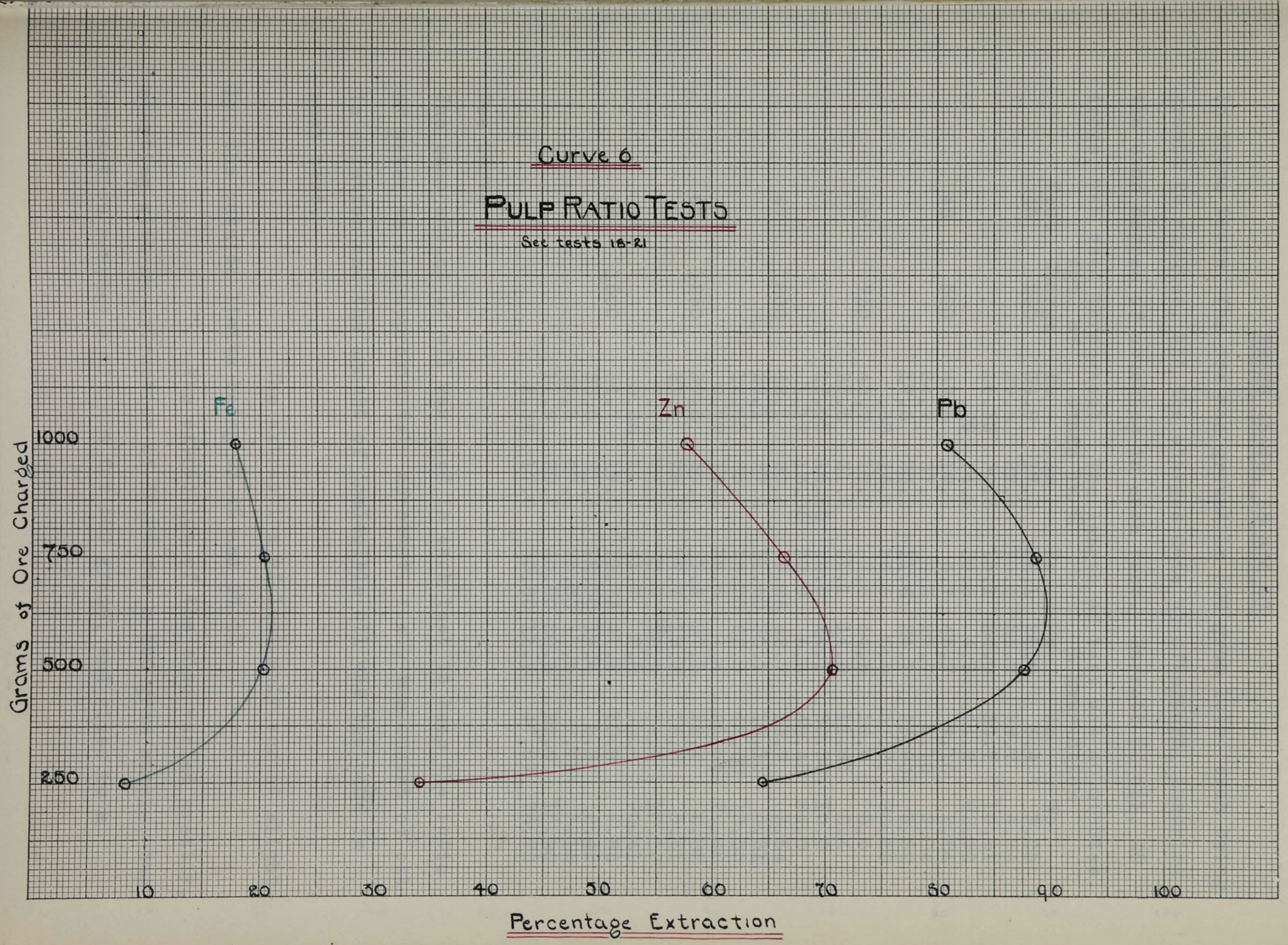
To determine the effect that pulp ratios have on extraction; 250, 500, 750 and 1000 gram samples were ground for 20 minutes and floated by the use of 25 drops of F.P.L.#24 in each test. The tests were run for 40 minutes in each case.

Test			Grade in %			% Extraction		
		Sample	Pb	Zn	Fe	Pb	Zn	Fe
18	250	1st	39.0	21.6	9.17	22.40	8.78	2.95
		2nd	28.0	31.6	8.77	42.30	25.20	5.54
		Tails	5.13	18.2	31.80	35.30	66.02	91.51
19	500	1st	32.9	25.4	9.85	67.5	32.6	9.12
		2nd	12.1	37.2	13.70	20.8	38.8	11.20
		Tails	2.66	10.8	38.10	11.7	29.4	79.68
21	750	1st	40.2	23.5	8.67	58.8	22.4	6.02
		2nd	14.0	33.1	14.00	29.9	44.0	14.10
		Tails	2.57	12.4	37.8	11.3	33.6	79.88
20	1000	1st	35.0	26.2	7.72	59.5	36.4	7.02
		2nd	13.0	16.9	13.2	21.6	21.3	10.80
		Tails	2.96	12.0	35.4	18.9	42.3	82.18

The results of total extraction are plotted on curve 6.

The total extraction of lead, zinc and iron, reaches a maximum for a charge between 500 and 750 grams. The curves all follow one another more or less. These results as far as pulp ratio tests, are not accurate, because each sample was ground for 20 minutes-and in the 250 gram sample more grinding would be done than in the 1000 grams in that time.

The differential action of F.P.L. #24 is noted from these tests.



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TESTS 45-48, 66 and 67

In these tests, the ore was ground in 500 gram lots, each being ground 20 minutes, and the charges made up afterward, insuring the same degree of crushing in each test. Barrett #4 oil, 25 drops, was used throughout. The length of test was 40 minutes.

Test	Wgt. of Charge	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
45	250	34.8	17.2	12.1	25.9	6.4	3.05
		29.6	22.4	10.8	35.2	18.7	4.34
		16.35	30.3	15.1	34.0	30.7	10.61
		.79	14.5	38.6	4.9	44.2	82.00
48	500	47.6	19.8	6.7	45.7	9.15	2.24
		34.2	27.2	8.3	23.7	9.10	2.04
		17.6	36.2	11.6	24.1	23.90	5.52
		.89	16.5	36.6	6.5	57.20	90.20
46	750	43.7	19.9	7.8	54.5	16.2	3.6
		25.6	31.2	11.1	14.8	11.85	2.4
		12.95	16.65	14.5	24.1	20.30	10.0
		1.19	13.95	39.9	6.6	48.45	84.0
47	1000	42.1	20.5	9.26	42.7	13.7	3.54
		29.1	27.4	11.60	30.1	18.15	4.51
		12.55	35.7	18.30	22.8	42.60	12.55
		0.79	14.3	39.5	4.4	25.55	79.40
67	1250	39.6	20.8	11.6	57.5	18.4	5.88
		21.1	29.3	17.7	19.2	16.2	5.61
		9.44	26.2	23.9	20.5	34.6	18.10
		0.66	11.7	41.7	2.8	30.8	70.41
66	1500	44.7	19.0	11.75	41.2	10.0	4.86
		35.5	21.4	12.50	15.4	5.3	2.42
		25.3	27.8	15.30	11.5	7.23	3.12
		11.9	30.7	20.80	20.3	29.9	15.90
		2.36	17.0	33.60	11.6	47.57	73.70

See curve 7.

The same amount of oil was used in each test to keep the ratio of water to oil approximately constant. i.e., the amount of oil in solution and the amount of immiscible oil was the same in each test.

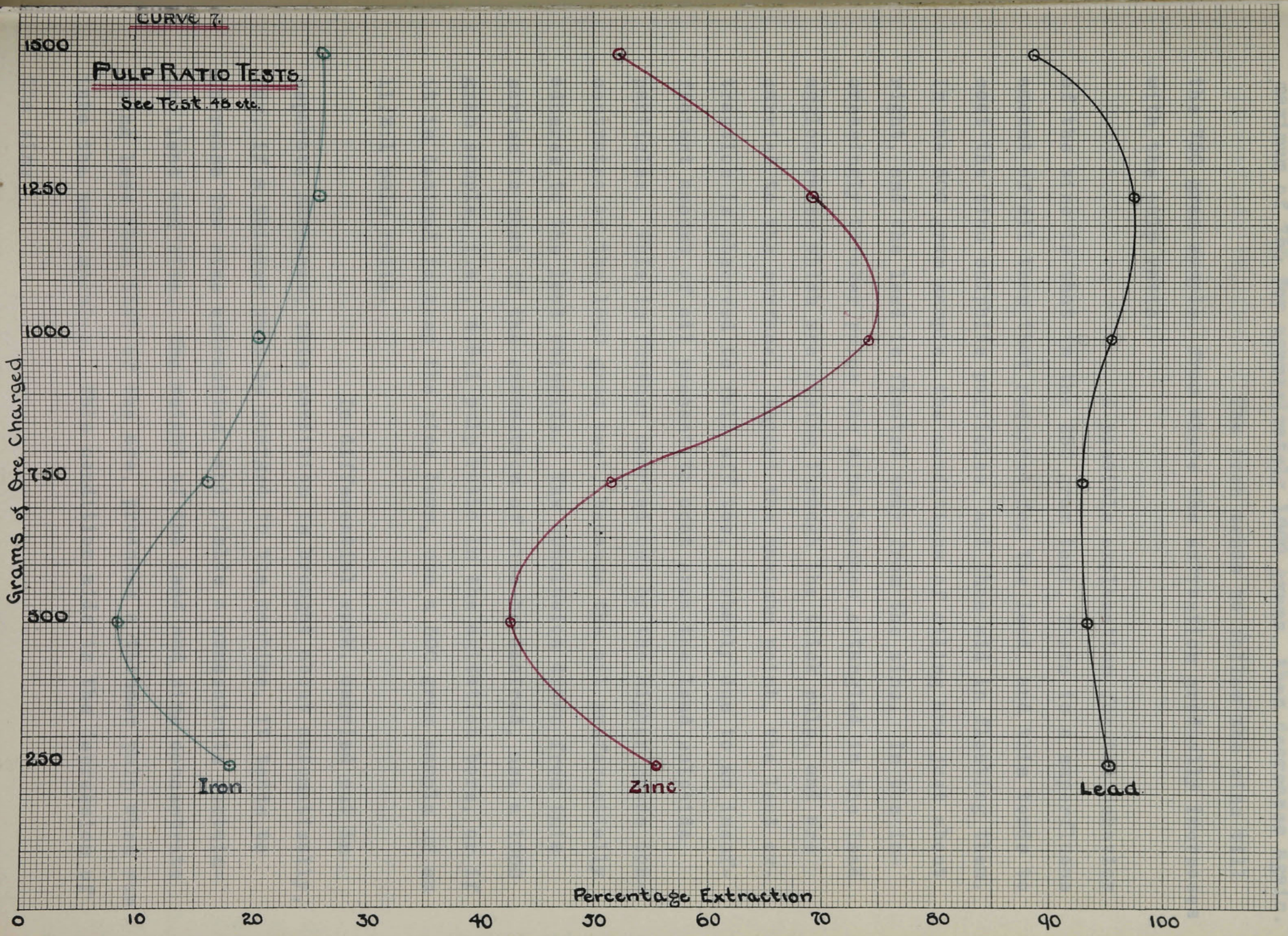
The extraction of lead only varied slightly, the outside limits being 93.4% and 97.2%.

The extraction of the zinc varied greatly, starting with an extraction of 55.8% for a 250 gram sample, the extraction reaches a minimum for 500 grams, and rises to a

CURVE 7.

PULP RATIO TESTS.

See Test 48 etc.



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maximum of 75% for approximately 1000 grams, then decreases again.

The iron tends to follow the zinc till the 750 gram sample, from where the extraction gradually increases with the pulp ratio.

A possible explanation for the behavior of the zinc is that in the 250 gram test, there is a superfluous amount of oil than that required for the lead, and this tends to coat the zinc sulphide particles, and thus aid in floating them. In the 500 gram sample, the conditions of oiling are just about right, and the lead is floated away from the zinc. In the increasingly thicker pulps the zinc becomes entangled in the lead agglomerates which are rising through the thick pulp, and are carried to the surface. Beyond the maximum point, the lead extraction is observed to fall off too, probably due to an insufficient amount of oil present to coat even the lead sulphide particles. This is further carried out by the higher grade concentrates of the 1500 gram test, because the oil preferentially adheres to the lead sulphide. The conclusion drawn from this series is that if the extraction of zinc be desired, use a 1000 gram sample, i.e., 4.5:1 pulp ratio in the agitation bore, or if it is desired to keep the zinc down, use a 500 gram sample or an 11.2:1 pulp ratio.

In differential work, carried out in separate machines, this condition is brought about automatically, for, if a thicker pulp be charged to the machine, it tends to increase the zinc extraction, and yields a concentrate containing lead and zinc. The weight of the lead and zinc concentrate being less than that of the ore, produces a thinner pulp when run into the next machine. This condition aids in the depression of the zinc.

This effect opposed in the case where a lead concentrate is taken off first, as the pulp is gradually becoming thinner.

OILS USED

Barrett No.4 is coal distillate and has a large time factor, i.e., it is a slow frother.

F.P.L.# 24 is very similar to B#4.

Cresol is a light, very soluble oil and hence is a good frother, but has a low carrying power.

Pine Oil is a light distillate of pine wood and is very soluble and a good frother.

Eucalyptus Oil is a light wood distillate, and is a very heavy frother and has a very sudden action.

Water Gas Tar is a by-product of the gas producers, and the sample used contains amount of carbon in suspension. It has a specific gravity of about 1 and contains both a soluble and insoluble fraction.

Coal Tar, as its name implies, is a tar derived from coal distillation and is a heavy carrier of mineral.

Xylidin Mixture is a mixture of Xylidin 40% and X-cake (Alphanaphylamine) 60%.

The Xylidin is a lighter coal distillate while the X-cake is not an oil at all, and hence the use of it above would do away with the payment of royalties.

Cobalt Mixture is made up of

Barrett No.4	70%
Coal Tar	10%
Pine Oil	20%

Calibrations of the oil droppers for 500 gram samples are as follows

Oil	1 drop= #/ton
B#4	.086
F.P.L.#24	.140
Sp#3	.090
Eucalyptus	.08
Cresol	.092
Cresol 5% F.P.L.#24 95%	.09

Oil	1 drop= #/ton
Tar 50%) F.P.L.# 24 50%)	.09
W.G.T.	.085
W.G.T. 50% F.P.L.#24 50%	.092
Xylidin M.	.10
Cobalt Mix.	.107

Oil	#/ton
Sp.2	.092
Sp.3	.096

THE EFFECT OF VARIOUS OILS

To determine the effect of various oils which have been used in practice, 500 gram samples were ground for twenty minutes. These were floated with the various oils keeping other conditions constant throughout, such as time of adding oil and skimming etc. The first concentrate shown was taken after 25 minutes and the tests completed after 40 minutes.

(Tests will be shown on following page.)

The Effect of various Oils

Table b.

Test No.	Oil	Drops	#/ton	Grade in % Pb	Zn	Fe	%Extraction Pb	Zn	Fe
19	FPL24	25	3.5	32.9	25.4	9.85	67.5	32.6	9.12
				12.10	37.2	13.70	20.8	38.8	11.20
				2.66	10.8	38.10	11.7	29.4	79.68
48	B#4	25	2.16	41.9	22.9	7.37	69.4	18.25	4.28
				17.6	36.2	11.6	24.1	23.9	5.52
				.89	16.5	36.6	6.5	57.2	90.20
53	Sp#1 5% Pine) 95% B#4)	25	2.3	36.2	24.3	10.0	68.5	25.8	8.2
				13.0	35.7	16.7	14.3	21.9	8.0
				3.11	16.8	34.8	17.2	52.3	83.8
57	Sp#2 10% Pine	25	2.4	31.7	26.3	14.1	79.6	34.9	14.4
				7.84	31.7	25.2	15.5	33.0	18.6
				1.22	15.0	40.7	4.9	32.1	67.0
68	Sp#3 2%P.	25	2.26	38.4	23.0	11.35	75.1	25.5	7.7
				10.6	34.6	23.80	20.1	39.0	16.5
				.94	12.5	43.5	4.8	35.5	75.8
.03	Eucal.	20	1.6	17.7	22.9	25.9	65.0	50.6	41.3
				10.4	21.1	29.7	27.7	33.8	34.9
				3.88	13.6	29.6	7.3	15.6	23.8
.04	Cresol	20	1.84	42.2	18.4	11.6	33.2	8.2	3.8
				18.9	32.9	17.0	56.3	55.4	21.4
				2.46	14.1	38.9	10.5	36.4	74.8
.05	Cresol 5% FPL95%	25	2.25	38.8	23.7	9.5	52.7	18.2	5.6
				14.7	36.8	17.0	34.3	47.7	16.2
				2.84	13.3	40.0	13.0	34.1	78.2
.06	Tar 50% FPL 50%	15	1.35	15.1	23.7	25.1	84.0	75.6	56.3
				6.72	18.5	36.7	8.6	13.7	19.0
				4.36	11.2	37.0	7.4	10.7	24.7
.11	W.G.T.	25	2.1	53.2	6.0	9.6	23.0	1.47	1.35
				41.1	21.5	9.2	34.9	10.39	3.20
				5.77	21.1	31.8	42.1	88.14	95.45
.12	W.G.T.50% FPL#2450%	25	2.3	53.0	17.0	7.4	47.5	8.4	2.6
				23.3	34.3	13.7	31.6	25.4	6.9
				3.4	19.5	39.4	20.9	66.2	90.5
83	Xylidin	25	2.5	30.9	25.9	12.1	78.6	40.5	13.4
				8.16	34.4	20.6	14.9	38.7	16.5
				1.67	10.5	41.6	6.5	20.8	70.1
Last Year)	Cobalt M.	3.6		13.8	23.4	29.0	76.7	93.0	80.3
				2.5	9.6	37.7	3.3	7.0	19.7

This test was run in an acid circuit. Other tests, however, using eucalyptus oil all bring out the fact that it is too sudden in its action and hence of no value for the differential flotation of this ore.

Test 106 was discontinued after 25 minutes, The 50% Oil of Tar and 50% F.P.L.#24 mixture was too sudden in its action and was discarded after this test. Cobalt mixture is similar in its action and as seen further in the pulp ratio tests, it is valueless in close differential work.

With all the above oils the extractions of lead, zinc and iron are all high but the grade of the concentrates is poor.

At the other extreme is water gas tar which gives a good high grade lead concentrate but the extraction is very poor.

Barrett No.4 and F.P.L.#24 are somewhat similar in their action, B#4 giving slightly better differential action, its extraction of lead is higher but the extraction of zinc and iron lower than with F.P.L.#24. The latter particularly aids the extraction of zinc.

A curious thing to note is the behavior of a few percent of pine oil added to B#4. The extraction obtained with the 5% mixture is lower than that obtained with either the 10% or 2% mixtures and also lower in the lead extraction than the straight B#4.

The best differential action both in grade and extraction was obtained with the 2% mixture, so the other two were discarded from further use. Pine oil is a good frothing oil.

Cresol gives a good grade of concentrates at first, but as the action appears to be slow the second concentrate is rather a poor grade, although the total extraction is fair. Cresol is a very soluble oil.

For this reason a mixture of Cresol 5% and F.P.L.#24 95% was made up. The result appears to be a mean between the results obtained with the two components.

The mixture of Water gas tar 50% and F.P.L.#24 50% gives a very good grade of concentrate but the total extraction is low. With the use of other reagents very good results were obtained with this oil. Again, the action of the mixture gives results which are approximately the mean of the results obtained by the components.

The Xylidin mixture gives a fair differential action with a fairly good total extraction. It appears to be of benefit in the extraction of zinc.

SERIES WITH FPL#24 3.5#/ton

Table 7.

Test No	Reagent	Amount	Pb	Zn	Fe	Pb	Zn	Fe
19	-	-	32.9	25.4	9.85	67.5	32.6	9.12
			12.1	37.2	13.70	20.8	38.8	11.20
			2.66	10.8	38.10	11.7	29.4	79.68
22	Na_2S	2#/ton	37.1	26.1	11.4	69.6	27.8	9.63
			14.1	39.1	15.2	20.0	31.6	9.56
			1.97	13.8	35.4	10.4	40.6	80.81
25	NaOH	4#/ton	39.5	25.4	6.27	69.4	23.1	4.6
			16.6	37.8	12.30	27.6	32.5	8.3
			.5	14.8	36.80	3.0	44.4	87.1
26	NaOH	4#/ton	40.1	23.3	18.2	36.5	12.95	6.35
	Na_2S	2#/ton	23.45	33.2	18.1	42.0	36.2	12.39
			3.78	14.8	37.9	21.5	50.85	81.26

In each of these tests the ore was ground for 20 minutes. The reagents were added in the machine without separate agetation. The ore was charged and the oil added at regular intervals, and the first concentrate taken off after 25 minutes, and the second concentrate and tails after 40 minutes.

The effect of the sodium sulphide is to increase both the grade of concentrate and the extraction of lead. The grade of zinc in the second concentrate is higher, but the total extraction is considerably lower. The percentage of iron in the concentrate is a little higher but the extraction decreases very slightly.

Sodium hydroxide still further increases the grade of concentrate and total extraction of lead, while the grade of zinc is practically the same in the concentrates, while the tailings run higher. The total extraction is lower. The iron is cut down considerably in grade and total extraction.

A combination of the two reagents again increases the grade of the lead concentrate, but the percentage in the tailings is higher and the extraction cut down considerably.

The percentage of zinc in all these samples is cut down and the extraction is considerably lowered. Although the percentage of iron in the concentrates is much higher, the extraction is slightly lower than that with straight oil, but higher than that with NaOH only.

SERIES WITH B#4, 2.16#/ton.

Test No	Reagent	Amount	Grade in % Pb	Zn	Fe	Extraction Pb	Zn	Fe
48			41.9	22.9	7.37	69.4	18.25	4.28
			17.6	36.2	11.6	24.1	23.9	5.52
			.89	16.5	36.6	6.5	57.2	90.2
23	Na_2S	2#/ton	41.7	27.8	7.1	68.0	22.6	4.6
			16.3	36.0	1.35	28.7	32.8	1.0
			.89	14.3	38.00	3.3	44.6	94.4
27	Na_2S	2#/ton	40.8	22.2	8.75	50.2	16.1	4.46
	NaOH	4#/ton	23.2	32.2	12.20	27.9	23.7	6.13
			3.88	14.1	37.00	21.9	50.2	89.41
36	Na_2S	2#/ton	43.5	22.0	9.15	51.5	16.2	4.75
			17.5	35.5	15.80	29.1	36.6	11.60
			3.78	14.9	37.0	19.4	47.2	83.65
37	Na_2S	2#/ton	43.8	22.4	8.3	57.0	18.4	4.5
	NaOH	4#/ton	21.5	31.4	13.8	24.0	22.1	6.3
			3.1	16.8	38.1	19.0	59.5	89.2
38	Na_2S	2#/ton	42.9	23.9	13.4	33.4	11.2	4.63
	H_2SO_4	2#/ton	24.8	33.6	11.6	37.8	30.9	7.87
			5.05	16.75	34.6	28.8	57.8	87.50
40	Na_2S	4#/ton	38.6	23.6	1.58	76.0	20.2	.69
			7.95	40.0	11.80	17.25	38.0	8.31
			.97	13.9	40.90	6.75	42.8	91.00

500 gram samples were ground 20 minutes for each test. In tests 23 and 27, reagents were added directly to the machine, while in tests 36,37,38 and 40, the ore was agitated for 20 minutes with the reagents at 1:1 pulp ratio.

Test 23. The effect of sodium sulphide is to slightly increase the lead extraction without altering the grade of the lead concentrate. The percentage of zinc in the concentrates is increased, and the total extraction considerably increased. The iron is thrown more into the tails giving a cleaner grade of concentrate and lowering the extraction.

Test 27. The addition of sodium hydroxide lowers the grade of the concentrates by increasing the extraction of iron and greatly decreasing the extraction of lead and throwing down a little zinc.

Comparing these tests with 22 and 26, table 7, the effect of the two oils is obtained. B#4 gives a higher grade of concentrates, with as good, and in some cases better, extractions of lead and zinc.

Tests 36 and 37. The effect of separate agitation is to increase the grade of lead concentrate but to decrease the percentage of zinc, and increase that of iron. With the use of sodium sulphide only the extractions of lead and zinc fall off, while that of iron increases. In the alkaline circuit, the lead extraction is increased, the zinc decreased, and the iron is practically the same.

Test 38. The use of an acid circuit increases the percentage of lead in the tails without much effect on the zinc. The concentrates run higher in iron. The extraction of lead is decreased, and that of zinc and iron increased. The use of acid in this case is detrimental.

Test 40. Increasing the amount of sodium sulphide from 2#/ton (Test 36) to 4#/ton, decreases the percentage of lead in the first concentrate, but greatly increases the extraction. A very good grade of zinc concentrate is obtained with a slightly higher extraction. The percentage of iron in the concentrates and the extraction are exceedingly low.

From the above, the best differential action to float the lead away from the zinc and iron is obtained by agitating the ore with 4#/ton of sodium sulphide in a neutral circuit.

USE OF SO_2

500 gram samples were ground 20 minutes, and floated with Cobalt Mixture No.1,- #/ton, adding the reagent directly to the machine.

Table 9

Test	Reagent	Am't	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
29	SO_2	10cc	38.0	15.8	15.2	34.3	8.7	5.86
			17.15	21.8	27.0	42.4	32.9	28.60
			4.85	20.0	32.0	23.3	58.4	75.54
30	SO_2	20cc	34.5	14.1	15.5	20.4	5.4	3.6
			18.2	17.4	39.5	39.0	24.4	34.0
			7.47	19.8	28.7	40.6	70.2	62.4

SO_2 when in solution forms a certain amount of sulphurous acid, and the acid circuit probably accounts for the low grade concentrates. The effect of increasing the amount of SO_2 used, is to further lower the grade of concentrates and to decrease the lead and zinc extractions, but to increase the extraction of iron.

TESTS 28 and 39

500 gram samples were ground 20 minutes and floated with B#4, 2.16#/ton. In test 28, 10 cc of saturated SO_2 solution was added directly to the machine, while in test 39 the ore was agitated 20 minutes with the SO_2 before going to the flotation machine.

Table 10.

Test	Reagent	Am't	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
28	SO_2	10cc	38.5	15.1	16.7	26.6	6.4	4.9
			9.2	20.9	28.8	73.4	93.6	95.1
39	SO_2	10cc	44.0	18.0	12.1	18.7	3.4	1.85
			31.7	30.9	2.07	60.0	25.6	1.35
			2.42	18.7	31.1	21.3	71.0	96.80

The effect of SO_2 is again to greatly decrease the extraction.

Separate agitation appears to be beneficial, as it increases the grade of the concentrates, and increases the extractions of lead and zinc, particularly of lead, and decreases the extraction of iron.

SO_2 is not of any great value in the flotation of this ore, and if used at all, separate agitation is of benefit.

OTHER TESTS WITH COBALT M. No.1

For these tests, 500 gram samples were ground for twenty minutes and floated with 2.2#/ton of Cobalt Mixture. The reagents used were added in the machine without separate agitation. The first concentrates were taken after 25 minutes, and the second concentrates and tails after 40 minutes.

Test	Reagent	Am't	Grade in %			% Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
24	Na_2S	2#/ton	27.6	29.5	12.5	76.4	47.6	14.8
			10.8	24.7	21.8	21.0	30.7	18.3
			.69	9.1	40.6	2.6	21.7	66.9
16	$CuSO_4$	2#/ton	23.6	29.1	15.0	70.9	55.1	18.1
			12.5	25.4	23.1	24.0	30.8	17.8
			1.38	5.9	42.2	5.1	14.1	64.1
33	$CuSO_4$	2#/ton	23.8	30.8	13.9	74.6	55.1	14.3
	H_2SO_4	2#/ton	9.3	28.6	27.4	18.1	31.7	17.5
			2.23	7.1[illegible]	62.5	7.3	13.2	78.2

Sodium sulphide has the action of slightly increasing the extraction of lead, and decreasing that of zinc and iron. The grades of concentrate are poor with this oil.

Copper sulphate tends to increase the extraction of zinc, and to a lesser extent the iron, while that of lead is slightly less. The grade of concentrates is poor.

The presence of acid in the pulp affects the iron chiefly by throwing it more into the tails, thereby decreasing its extraction. The zinc is scarcely affected, while the lead extraction, although totally lower is somewhat better in the first concentrate.

The presence of acid is beneficial to differential work with this oil.

B#4. - 2.16#/ton

500 gram samples ground for 20 minutes were used throughout. The reagents were added in the machine and tests were run for 40 minutes.

Test	Reagent	Am't	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
48	-	-	41.9	22.9	7.37	69.4	18.25	4.28
			17.6	36.2	11.6	24.1	23.9	5.52
			.89	16.5	36.6	6.5	57.2	90.20
41	Na_2CO_3	4#/ton	41.6	20.4	18.0	75.0	21.7	11.4
			16.8	31.7	15.6	22.9	25.3	7.1
			.29	14.0	37.9	2.1	53.0	81.5
44	Na_2CO_3	8#/ton	35.0	24.9	11.5	76.6	29.1	9.46
			15.8	38.4	16.1	11.25	14.6	4.28
			6.73	40.5	18.4	6.93	22.2	7.6
			.99	12.2	40.2	5.22	34.1	79.20
49	$Na_2S_2O_3$	2#/ton	42.3	23.4	8.72	58.5	18.43	5.28
			15.1	35.8	15.3	21.1	28.55	9.32
			3.77	17.3	36.6	20.4	51.02	85.40
64	$FeCL_3$	2#/ton	39.8	22.6	9.95	49.2	16.1	4.65
			18.1	31.0	17.2	30.8	29.9	10.75
			3.5	15.9	38.3	20.5	54.0	84.40
65	$FeCL_3$	1#/ton	29.2	29.5	10.2	57.8	32.9	7.8
	$CnSO_4$	1#/ton	15.3	32.0	19.2	32.8	38.6	15.6
			1.89	10.2	40.3	9.4	28.5	76.6
79	KCr_2O_7	2#/ton	17.0	39.4	15.8	12.4	18.3	3.68
			14.3	21.9	32.1	24.0	23.4	17.20
			9.45	13.5	36.9	63.6	58.3	80.92
80	Na_2HPO_4	2#/ton	40.6	23.8	8.3	38.1	13.3	3.12
			17.9	33.4	16.4	43.5	48.5	16.00
			3.96	13.8	43.4	18.4	38.2	80.88
90	NH_4CL	2#/ton	45.7	21.7	10.2	43.6	12.4	3.75
			21.6	35.1	14.9	35.8	34.9	9.75
			3.74	15.9	39.5	20.6	52.7	86.50

Test 41. Sodium Carbonate has not much effect on the percentage of lead in the concentrates, but it increases the total extraction particularly in the first concentrate. The percentage of zinc in the concentrates is lowered, but the total extraction is increased. The iron is increased in both percentage of concentrates and total extraction. Sodium Carbonate increases the extraction of all three sulphides, but brings out a sharper differentiation between the lead and zinc.

Test 44. By increasing the amount of Sodium Carbonate, the grade of lead concentrate is lowered, while the grade of zinc concentrate is greatly increased. The extraction of lead is slightly lowered, that of zinc greatly increased, and that of iron slightly increased.

To obtain a clean lead concentrate it would be of benefit to use a smaller quantity of sodium carbonate.

Test 49. The use of sodium thiosulphate has very little effect on the grade of concentrates. The extraction of lead is considerably less while that of zinc and iron is a little higher.

Test 64. Ferric Chloride lowers the percentage of lead and zinc in the concentrate and increases that of iron. The extraction of lead is decreased, while that of zinc and iron is increased. Ferric chloride is detrimental to flotation in this way.

Test 65. When ferric chloride is used in conjunction with copper sulphate, the percentage of lead in the concentrates is further decreased, while that of zinc and iron is increased. There is a large increase in the extraction of all three sulphides, however.

Test 79. The use of potassium dichronate decreases the percentage of lead in the concentrates, but greatly increases the percentage of zinc and also that of iron. The extraction of lead is surprisingly low, while that of zinc is about the same, and the iron increases. Potassium dichronate tends to float the zinc in preference to lead.

Test 80. Sodium dibasic phosphate does not alter the grade of concentrate greatly, but decreases the extraction of lead, and increases that of zinc and iron.

Test 90. Ammonium chloride increases the grade of the lead concentrate without much effect on that of the zinc concentrate. The extraction of lead is lowered, while that of zinc and iron is increased.

COBALT MIXTURE No.1. 2.68 #/ton.

500 gram samples ground for 20 minutes were floated in the machine with 2.68#/ton of cobalt mixture No.1, the reagents being added in the machine. The tests were run for 40 minutes.

Test No	Reagent	Am't	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
42	Na_2CO_3	4#/ton	29.5	23.2	16.6	71.9	37.0	14.6
			13.8	30.7	17.3	14.7	21.3	6.66
			7.03	27.1	38.5	11.0	27.5	21.80
			.69	6.23	44.7	2.4	14.2	56.94
50	Na_2SO_3	2#/ton	24.7	27.4	17.6	83.0	57.5	26.7
			7.73	27.5	27.8	11.24	24.9	18.3
			1.98	9.53	41.5	5.76	17.6	56.0
62	$FeCl_3$	4#/ton	25.6	23.7	22.0	44.5	25.9	15.3
			13.5	25.8	25.9	39.9	47.9	31.8
			4.82	12.6	39.0	15.6	26.2	52.9

Test 42. Sodium Carbonate increases the grade of lead and zinc concentrates, and decreases the percentage of iron. The extraction of lead is slightly higher, and the zinc slightly lower, while that of iron is considerably lower.

Test 50. Sodium thiosulphate slightly increases the grade of the lead and zinc concentrate, and slightly decreases the percentage of iron. The extraction of all three sulphides is lowered.

Test 62. Ferric chloride slightly increases the grade of lead and zinc concentrates, and decreases the percentage of iron present. The extractions of lead and zinc and iron are much lowered.

Sodium carbonate appears to be the most beneficial, while ferric chloride is detrimental.

F.P.L.#24.

500 gram samples were ground 20 minutes, and floated with 3.5#/ton of F.P.L.#24, and the reagents were added in the machine with the exception of test 99. In this case, difficulty was obtained in getting the reagent into solution, so it was added in the ball mill.

Test No	Reagent	Am't	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
19	-	-	32.9	25.4	9.85	67.5	32.6	9.12
			12.1	37.2	13.70	20.8	38.8	11.2
			2.66	10.8	58.10	11.7	29.4	79.68
43	Na_2CO_3	4#/ton	41.0	20.9	12.2	75.2	25.0	8.82
			10.1	34.9	14.0	6.8	15.3	3.72
			6.7	34.1	17.1	8.98	30.2	9.26
			1.88	9.5	41.5	9.02	29.5	78.20
51	$Na_2S_2O_3$	2#/ton	39.4	23.0	9.4	65.3	21.7	6.08
			14.4	25.6	14.4	17.6	17.8	6.92
			2.92	18.1	37.6	17.1	60.5	87.0
52	do.	4#/ton	42.3	21.2	9.2	61.9	18.8	5.84
			14.9	31.4	13.5	16.1	20.2	6.01
			3.87	17.7	36.2	22.0	61.0	88.15
61	FeCl	4#/ton	25.3	28.1	18.0	46.5	28.7	12.1
			13.2	29.0	23.5	31.0	37.5	20.2
			4.7	12.8	38.4	22.5	33.8	67.7
99	Na SiO	2#/ton	44.1	20.3	8.8	58.4	18.0	4.6
			17.5	36.3	15.7	29.5	40.8	10.4
			2.62	13.9	48.7	12.1	41.2	85.0

Test 43. Sodium carbonate increases the grade of the lead concentrate at the expense of zinc. The percentage of iron is also slightly higher. The extractions of all three sulphides are higher.

Test 51. Sodium thiosulphate increases the grade of lead concentrate at the expense of the zinc, the percentage of iron being about constant. The extractions of all three sulphides are much lower, particularly that of zinc, which is just about cut in half.

Test 52. The effect of increasing the amount of Sodium thiosulphate is to further increase the grade of the lead concentrate, and to increase the grade of the zinc concentrate without much effect on the percentage of iron. The increased quantity further causes a slight decrease in extraction of all three sulphides.

Test 61. Ferric chloride decreases the grade of the lead and zinc concentrates with a decided increase in the percentage of iron. The extractions of lead and zinc are lowered, while that of iron is increased.

Test 99. Sodium silicate greatly increases the grade of lead concentrate, with a slight decrease in that of the zinc concentrate. The percentage of iron in the lead concentrate is lowered, but raised in the zinc concentrate. There is a slight drop in the lead extraction with a greater one in the zinc and iron.

SPECIAL NO.1

B#4 - 95%
Pine Oil - 5%

500 gram samples were ground for 20 minutes and floated with 2.3 #/ton of Sp.#3. The reagents were added in the machine and the tests run for 40 minutes, a first concentrate being taken off after 25 minutes.

Test No	Reagent	Am't	Grade in %			% Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
53	-	-	36.2	24.3	10.0	68.5	25.8	8.2
			13.0	35.7	16.7	14.3	21.9	8.0
			3.11	16.8	34.8	17.2	52.3	83.8
54	Na_2S	2#/ton	38.0	24.3	10.4	71.2	27.3	8.54
			12.55	34.8	17.4	15.3	25.8	9.46
			2.64	15.2	36.2	13.5	46.9	82.00
55	$CuSO_4$	2#/ton	30.0	29.7	10.1	75.1	41.6	10.7
			10.84	36.3	20.5	23.2	43.5	18.8
			.47	7.15	43.7	1.7	14.9	70.5
56	NaOH	2#/ton	37.6	24.2	11.1	68.1	25.9	8.6
			12.1	34.4	17.9	20.1	33.6	12.7
			2.45	14.2	38.1	11.8	40.5	78.7

Test 54. Sodium sulphide increases the grade of the lead concentrate with very little effect on the zinc and iron percentage. The extraction of all three sulphides is a little higher.

Test 55. Copper sulphate decreases the grade of the lead concentrate and increases that of the zinc concentrate with an increase of iron in the latter. The total extraction of all three sulphides is much higher, but most noticeably that of the zinc.

Test 56. Sodium hydroxide has a very little effect on the grade of concentrates, showing only a slight increase in lead and iron, and decrease in zinc. The total extraction of all three sulphides is increased.

SPECIAL NO.2.
Barrett No.4- 90%)
Pine Oil - 10%)

500 gram samples were ground for 20 minutes and floated with 2.4 #/ton of Sp.#2. The reagents were added in the machine, and the tests run 40 minutes, the first concentrate being removed after 15 minutes, and the second after 25 minutes.

Test No	Reagent	Am't	Grade in %			% Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
57	-	-	39.0	23.0	11.65	59.6	18.6	7.21
			20.3	31.4	18.00	20.0	16.3	7.19
			7.84	31.7	23.2	15.5	33.0	18.6
			1.22	15.0	40.7	4.9	32.1	67.0
58	$CuSO_4$	2#/ton	33.0	28.3	10.9	66.3	34.6	9.53
			12.8	40.0	23.8	18.2	34.6	14.70
			7.36	27.6	30.2	10.2	23.3	18.27
			1.89	4.29	45.6	5.3	7.5	57.50
59	Na_2CO_3	2#/ton	38.2	22.7	11.5	60.5	23.3	18.27
			15.3	34.1	16.4	13.0	18.7	5.7
			9.07	33.4	22.7	12.4	29.4	12.8
			3.68	11.7	47.4	14.1	28.6	74.0
63	$FeCl_3$	2#/ton	34.5	24.1	14.0	54.6	20.4	8.2
			15.5	31.2	20.8	36.2	39.0	17.8
			1.7	14.0	37.3	9.2	40.6	74.0

Test 58. Copper sulphate decreases the grade of the lead concentrate but increases that of the zinc concentrate, the percentages of iron being also higher. The extraction of lead in the first concentrates is higher, although the total extraction is slightly lower. The extraction of zinc is considerably higher while iron shows an increase also.

Test 59. Sodium carbonate appears to decrease the percentages of lead and iron in the concentrates to a small degree, and to increase the grade of the zinc concentrate. The extractions of lead and iron are lower and the zinc extraction higher.

Test 63. Ferric chloride slightly increases the grade of the lead concentrate, whereas the percentage of iron and zinc concentrate is decreased in grade. The extractions of all three sulphides is lower.

TESTS 69,70 and 71

These tests were run to attempt a differential roasting of the ore.

1000 grams ground for 35 minutes and roasted for 3 hours at about 900 C. and the sample split into two equal parts. Each was ground for 20 minutes to break up the lumps which were formed.

The first sample was floated with sodium hydroxide, added in the machine, and the second with copper sulphate and sodium hydroxide, both added in the machine. For each sample 2.86#/ton of Special #2 was used. The duration of the tests was 45 minutes.

The results were totally negative. The ore had evidently been roasted too long, as only a "flash" roast is required to give a surface oxidation to the galena without affecting the zinc.

A series of tests to determine the correct time of roast and the temperature required, would take more time than is at our disposal, and as this part of the work was covered several years ago, the effects of roasting on this ore were not determined, on the suggestion of Professor Bell.

To show the great effect on surface alteration that a little heat brings about, may be demonstrated by test 74, where the sample had previously been dried in the drying cabinet for a very short time.

1000 grams of ore had been ground for 30 minutes and dried. It was then agitated 30 minutes with 2#/ton of copper sulphate at a 1:1 pulp ratio. The oil used was Special #3, 1.1#/ton. The test was run for 50 minutes.

	Grade in %			% Extraction		
Sample	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	24.3	24.9	15.5	10.0	6.4	3.38
2nd Conc.	18.1	36.9	11.4	30.8	36.3	9.82
Tails	10.0	16.6	29.1	59.2	57.3	86.8

The very low extractions are particularly noticeable, especially that of lead. Galena being the most easily oxidized, is thrown down to the greatest extent. For this reason, precautions should be taken in the handling of this ore to prevent oxidation, particularly when ground to the size in preparation for flotation. It is best then to keep the ore under water.

Sodium carbonate is a difflocculator. It is seen to aid the extraction of lead and to suppress the zinc and also the iron. Usually a high grade lead concentrate can be obtained with this reagent. It is possible to obtain a very brittle froth by the use of sodium carbonate without any oil. This is much more pronounced in the sub-aeration machine.

Sodium Sulphide probably acts wholly as a difflocculator with this ore. In some works it is claimed to give a coating of sulphide to some minerals and thereby causing them to float. There could be no such effect in the case of this ore which runs 90% sulphides. In all the tests carried out with it, the zinc and iron have been greatly suppressed, giveng a clean lead concentrate.

Sodium Chloride attacks chiefly the zinc, throwing it into the tailings. Whether its effect is chemical or physical is hard to say, but sodium chloride does not effect the mineral permanently.

SPECIAL No. 3.

Barrett No. 4 - 98%)
Pine Oil - 2%)

A series of tests were run to determine the effect of grinding with the reagent present and also the effect of grinding with oil and a combination of the two. 1000 gram samples were used and the time of grinding was 30 minutes in each test. The oil used was 1.11 #/ton of Special #3 and copper sulphate added as a modifying agent. The use of copper sulphate has been shown to increase the zinc extraction and the use of 1000 gram samples, i.e., a pulp ratio of 4.55 : 1 in the agitation box, has the same effect. For this reason the two conditions are combined.

Test No.	Amt. of $CuSO_4$	Where Added	Grade in %			% Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
73	2 #/ton	In Machine	32.8	24.8	11.2	46.1	13.6	7.4
			13.8	31.2	19.5	30.4	49.5	35.2
			1.40	33.2	45.6	3.5	36.9	57.4
75	2 #/ton	In Ball Mill	30.5	25.9	14.5	35.8	21.1	7.6
			17.0	26.9	23.8	58.4	66.1	36.3
			2.28	7.37	49.5	5.8	12.8	56.1
76	4 #/ton	In Ball Mill	27.4	24.2	16.1	26.9	16.75	8.0
			16.0	26.7	22.4	65.0	76.5	47.0
			3.46	4.0	36.5	8.1	6.75	45.0
77	2 #/ton	In Ball Mill	26.45	20.4	24.95	44.2	21.4	18.2
		Oil also added	14.7	26.6	26.20	45.2	51.1	35.0
			3.45	14.3	34.9	10.6	27.5	46.8
78	2 #/ton	In Machine	26.2	16.5	26.5	61.3	26.0	28.7
		Oil in Ball Mill	12.4	31.4	26.0	33.3	56.3	31.9
			2.36	11.5	37.2	5.4	17.7	39.4

TESTS 73 & 75:

As before copper sulphate gives a low grade concentrate with a high extraction.

The effect of grinding in the reagent is to lower the grades of lead and zinc concentrates, increasing the percentage

of iron in each. The extraction of lead is slightly lowered while that of zinc is greatly increased, and that of iron only slightly raised. The lead appears to a greater extent in the zinc concentrate.

From these results it can hardly be said that adding the reagent in the ball mill increases the consumption. In the case of copper sulphate, it probably decreases it. One inference from this is that copper sulphate has little if any chemical effect on the surface and its whole value as a reagent in flotation is due to its action as an electrolyte and flocculator.

TEST 76:

By increasing the amount of copper sulphate used, a still lower grade of concentrate with a slightly higher percentage of iron in the first concentrate is obtained. The extraction of lead is again decreased, while that of zinc and iron shows a decided increase. The lead is further concentrated in the second or zinc concentrate.

TEST 77:

By adding both the copper sulphate and oil in the ball mill, the grade of the concentrates is further lowered. The extraction of lead and zinc is lower than in Tests 75 and 76 while that of iron remains high.

TEST 78:

Comparing this test with that of Test 73, grinding with the oil decreases the grade of lead and zinc concentrates showing a decided increase in the percentage of iron present. The

extraction of lead is lower although it is concentrated more in the first concentrate. The extraction of zinc shows a large increase in both concentrates while the iron extracted is greatly increase, the increase going into the first concentrate.

From the above results the highest extraction of zinc is obtained by adding the copper sulphate in the grinding circuit and the use of the larger quantity increases it. The grade of concentrate is decreased thereby. Such a process would be good for a rougher extraction of zinc after the lead had been removed, and preliminary to a zinc cleaning test to increase the grade and remove the iron to some extent.

The probable effect of adding oil in the grinding circuit is that the iron sulphide is oiled by the emulsion of oil before it has a chance to be wetted by water, particularly so when the copper sulphate is not present.

Further tests were run to determine the effect of using the liquid from one test in another test, the reagent used being copper sulphate, 2 #/ton. In each test 2.26 #/ton of Special #3 were used and test run 40 minutes.

TEST NUMBER	Pb	Zn	Fe	Pb	Zn	Fe
92	20.0	31.6	25.2	98.02	93.0	43.0
	0.55	3.88	54.0	1.98	7.0	57.0
97	24.4	26.9	23.7	99.2	81.1	49.4
	0.29	11.2	43.0	0.8	18.9	50.6

In test 97 the percentage of lead in the concentrate is raised while that of zinc and iron is lowered. The extraction of lead and iron is increased while that of zinc is decreased.

It was impossible to determine the quantity of copper sulphate left in the liquid from the first test owing to the high dilution.

It may be gathered from these tests, however, that it will work where the tailings from the flotation machines are filtered that it might be of advantage to return the solutions to the machines adding only a small amount of fresh copper sulphate and thus decreasing the consumption and obtaining practically the same results.

XYLIDIN MIXTURE

500 gram samples were ground for 20 minutes and floated with 2.5 #/ton of xylidin mixture. Various reagents were used, as noted in table on the following page.-

Test No.	Reagent	Am't	Time of Taking Sample	Grade in % Pb	Grade in % Zn	Grade in % Fe	% Extraction Pb	% Extraction Zn	% Extraction Fe
83	-	-	15	30.9	25.9	12.1	78.6	40.5	13.4
			45	8.16	34.4	20.6	14.9	38.7	16.5
	H	-	45	1.67	10.5	41.6	6.5	20.8	70.1
84	NaCl	8#/ton	15	44.8	20.1	9.7	57.1	15.9	5.1
	Added in Ball Mill	-	25	19.1	35.2	13.9	23.0	26.4	6.8
	-	-	40	7.18	35.2	21.2	11.9	36.4	14.6
	-	-	40	1.97	8.66	45.0	7.8	21.3	73.5
85	Na_2CO_3	4#/ton	15	44.5	21.4	9.2	63.8	16.7	5.5
	-	-	25	16.9	35.8	14.7	15.5	18.1	5.7
	-	-	40	7.5	36.6	20.9	12.2	32.7	14.3
	-	-	40	2.06	10.7	43.3	8.5	32.5	74.5
86	Na_2HPO_4	2#/ton	15	42.5	21.9	8.5	34.2	10.3	2.62
	-	-	25	26.9	31.1	11.4	32.8	22.2	5.33
	-	-	40	10.8	35.2	19.8	15.9	30.6	11.2
	-	-	40	3.64	13.4	44.9	17.1	36.9	80.85
88	NH_4Cl	2#/ton	15	39.8	24.8	12.8	67.0	26.1	8.3
	-	-	40	10.3	35.9	20.4	27.3	59.4	20.9
	-	-	40	1.69	6.7	53.1	5.7	14.5	70.8
89	NH_4Cl	4#/ton	15	39.4	23.8	11.1	69.5	23.5	7.25
	-	-	40	9.25	38.3	21.5	25.8	60.0	22.15
	-	-	40	1.28	7.75	49.9	4.7	16.5	70.6
91	NH_4Cl	2#/ton	15	48.0	21.8	11.1	49.5	4.58	3.73
	Added in Ball	-	40	15.2	36.8	18.4	35.2	50.82	13.67
	Mill	-	40	3.24	15.2	51.7	15.3	44.60	82.6
72	-	-	25	41.6	16.5	13.1	40.8	11.0	6.4
	-	-	40	22.4	26.2	18.5	17.5	13.5	7.0
	NaOH	4#/ton	45	13.5	22.4	15.9	3.8	4.25	2.2
	-	-	45	6.89	19.0	30.6	37.9	71.25	84.4

Xylidin, as it has been stated before gives rather a low grade concentrate, but the extractions of lead and zinc are very good, without bringing up very much iron.

TEST 84:

Salt has very little effect on the grade of concentrates, only raising them slightly. The extractions of all three sulphides are lowered only slightly.

TEST 85:

Sodium carbonate increases the grade of concentrates slightly, and gives a lower extraction of all three sulphides,

principally that of zinc.

TEST 86:

Sodium dibasic phosphate slightly lowers the grade of concentrates and gives a lower total extraction particularly that of lead.

TEST 88:

Ammonium chloride gives higher grade concentrates with about the same percentages of iron. The extractions of lead and zinc are higher while that of iron is about the same. This reagent retards the action of the xylidinate first and in this way more of the lead and zinc are thrown into the second concentrate.

TEST 89:

An increased amount of ammonium chloride increases the grade of the zinc concentrate slightly without much effect on the percentages of lead and iron. The extraction of lead is slightly increased, that of zinc slightly decreased, while the iron is constant. It aids the differential action only slightly.

o TEST 91:

A 1000 gram sample was used in this case and ammonium chloride added in the grinding circuit. Comparing with Test 88, the combined effects are to increase the grade of both lead and zinc concentrates, and decreasing the percentage of iron in each. The extraction of all three sulphides is much lower, particularly that of zinc.

o TEST 72:

A 1000 gram sample was used in this test. The reagent, sodium hydroxide, was not added till after 40 minutes run. The

increased pulp ratio raises the grade of lead concentrate and lowers that of the zinc. The total extraction was very low. The addition of NaOH was of little benefit.

In the first series of tests 1000 gram samples were ground with the reagents, 2#/ton, for 30 minutes and floated with 1.13#/ton of Special #3 Oil. The tests were run for 45 minutes, the first concentrate being taken off after 15 minutes.

In the second series 500 gram samples ground for 90 minutes were used. 2.26#/ton of Special #3 were used.

Test No.	Reagent	Am't.	Grade in %			% Extraction		
			Pb	Zn	Fe	Pb	Zn	Fe
68	-	-	38.4	23.0	11.35	75.1	25.5	7.7
	-	-	10.6	34.6	23.8	20.1	39.0	16.5
	-	-	.94	12.5	43.5	4.8	35.5	75.8
81	Na_2HPO_4	2#/ton	42.8	21.9	11.6	62.5	18.0	7.2
	-	-	13.2	35.0	20.3	27.2	40.6	22.8
	-	-	2.36	17.0	38.0	10.3	41.4	70.0
82	Na_2S	2#/ton	48.3	19.8	20.0	55.5	13.7	10.2
	-	-	14.9	33.6	16.5	31.9	43.7	14.4
	-	-	2.76	15.0	37.5	12.6	42.6	75.4
87	NH_4Cl	2#/ton	46.5	21.8	10.7	48.0	13.3	3.47
	-	-	16.2	35.4	20.7	36.6	47.0	14.70
	-	-	2.26	14.7	56.9	15.4	39.7	81.83
98	Na_2SiO_2	2#/ton	40.6	21.4	10.2	40.8	15.4	4.2
	-	-	19.6	29.8	16.9	34.7	37.7	12.2
	-	-	4.55	12.2	37.9	24.5	46.9	83.6
115	Na_2SiO_2	20#/ton	37.8	28.3	7.6	13.3	8.3	1.6
	-	-	29.4	28.5	14.3	16.5	10.3	3.8
	Added in Mill	-	21.0	30.7	20.7	20.1	18.8	8.8
	H_2SO_4	4#/ton	9.3	18.0	34.8	50.1	63.6	85.8

TEST 81:

Sodium dibasic phosphate in combination with a higher pulp ratio increased the grade of the lead and zinc concentrates, decreasing the percentage of iron in the latter. The extractions of lead and zinc were lowered while that of iron was raised.

TEST 82:

Sodium sulphide under similar circumstances, largely increased the grade of lead concentrate but decreased that of zinc. An anomaly appears in the percentage of iron, that in the lead concentrate being higher than before while that percentage in the zinc being lower. Sodium sulphide decreases the extraction of lead and zinc in this case without affecting that of iron.

TEST 87:

Ammonium chloride increases the grade of lead and zinc concentrates, decreasing the percentage of iron. The extractions of all three sulphides are lowered, particularly that of lead.

TEST 98:

Sodium silicate increased the grade of lead concentrate but decreased that of zinc and lowered the percentage of iron in each concentrate. The total extraction was considerably lowered.

TEST 115:

The one was ground with 20#/ton of Na_2Si0_2 and after 25 minutes of flotation 4#/ton of H_2SO_4 were added. It was difficult to obtain a froth at first, more oil was used in this test, i.e., 2.7#/ton. In filtering the samples great difficulty was encountered. Probably the action of sulphuric acid or sodium silicate produces a colloidal silicate which in turn acts as a protective colloid. The results seem to carry this out.

The concentrates are lower in grade and the total extraction extremely low. The action of the sodium silicate alone,

as seen by the first concentrate tends to suppress all three sulphides.

EUCALYPTUS OIL

500 gram samples were ground for 20 minutes in Test 103, an acid circuit used. This test was cut off after 25 minutes. In Test 107 the sodium sulphide, 4#/ton was added in the machine and .88#/ton of eucalyptus oil used.

Test No.	Reagent	Am't.	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
103	H_2SO_4	4#/ton	17.7	22.9	25.9	65.0	50.6	41.3
	-	-	10.4	21.1	29.7	27.7	33.8	34.9
	-	-	3.88	13.6	29.6	7.3	15.6	23.8
107	Na_2S	4#/ton	21.9	27.1	19.0	62.8	42.3	22.4
	-	-	12.5	30.9	22.7	26.1	35.0	19.4
	-	-	3.13	11.7	39.7	11.1	22.7	58.2

The grades of concentrates in both tests are poor, with a high percentage of iron especially in test 103. The total extraction in both cases is very high. The sodium sulphide tends to keep down a larger amount of iron than the acid does.

Eucalyptus oil showed a very poor differential action, its action being too sudden, consequently it was discarded.

WATER GAS TAR - 50%)
F. P. L..#24 - 50%)

For a series of tests run with this mixture, 500 gram samples were ground with the reagent for 20 minutes. They were floated with 2.3#/ton of oil, the first concentrate being taken after 15 minutes and the duration of the tests were 40 minutes. The main object at this stage of testing was to obtain a good grade lead concentrate with a fair extraction without much attention to the zinc.

Test No.	Reagent	Am't.	Grade in % Pb	Zn	Fe	% Extraction Pb	Zn	Fe
112	-	-	53.0	17.0	7.4	47.5	8.4	2.6
	-	-	23.3	34.3	13.7	31.6	25.4	6.9
	-	-	3.4	19.5	39.4	20.9	66.2	90.5
113	Na_2CO_3	8#/ton	53.1	17.5	7.3	54.8	9.4	3.0
	-	-	28.8	31.5	12.2	22.9	13.6	4.0
	-	-	13.3	39.9	15.3	13.2	19.5	5.7
	-	-	1.58	19.0	38.2	9.1	57.5	87.3
114	Na_2S	4#/ton	56.8	14.4	7.6	25.6	3.7	1.4
	-	-	43.2	22.5	10.5	28.3	8.3	2.8
	-	-	19.6	35.0	14.3	21.7	21.9	6.4
	-	-	3.96	18.8	36.0	24.4	66.1	89.4

TEST 113:

Sodium carbonate slightly increases the grade of the lead concentrate and also the zinc concentrate with only a slight increase in the percentage o f iron. The extraction of lead is considerably increased, zinc to a lesser degree, and iron only slightly.

TEST 114:

Sodium sulphide increases the grade of the lead concentrate but decreases that of the zinc, while the percentage of iron is slightly decreased. The extraction of lead is somewhat lower, with the zinc and iron extraction almost the same.

This oil gives a very good grade of lead concentrate.

ACTION OF THE OILS AND REAGENTS.

Before proceeding with the discussion of the re-treatment tests a summary of the action of the various oils and reagents used should be given.

OILS:

Oils such as cobalt mixture and eucalyptus were found to be too sudden in the action and are of little value

in differential flotation of this nature. Their use would require a low grade one where the essential requisite would be a high extraction and a clean tailings which could be discarded. The mixture of oil of tar 50% and F.P.L. #24 50% belongs to this class.

Water gas tar on the other hand, gives a high grade concentrate but the extraction is very poor. This is because the oil has very little carrying power and, further, the froth produced is very brittle.

Barrett No. 4 and F.P.L. #24 are somewhat similar in character and in their action. Barrett No. 4 gives a higher extraction of lead and a lower extraction of iron and hence has a little better differential action. F.P.L. #24 on the other hand is more beneficial to the extraction of zinc. Both oils, however, have the desired time factor for differential work.

A small percentage of pine oil added to Barnett No. 4 has been found to greatly increase the extraction of zinc, and slightly increase that of lead with a little greater extraction of iron. The increased extraction overbalances the slight decrease in grade of concentrate.

In the preceding tests 2 % of Pine Oil was found to be the most beneficial amount both from the extraction and the economical standpoints.

Xylidin proved to be of great benefit in the extraction of zinc with an average extraction of iron. It is impossible to affect a clean separation of lead and zinc with this mixture. Xylidin is very expensive, and the cost in prac-

tice would probably overcome any increased extraction produced by it.

Cresol gave a fair grade of concentrate with an average extraction. The mixture of cresol 5 % and F.P.L. #24 gave an increased differential action over the straight F.P.L. #24. Tests with this were not carried out owing to a lack of time and the fact that better results were being obtained with a water gas tar mixture.

Water gas tar 50 % and F.P. L. #24 50 % gave the highest grade lead concentrates with a relatively high extraction. Its most important use is for a high grade lead concentrate, using some other oil to extract the zinc.

REAGENTS:

COPPER SULPHATE.

The use of copper sulphate gave a high extraction of zinc in all the preceding tests. The grade of zinc concentrates were rather low but this is due principally to the presence of the lead. In the following tests where copper sulphate was added after the removal of the lead ,high grade zinc concentrates were obtained.

By an examination of the results and the appearance of the froths, the effect of this reagent is to flocculate slimes and form agglomerates, these rising to the surface in the froth. It is a well known fact though it is a good electrolyte. The facts against there being a chemical surface effect are these. Very small quantities give as good results, if not better, than large quantities. As low as 0.1 of a pound per ton has been used in practice. Also better results have been obtained adding

the reagent direct to the machine than by agitating with it, and in the latter case the ore is in contact longer with the copper sulphate.

Sodium hydroxide, like most alkalies, is a deflocculator and from this it would appear that cleaner concentrates would be obtained, since each particle may act under its own tendencies either to float or to sink. The extraction would probably be cut down due to a loss in the very fine slimes. This is found to be true in most cases. Sodium hydroxide tends to form a soap with some oil, however, and a lowering of the grade is the result of the increased frothing. Barrett No. 4 is an oil of this character. Excessive alkalinity has been proven to produce poor differential work at Broken Hill, Australia.

Acids seem to have properties which conflict with one another. One property is that of lowering the surface tension of water and increasing its wetting ability. This is beneficial in that it produces a clearer froth by insuring a wetting of the gangue. Another property is that it tends to emulsify some oils which are usually detrimental to flotation. It is quite probable that some acids have a chemical effect on the ore in some cases, partially destroying its floatability, in other cases it may produce chemical minute gas bubbles at the surface of the sulphides and increasing their floatability. This may account for the higher percentage of iron in the same concentrates obtained in the use of an acid circuit. Lastly all

acids are flocculators, which usually produce dirtier concentrates.

Sulphide is the easier oxidized mineral, it is possible that the surface of the galena is oxidized enough to prevent it from floating.

Ferric chloride tends to increase the extraction of iron. In leaching pyrrhotite with ferric chloride there is a violent chemical action with the evolution of gas. It is probable that this action goes on in a minute degree in flotation and enough gas is generated at the surface of the pyrrhotite to float some particles of it.

Ammonium chloride in all cases slightly raised the grade of the lead concentrate & lowered the total extractions. The extraction of zinc in some cases is raised. The effect either way is small.

Taking advantage of these various effects, the following re-treatment tests were made.-

TESTS 32 - 35.-

TEST 32:

A 1000 gram sample was ground for 20 minutes and floated with cobalt mixture using 1.07 #/ton. 2#/ton of copper sulphate was added in the machine and the test run for 40 minutes.

It was attempted here to produce a concentrate containing the lead and zinc and a tailings which could be discarded. The results of the analysis of these tailings were:-

Grade			% of Total		
Pb	Zn	Fe	Pb	Zn	Fe
2.42	7.72	41.6	5.7	12.15	41.9

TEST 33:

The concentrates were washed with alcohol to dissolve out the cobalt mixture.

The concentrates were then ground 15 minutes with NaCl 10#/ton and NaOH 4#/ton.

On changing the flotation machine, an immediate froth formed, overflowing the box. This was probably due to the presence of some alcohol which was not thoroughly washed out. The test was a failure for this reason.

TEST 34:

This test was carried out similar to test 32, but only run 34 minutes and using 0.8#/ton of oil. The resulting tails were:-

Grade			% of Total		
Pb	Zn	Fe	Pb	Zn	Fe
3.78	9.3	40.3	13.2	22.0	56.2

TEST 35:

As the cobalt mixture had to be eliminated from concentrates to affect a separation of lead from zinc, a solution of potassium hydroxide was used to wash the concentrates.

The concentrates were then ground for 10 minutes with NaCl 10#/ton and NaOH 4#/ton. The ore was charged to the ma-

chine and only 5 drops of B #4 used. The test was run for 30 minutes giving a concentrate and tails as follows:-

Grade in %			% of Total		
Pb	Zn	Fe	Pb	Zn	Fe
22.3	37.6	11.1	35.0	39.7	6.8
17.35	19.0	31.4	51.8	38.3	37.0

The results were not at all promising. It appears to be difficult to separate the lead and zinc once they have been floated together. Perhaps this is due to either the presence of oil in the concentrate or to a permanent effect of copper sulphate.

TESTS 92 - 94:

A 1000 gram sample was ground 25 minutes and floated with 1.13#/ton of Special #3 Oil, using 2#/ton of copper sulphate in the machine. The tests were run 40 minutes. The results were:-

Sample	Grade in Percent			Percent of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
Conc.	20.0	31.6	25.2	98.02	93.0	43.0
Tails.	0.55	3.88	54.4	1.98	7.0	57.0

The extraction of lead and zinc are both very good. This concentrate was then ground ten minutes without previously washing, and floated without using any reagents:-

Sample	Grade in Percent			Percent of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
Conc.	23.7	38.8	14.5	71.5	70.5	15.2
Tails.	14.1	20.0	43.0	26.5	22.5	27.8

This treatment eliminated a considerable percentage of the iron but failed to affect a separation of lead and zinc.

TEST 94:

The tails from Test 92 were treated with 2#/ton of $K_2Cr_2O_7$ and 1.35 #/ton of Special #3, to see if it were possible to make a further extraction of zinc. The test ran 40 minutes, a first concentrate being taken off after 15 minutes.-

Sample	Grade in Percent			Percent of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	3.98	15.6	45.6	0.95	2.32	3.82
2nd "	3.30	12.3	51.4	0.53	1.19	2.78
Tails	0.19	2.3	55.3	0.50	3.49	50.4

A concentration of zinc was affected from 3.88 % to 15.6 % but the percentage of iron is excessively high.

TEST 60:

The problem was then attacked from another angle i.e., that of taking a lead concentrate clean from zinc and iron, then floating the zinc out of the tails for the first test.

It was found that a clean lead concentrate with a good extraction could be obtained in the sub-aeration machine using only sodium carbonate.

For this purpose 500 grams of ore were ground 20 minutes and treated for 18 minutes in the sub-aeration machine, using 20#/ton of Na_2CO_3. The following concentrate was obtained:-

Grade in %			% Extraction		
Pb	Zn	Fe	Pb	Zn	Fe
36.8	19.6	13.9	75.0	22.9	10.9

The percentage of iron seems rather high in this concentrate.

The tails from the sub-aeration machine were filtered and charged to the mechanical agitation machine and 2 #/ton of copper sulphate added. The oil used was .92 #/ton of Special #2. The first concentrate was then taken after 15 minutes and the test run 30 minutes. The results were:-

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	6.42	44.5	15.9	7.34	29.2	6.95
2nd "	6.6	41.2	16.4	8.14	29.1	8.55
Tails.	2.36	8.1	47.2	9.52	18.8	73.60

These two concentrates could be thrown together giving a concentrate running 42.8 % zinc with an extraction in that concentrate of 58.3 %. The grade is very good but the extraction somewhat low.

TESTS 95 & 96:

1000 grams of ore were ground for 25 minutes and treated in the machine with 4 #/ton of Na_2S, to float off the lead. The oil used was .9 #/ton of Special #3. The test was run for 25 minutes. It is noted here that the results of the first concentrate are practically as good with this amount of oil as obtained in test 40, with 2.26 #/ton.

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
Conc.	43.5	21.7	10.3	73.0	20.9	6.86
Tails	4.2	21.6	36.6	27.0	79.1	93.14

This gave a fair grade of lead concentrate with a good extraction.-

TEST 96:

The tails were filtered then treated in the machine with 2 #/ton of $CuSO_4$ and 1.8 #/ton of Special #3. The first concentrate was taken after 15 minutes and the test run 30 minutes.

The re-treatment gave:-

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	10.4	44.0	18.5	20.7	50.0	14.5
2nd "	4.95	36.6	22.6	5.4	22.81	9.84
Tails	.29	3.3	52.1	.9	6.29	68.8

A good grade of concentrate being obtained with a fair extraction. Combining the two concentrates a result is obtained.-

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
Lead Conc.	43.5	21.7	10.3	73.0	20.9	6.86
Zinc "	8.48	41.4	19.97	26.1	72.81	34.34
Tails.	.29	3.3	52.1	0.9	6.29	68.80

In the following tests, the conditions were made such as to float the lead. When the lead concentrate was obtained conditions were altered to float the zinc, thus carrying out the test without filtering the tails.

TEST 116:

The 500 gram sample was ground with 8 #/ton of Na_2CO_3, then charged to the machine. The oil, water gas

ter 50 % and F.P.L. #24 50 %; was added a few drops at a time as shown by test sheet. After 19 minutes the first concentrate was taken off, after 25, the second, and here 2 #/ton of $CuSO_4$ was added. After 40 minutes the third concentrate was removed and finally the last and tails after 55 minutes run.

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	47.8	15.8	8.4	63.0	14.4	5.0
2nd "	27.4	19.1	12.5	14.0	7.0	3.0
3rd "	8.5	35.8	13.8	15.3	45.8	11.6
4th "	5.5	43.7	18.9	3.6	20.3	5.7
Tails.	1.2	5.2	47.5	4.1	12.5	74.7

The results from this test are very promising.

TESTS 117 - 120:

From an examination of the results obtained with salt, it was seen that with most oils the zinc was suppressed, but when used with xylidin mixture, a high extraction was obtained. The following tests made use of that fact.

A 500 gram sample was ground for 20 minutes and agitated with NaCl 10 #/ton and NaOH 4 #/ton for 30 minutes. The oils used were W.G.T. mixture, .92 #/ton for the first concentrate, which was removed after 15 minutes. Xylidin mixture was then added .6 #/ton and a second concentrate taken off after 30 minutes. One drop of pine oil was added and a third concentrate and tails taken after 41 minutes.

The three concentrates were treated in Tests 118, 119 and 120, respectively.

TEST 118:

The concentrate was treated for 10 minutes in the sub-aeration machine with Na_2CO_3, 8 #/ton. A concentrate and tails were taken. This was to bring up the lead and suppress the zinc.

TEST 119:

The second concentrate was treated with Na_2S, 4 #/ton in the standard M. S. machine using 2.3 #/ton. The test ran 20 minutes, yielding a concentrate and tails. The effect desired was to bring up any lead in the concentrate first, but no lead froth appeared.

TEST 120:

The third concentrate was treated with $CuSO_4$, 2 #/ton and Special #3, 1.8 #/ton, yielding a concentrate and tails after 15 minutes.

The results of the re-treatment were:-

Sample	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
Conc.	45.7	22.1	6.0	42.0	11.0	2.2
"	27.8	17.1	28.6	8.0	2.6	3.3
"	23.2	37.8	11.4	13.9	12.1	2.7
"	13.9	35.0	19.6	18.2	24.8	10.3
"	7.1	39.1	18.2	5.6	17.0	5.7
"	4.9	18.0	40.7	5.3	10.6	17.6
Tails.	2.1	11.7	42.2	7.0	21.9	58.3

The results were rather disappointing in the extraction of lead in the first concentrate. The total extraction of lead and zinc are good but the iron is also high and the differential action poor.

TEST 121:

In this test it was again attempted to make a

differential separation by grinding 500 grams of ore with 8 #/ton of Na_2CO_3. The oil used was W.G.T. mixture, and was added a few drops at a time for twenty four minutes. The first concentrate was taken off after 20 minutes, and when the $CuSO_4$, 1 #/ton was added after 24 minutes, a second concentrate was removed. Oil was again added at equal intervals of time till after 48 mins. of running, and a third concentrate taken off. The oil now added was B-4 to increase the zinc extraction. The test was run for another 12 minutes, yielding a fourth concentrate and tails.

Sample	Grade in %			% Extraction		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	44.8	20.4	9.0	68.3	18.1	5.7
2nd "	23.0	31.4	13.9	9.3	6.7	2.1
3rd "	7.7	41.0	15.7	18.0	55.7	15.2
4th "	4.9	36.6	19.6	2.2	8.5	3.2
Tails	0.6	5.0	48.4	2.2	11.0	74.0

The grades of lead and zinc concentrates are fairly good with a good extraction and a good elimination of iron. The total extraction is a little higher than that of Test 116, with about the same extraction of iron. The grade of lead concentrate is not quite so good, neither is the zinc. This latter result is probably due to the decreased amount of copper sulphate.

TEST 122:

The amount of reagents and grinding, etc. were the same as in Test 121 but the time of removing concentrates and adding the $CuSO_4$ was shorter. No Barrett No. 4 was

added in this test.

Sample	Grade in %			% Extraction		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	50.6	17.2	7.8	64.8	12.5	4.3
2nd "	9.6	42.0	13.2	27.4	68.5	15.5
Tails	1.8	7.7	44.8	7.8	19.0	80.2

The grades of concentrate in this test are better than before with a smaller percentage of iron. The extraction of lead and zinc is somewhat lower, but the elimination of iron is greater.

TEST 126:

A 500 gram sample was ground with 2 #/ton of Na_2CO_3 for 30 minutes. It was floated with W.G.T. Mixture added a few drops at a time, as shown on the test sheet, the total amount being 1.8 #/ton, and Special #3 added in a similar manner, totalling .63 #/ton. $CuSO_4$ was added, one #/ton being added after 21 minutes and another equal quantity added after 41 minutes. Concentrates were taken off at 17, 21, 40 and 60 minutes, the test being completed after 60 minutes. The impellor speed was 1700 R.P.M.

Sample	Grade in %			% Extraction		
	Pb	Zn	Fe	Pb	Zn	Fe
1st Conc.	49.5	18.1	8.2	62.1	12.5	4.5
2nd "	27.0	34.4	11.2	11.4	8.0	2.0
3rd "	9.3	41.8	13.3	17.1	42.3	10.6
4th "	5.5	34.7	19.8	7.2	25.0	11.2
Tails	0.6	5.7	47.2	2.2	12.2	71.7

The grade of lead is a little higher than in Test 116, but the percentag e of zinc in the first concentrate is higher. The grade of the zinc concentrate is not as good as in 116, while the percentage of iron in the concentrate is approximately the same. The extraction of lead and iron in this case is higher, while that of zinc is about the same. These effects are obtained with 6 #/ton of Na_2CO_3 less, but with higher impellor speed. It is difficult to say which is the more economical.

TEST 100:

To determine the effect of adding the oil to the machine before the introduction of the pulp and thereby insuring a proper dissemination of the oil through the water before coming in contact with any sulphides a test was carried out in the following manner.

A 500 gram sample was ground for 20 minutes. 2.26 #/ton of Special #3 were added to the machine and agitated for five minutes before the introduction of the pulp. The pulp was added and the test run 40 minutes, the first concentrate being taken after 15 minutes.

Test No.	Pb	Zn	Fe	Pb	Zn	Fe
68	48.2	18.5	8.8	54.3	11.8	3.37
	14.5	33.1	21.4	40.9	52.7	20.83
	.94	12.5	43.5	4.8	35.5	75.8
100	32.4	22.2	13.6	77.5	30.8	12.3
	12.9	33.1	15.4	15.9	24.7	7.4
	1.16	14.5	40.5	6.6	44.5	80.3

The effect of adding the oil first is to lower the percentage of lead in the first concentrate, increasing that of zinc and iron. Furthermore the tailings run higher in lead and zinc. The extraction of lead, zinc and iron are all lower.

By adding the total amount of oil first the differential action is spoiled, probably due to the greater amount of oil present at the time. In this way, there is more than enough oil for the lead and consequently the zinc and iron picked up oil immediately. In the other tests the oil is added a little at a time and the lead is differentially floated, carrying with it a considerable proportion of oil, principally the insoluble portion. Thus at no time is there as much oil present as in test 100.

Thus the action produced by adding the oil before the pulp is more sudden.

TESTS 108 & 110:

These tests were run to determine the effect obtained by (a) adding the oil in larger quantities as has been done up till the present or (b) by adding the oil one drop at a time, such a condition encountered in the continuous machines.

500 gram samples were ground for twenty minutes and agitated with 2 #/ton of $CuSO_4$ for 40 minutes. The oil used in each case was 2.25 #/ton. Test 108 was carried out as in (a), while Test 110 was carried out as in (b).

The tests were of 40 minutes duration and the first concentrate taken off after 15 minutes.

Test No.	Grade in %			% Extraction		
	Pb	Zn	Fe	Pb	Zn	Fe
108	22.7	34.0	10.7	61.1	50.5	11.9
	14.2	30.5	22.9	31.9	37.8	21.2
	1.99	6.0	46.0	7.0	11.7	66.9
110	28.9	30.7	9.7	22.5	12.9	3.1
	17.5	34.5	13.7	69.5	74.5	22.3
	2.0	5.7n	45.7	8.0	12.6	74.6

The grade of lead and zinc concentrates are better in Test 110 with a smaller percentage of iron present. The extractions of lead, zinc and iron are all more or less decreased, but the most notable effect is that the bulk of the lead and zinc is thrown into the second concentrate. In other words, adding the oil drop by drop necessitates a longer period of agitation before the mineral are floated. This is an important fact in the case of the tests run on the continuous machine which will be discussed later.

THE ACTION OF INCREASED IMPELLOR SPEED.

To determine this effect three tests were run, 123 - 125, using an impellor speed of between 1700 and 1800 R.P.M., as shown on the sheets. These tests were carried to exactly duplicate the tests 112, 40 and 114, respectively, and the results listed below for a comparison. Up till the present time the average speed was 1100 R.P.M.

Test No.	Reagent	Am't. # Ton	Grade in % Pb.	Zn.	Fe.	% Extraction Pb.	Zn.	Fe.
123	W.G.T.50%)	2.3	44.0	21.7	9.8	63.9	17.9	5.7
	F.P.L.50%)		11.1	36.8	17.5	31.3	59.0	19.7
			1.1	9.5	43.2	4.8	23.1	74.6
112	do	do	53.0	17.0	7.4	47.5	8.4	2.6
			23.3	34.3	13.7	31.6	25.4	6.9
			3.4	19.5	39.4	20.9	66.2	90.5
124	B. #4	2.16	40.4	22.1	11.4	79.9	27.4	10.3
	Na_2S	4.0	12.7	37.3	18.3	17.2	31.5	11.3
			0.6	15.2	39.6	2.9	41.1	82.4
40	do	do	38.6	23.6	1.58	76.0	20.2	0.69
			7.95	40.0	11.80	17.25	38.0	8.31
			.97	13.9	40.90	6.75	42.8	91.00
125	W.G.T.50%)	2.3	41.7	21.5	12.3	59.3	15.4	6.0
	F.P.L.50%)		22.5	34.1	15.2	20.1	15.3	4.7
	Na_2S	4#/ton	8.6	38.4	18.5	16.6	29.8	10.9
			0.7	13.8	39.8	4.0	39.5	78.4
114	do	do	56.8	14.4	7.5	25.6	3.7	1.4
			43.2	22.5	10.5	28.3	8.3	2.8
			19.6	35.0	14.3	21.7	21.9	6.4
			3.96	18.8	36.0	24.4	66.1	89.4

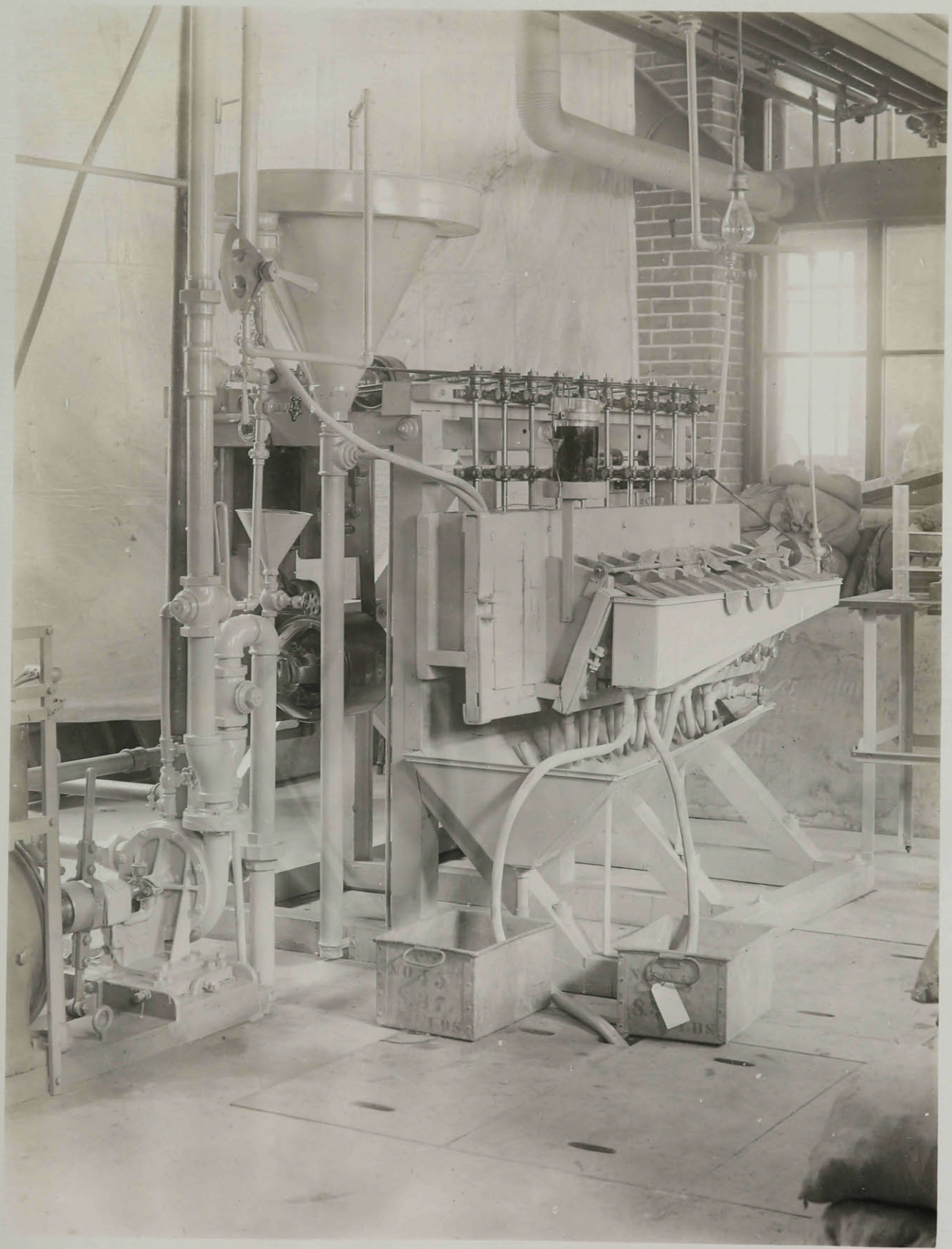
In each set of tests, increased speed lowers the grade of the lead concentrate but increases that of the zinc. The percentage of iron present is also increased. The total extraction is considerably increased, and with the water gas tar mixture, the extraction of zinc is enormously increased, This effect is made use of in later retreatment tests.

FLOTATION TESTS RUN ON CONTINUOUS 8.CELL MACHINE.

The ore for these tests was crushed in the rolls to pass the 1/8" screen preliminary to the fine grinding to be done in the Huntingdon Mill. This ore was bagged and weighed. Unfortunately there was only about 1000 pounds and thus greatly limited the number of tests as it took between 200 and 250 pounds of ore per test.

PLATE N° 4

THE 8-CELL
CONTINUOUS MECHANICAL AGITATION
MACHINE.



The - 1/8" ore was crushed in the Huntington Mill as required. The mill was fitted with 80 mesh screens and the product was pumped to a dewatering cone and transferred from there to a Pachuca tank for thorough mixing or separate agitation with reagents if required. Mixing and agitating was done at a 6:1 pulp ratio.

Pulp ratios were determined by taking samples of known volume from the Pachuca tank and weighing them; substitution of these values in the Specific Gravity formula: percentage of solids $d = \frac{100\ S \times (X-1)}{X\ (S-1)}$ gives the percentage of solids in the pulp,

where s = specific gravity of the ore

x = specific gravity of pulp = $\frac{\text{wgt. in grams}}{\text{volume in cc.}}$

The Specific Gravity of the ore was determined to be 4,21, giving the formula $d = 131\ \frac{X-1}{X}$

The pulp was fed continuously to the machine by means of a discharge from the Pachuca tank into a cone which was filled with a regulated water line to dilute the pulp to a 12:1 ratio as a feed to the machine. Ore was admitted to the machine at the rate of 2 pounds per minute.

Oil was fed to the machine by means of a dropper feeding the oil to the first agitation box. The dropper was calibrated and a curve plotted, showing drops per minute plotted against pounds per ton of ore.

In all the tests run a running start was taken, that is, the machine started and the ore and oil fed in and a good froth obtained in each box before commencing the tests.

During the tests samples of the feed and tails were taken for ten seconds at five-minute intervals, and the

concentrates all collected.

The weights of the pulp collected from the feed and tails were recorded as well as the weights of the dried samples.

The amount of ore fed during the test was calculated from the feed sample and this weight minus the weight of the concentrates gave the total weight of tailings for the test.

The preparation of samples and the assaying of these were carried out as in the small scale tests.

A detailed description of the apparatus, valves, etc., is purposely omitted here as it will be thoroughly covered in the thesis of Mr. R.G. Anderson.

TEST NO. 1 SULLIVAN ORE. - 177

Transferred at 10.10 to Pachuca Tank (air 20# pressure)

Samples taken from Pachuca to determine pulp ratios:

Wgt. of Sample	Volume	Specific Gravity	% Solids	Ratio
412	369	1.115	13.5	6.4:1
491	442	1.115	13.5	6.4:1

Sodium Sulphide, 4#/ton added at 10.20

Feed water added 6.2 #/ min. - regulator at 0.4

Oil used was B #4, 54 drop/min. = 3.8 #/ton

Started feed at 11.12

Commenced test at 11.19

Finished " " 11.44

Length of test = 25 minutes

CALCULATIONS.

FEED:

5 ten-second samples = 50 sec. = 899 gr. = 1.985#

for 60 " = 2.38#

Length of test = 25 min. = 59.5#

Less sample extracted 1.985

Total Feed = 57.515#

CONCENTRATES: Total Conc. = 13.585

TAILS: 43.93#

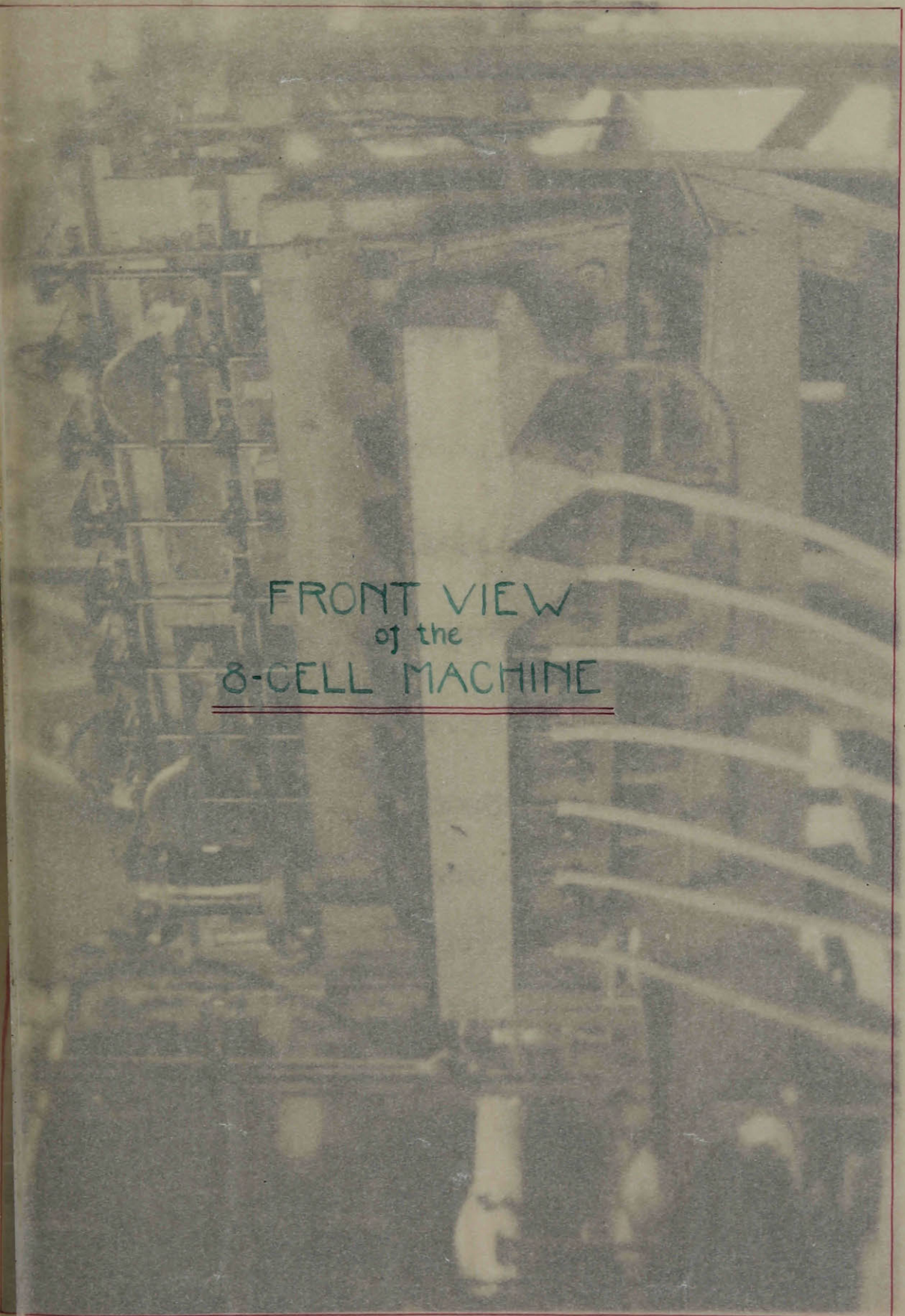
Results given by the analyses are:-

Sample	Grade in %			% Extraction		
	Pb.	Zn.	Fe.	Pb.	Zn.	Fe.
1st Conc.	24.6	21.4	19.4	10.05	5.10	3.60
2nd "	22.2	23.1	19.4	10.49	6.38	4.27
3rd "	19.0	24.3	19.4	6.52	4.87	3.03
4th "	15.9	24.4	17.65	3.21	2.88	1.62
5th "	15.0	24.1	23.4	2.19	2.06	1.55
6th "	12.4	22.8	25.0	3.00	3.22	2.75
7th "	11.75	20.5	23.7	2.62	2.67	2.40
Tails	9.40	18.9	27.0	62.00	72.80	68.10

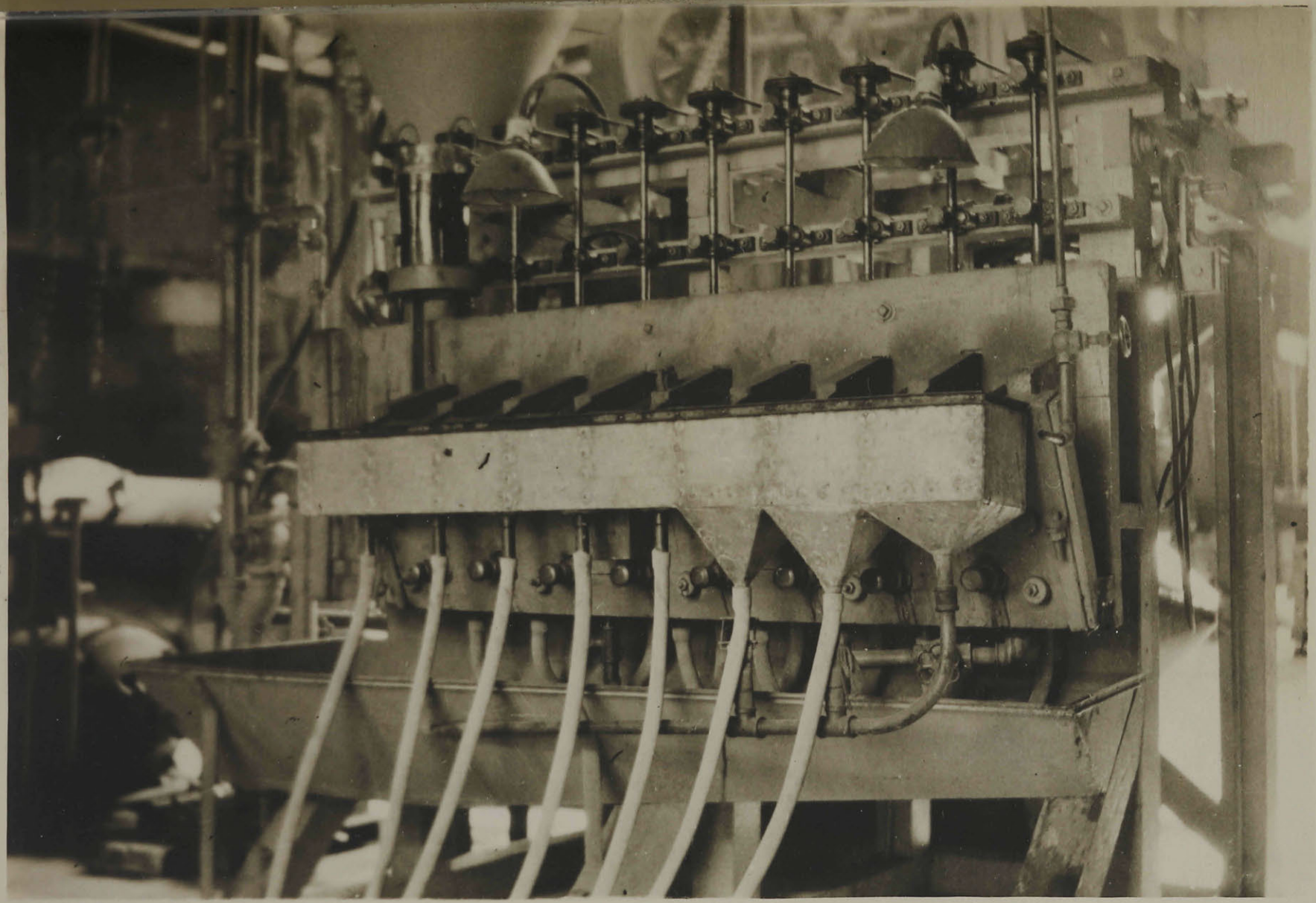
The object of the test was to obtain a lead concentrate, free from zinc and iron.

The results were exceedingly poor in both grades of concentrate and in extraction. A slight differential action is noted in the percentages of lead, zinc and iron in the concentrates, which are the froths of the seven boxes in succession. The percentage of lead shows a gradual decrease, the zinc gradually rises to the fourth box then falls off, while that of iron shows an increase with slight fluctuation.

PLATE N° 5



FRONT VIEW
of the
8-CELL MACHINE



TEST NO.2

Transferred ore to Pachuca at 3.00 P.M. - 279 pounds

Added Sodium Carbonate, 4#/ton at 3.07

PULP RATIO DETERMINATIONS:

Time	Wgt. of Sample	Volume	Sp.Gr.of Pulp	% Solids	Ratio
3.10	750 gr.	483 cc.	1.555	46.75	1.14:1
	642 gr.	412 cc.	1.56	46.75	1.14:1
3.27	Added 800#/water				
3.30	500 gr.	446 cc.	1.12	14.0	6.15:1
	505	452 cc.	1.12	14.0	6.15:1

Feed water added at the rate 6#/min, regulator at 0.4

Oil used B #4 at 52 drop /min. = 3.1 #/ton

Start test at 3.42

Complete " " 4.32

Time of test = 50 mins.

In this test, froth from the last box was returned to box #4.

CALCULATIONS.

FEED:

Wgt. of pulp in feed sample = 35.5#

" " ore in " " = 4.12#

% solids = 11.3% = 7.85 :1 Ratio

10 ten-second samples = 100 sec. = 4.12#

pounds per min. = 2.475#

Total feed for test =123.8#

Less sample extracted = 4.12

Total feed =119.68

CONCENTRATES: Cond. = 16.72

TAILS: Total Tails =102.96

PULP RATIO OF TAILS:

Wgt. of pulp in tails sample = 45.0#

" " ore " " " = 3.61

Ratio = 11.3:1

It was again desired to make a lead concentrate, clean from zinc and iron and the effect of Na_2CO_3 was tried.

Sample	Grade in % Pb.	Zn.	Fe.	% Extraction Pb.	Zn.	Fe.
1st Conc.	29.0	23.5	14.9	10.63	5.65	2.58
2nd "	23.2	25.1	14.15	6.13	4.36	1.77
3rd "	21.9	22.7	17.55	3.54	2.410	1.34
4th "	21.9	24.7	14.05	1.96	1.475	.601
5th "	21.5	24.1	16.10	1.62	1.20	.575
6th "	19.8	24.2	19.40	2.13	1.73	.995
7th "	21.5	25.7	19.7	1.74	1.37	.758
Tails	10.25	17.51	27.3	72.40	81.90	91.5

Although the grades of concentrates are better than obtained with Na_2S, the extractions are still lower. This seems to be in opposition to the results obtained on the single cell machine.

When the assay results of tests 1 and 2 were obtained, it was decided to attempt an extraction of the lead and zinc from the tailings from test 2 to see if the reagents used were the cause of the poor extraction.

TEST NO. 3

Retreatment of tails from Test No. 2

Transferred on to Pachuca tank at 9.55 A.M. - 84.5#

Added Copper Sulphate 2#/ton at 10.20

PULP RATIOS:

Time	Wgt. of Sample	Volume	Sp.Gr.of Pulp	% Solids	Ratio
10.10	505 gr,	386	1.305	32.0	2.2:1
	530 gr.	405	1.310	31.0	2.2:1
Added water					
10.15	474 gr.	443	1.08	9.7	9.3:1
	442 gr.	408	1.082	9.7	9.3:1

Feed start 11.01

Oil used = B #4, 52 drops/min. = 4.5 #/tons

Start test 11.06

Complete " 11.34

Time of test = 28 minutes

In this test froth from last box was returned to agitation box No. 1 for cleaning.

The first concentrate comprised of froths from the first 3 boxes -

The second concentrate comprised of froths from the last 4 boxes.

CALCULATIONS.

FEED:

Pulp Ratio of Feed:

Wgt. of pulp in feed sample = 20.44

" " ore " " " = 1.965

" " water " " " = 18.475

Ratio - 9.45:1

6 ten-second samples = 60 secs. = 590 gr. = 1.965#

Total for the test = 55.0# =

(forward)	Total for the test	=	55.0#
	Less sample	=	1.965
	Total feed	=	53.035
CONCENTRATES:	Conc.	=	24.560
TAILS:	Total Tails	=	28.475

PULP RATIO OF TAILS:

Wgt. of pulp from tails sample	=	21.69
" " ore " " "	=	1.19
" " water " " "	=	20.50
Ratio	=	17.2:1

The results of analyses were:-

Sample	Grade in % Pb.	Zn.	Fe.	% Extraction Pb.	Zn.	Fe.
1st Conc.	14.20	27.3	22.0	38.3	43.3	19.5
2nd Conc.	12.40	21.5	24.8	25.9	27.6	17.8
Tails	6.35	8.87	33.8	35.8	29.1	62.7

The feed for this test assayed Pb. = 10.05%, Zn.= 19.1%, Fe. = 27.2%, which is practically the composition of the original ore.

While the grade of the concentrates is not very good, the extraction is wonderfully improved, particularly that of zinc.

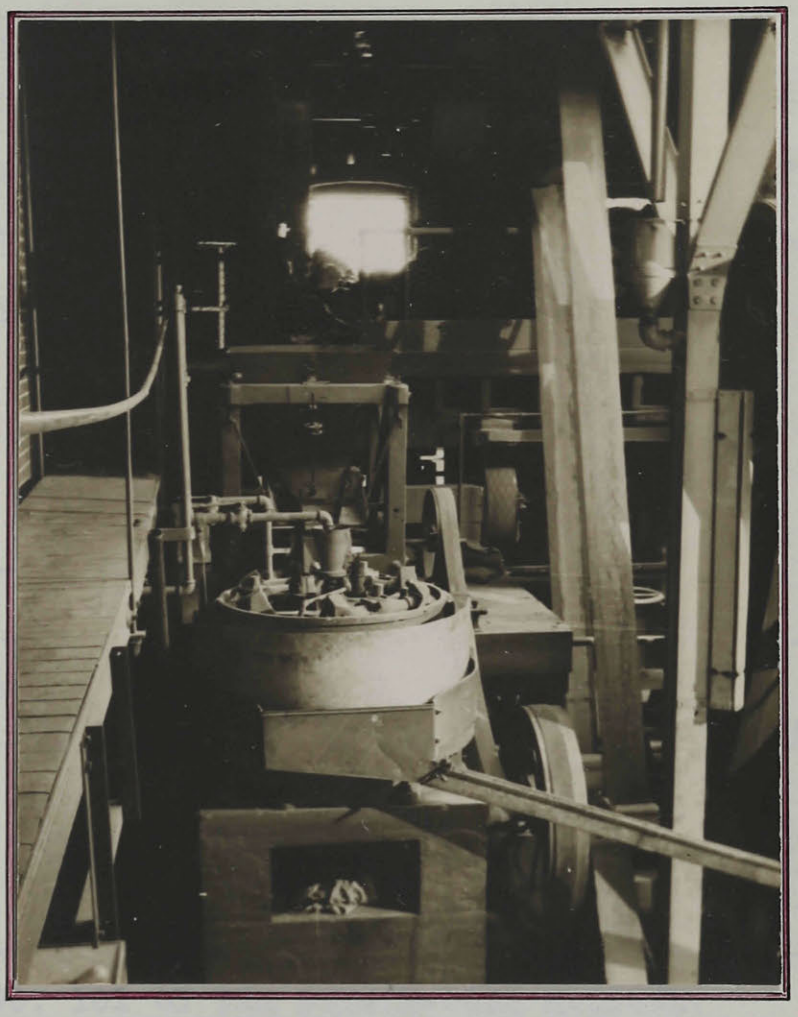
A comparison of the results of the three tests points to the possibility that this type of machine is better fitted for the extraction of a lead and zinc concentrate prior to a cleaning process, probably in the subaeration type machine, to separate the lead and zinc, than it is for the primary separation of lead from zinc. Small scale tests on the two types of

machines seem to point in the opposite direction. It seems fair to reason further that since the concentrates move with them a great bulk of the insoluble oil, that a differential separation of the lead and zinc, if present, will be a difficult proposition. A filtering and washing of these concentrates is an expensive proposition and much more complex than the other system where the tailings containing any iron could be run direct to the retreatment machine.

Another factor is brought in by grinding; the galena being the softer mineral is more easily crushed and thus freed from the other minerals with a lesser amount of grinding. Could not conditions in the machine be made such as to float this finer galena and suppress the coarser sphalerite and pyrrhotite, effecting a cleaner separation of lead, and then the tails be reground and a separation of the sphalerite and pyrrhotite affected?

An interesting experiment was made by the writer to prove this grinding effect.- A sample of the oversize ore remaining in the Huntington Mill after grinding preparatory to the above tests, was analyzed and found to contain - Pb. = 8.9%, Zn. = 28.9%, Fe. = 24.26%, showing a loss of 3% of the lead, a gain in 8% of zinc and a loss of about 4% of the iron content.

It was unfortunate that the supply of ore gave out at this time, only enough being left for one more large scale test.



HUNTINGDON MILL

As it takes two or three tests to familiarize oneself with the manipulation of the machine and adjustments of conditions, the results are of small value.

With the reamining ore, it was decided to re-run the $CuSO_4$ test and to take out samples of the ore for testing in the small machine, thereby obtaining a comparison of results and determine, if possible, the reason for the low extractions resulting from the previous tests.

For this investigation Test 4B was run.

SCREEN ANALYSES.

TEST NO. 4 ON LARGE MACHINE

Size	Feed		1st Conc.		2nd Conc.		Tails	
	Wgt.	%	Wgt.	%	Wgt.	%	Wgt.	%
+ 100	2.770	2.57	1.679	1.700	2.012	1.89	3.288	3.22
+ 150	24.405	22.61	21.841	22.200	28.147	26.40	26.244	25.70
+ 200	12.880	11.92	15.905	16.120	18,964	17.80	15.941	15.61
- 200	67.900	62.90	59.206	60.050	57.310	53.80	56.755	55.50
Total	107.955	100.00	98.631	100.07	106.433	99.89	102.228	100.03

TEST NO. 101 ON THE SINGLE-CELL MACHINE.

+ 100	2.770	2.57	0.119	0.238	0.835	0.732	3.965	3.75
+ 150	24.405	22.61	1.423	2.810	14.450	12.680	31.000	29.30
+ 200	12.880	11.92	2.005	3.970	13.160	11.550	14.060	13.30
- 200	67.900	62.90	47.020	93.000	85.560	75.000	56.800	53.70
Total	107.955	100.00	50.567	100.018	114.005	99.962	105.833	100.05

#37-

ASSAY OF SCREEN SIZES FOR TESTS4 B AND 101.

Test & Sample	Size	%	Wgt. of Total Sample in Size		Pb. %	Pb. Wgt.	Zn. %	Zn. Wgt.	Fe. %	Fe. Wgt.
Test 4B Feed	+100	2.57	47.821#	1.23#	8.0	.0983	20.5	.252	28.4	0.349
	+150	22.61		10.81	8.2	.8860	20.3	2.190	29.4	3.180
	+200	11.92		5.70	8.63	.4920	19.8	1.130	28.0	1.596
	-200	62.90		30.10	13.30	4.0100	20.4	6.140	27.1	8.160
Total		100.0		47.84		5.4863		9.712		13.285
1st Conc.	+100	1.70	4.0#	0.0680	8.2	0.0056	35.8	0.0245	19.3	0.013
	+150	22.20		0.8880	9.2	0.0816	29.4	0.2610	22.6	0.201
	+200	16.15		0.6460	11.9	0.0768	30.7	0.1980	20.3	0.131
	-200	60.05		2.4020	16.3	0.3910	28.4	0.6810	20.8	0.499
Total		100.0		4.0040		0.5550		1.1645		0.844
2nd Conc.	+100	1.89	3.81	0.0720	8.3	0.0060	33.9	0.0244	24.0	0.0173
	+150	26.40		1.0050	10.3	0.1035	32.6	0.3280	17.7	0.1780
	+200	17.80		0.6780	12.6	0.0854	29.0	0.1970	22.7	0.1540
	-200	53.80		2.0500	17.3	0.3542	21.6	0.4430	21.4	0.4380
Total		99.89		3.8050		0.5491		0.9924		0.7873
Tails	+100	3.22	40.011	1.290	6.6	0.0085	18.6	0.240	23.1	0.298
	+150	25.70		10.300	9.1	0.9370	19.5	2.010	26.0	2.680
	+200	15.61		6.240	9.4	0.5860	17.3	1.080	27.6	1.720
	-200	55.50		22.200	13.3	2.9500	18.5	4.110	28.3	6.280
Total		100.03		40.030		4.4815		7.440		10.978
101 1st Conc.	+150	03.048	108 gr.	3.29	Trace	---	32.2	1.06	36.9	1.21
	+200	3.970		4.29	1.8	0.072	25.4	1.09	39.0	1.67
	-200	93.000		100.50	11.8	11.850	36.3	36.50	17.4	17.50
Total		100.018		108.08		11.922		38.65		20.38
2nd Conc.	+150	13.412	245 gr.	32.90	1.9	0.625	30.2	9.94	29.3	9.64
	+200	11.550		28.2	3.7	1.048	34.8	9.85	25.7	7.27
	-200	75.00		183.90	15.1	27.750	30.7	56.40	21.7	39.90
Total		99.962		245.00		29.423		76.19		56.81
Tails	+100	3.75	476 gr.	17.85	6.06	1.08	19.5	3.48	33.3	5.94
	+150	29.30		139.50	8.80	12.28	17.7	24.50	33.2	46.30
	+200	13.30		63.20	12.50	7.90	11.9	6.89	37.3	23.55
	-200	53.70		255.55	13.40	34.20	6.8	17.35	36.8	94.00
Total		100.05		476.10		55.46		52.22		169.79

TABLE NO.4

Test	Size	Total Wgt. in Size Pb.	Zn.	Fe.	% of Total Pb.	Zn.	Fe.	% Extraction Pb.	Zn.	Fe
4 B	+100	0.0201	0.2889	0.3283	0.36	3.02	2.52	57.8	17.0	9.3
	+150	1.1221	2.5990	3.0590	20.04	27.10	24.30	16.40	22.6	12.3
	+200	0.7482	1.4750	2.0050	13.50	15.38	15.88	21.88	26.8	14.4
	-200	3.6952	5.2340	7.2170	66.10	54.50	57.30	20.20	21.5	13.1
Total		5.5854	9.5969	12.5093	100.0	100.0	100.0	19.8	22.5	13.1

TABLE NO. 5

101	+100	1.08	3.48	5.94	1.12	2.08	2.42	00	00	00
	+150	12.905	35.50	55.15	13.42	21.25	22.90	5.0	31.0	14.1
	+200	9.020	17.83	32.49	9.32	10.65	13.25	12.5	61.3	27.5
	-200	73.800	110.25	151.40	76.14	66.02	61.43	53.6	84.3	38.0
Total		96.805	167.06	244.98	100.0	100.0	100.0	42.7	68.7	30.7

TEST NO. 4.

Transferred to Pachuca tank at 11:20 A.M.

Added $CuSO_4$, 2#/ton at 11:40.

PULP RATIOS:

Time	Wgt. of Sample	Volume	Sp. Gr. of Pulp	% solids	Ratio
11:30	735 gr.	505 cc	1.455	41 %	1.95:1
	610 gr.	418 cc	1.456	41 %	1.95:1
Added water 12:00					
12:10	609 gr.	470 cc	1.30	29.5 %	2.39:1
	590 gr.	465 cc	1.27	29.5 %	2.39:1

Feed water added 14#/min., regulator at 0.8

Oil used B # 4, 60 drops/min. equals 6.2#/ton of ore.

Start feed, ------ 12.30
Start test, ------ 12.38
Complete, -------- 1.08
Time of test, ---- 30 minutes
Concentrates taken off as in Test No. 3

CALCULATIONS.

FEED:

Pulp ratio of feed,
Weight of pulp in sample equals 21.0 #
" " ore " " " 1.649 #
19.351 #

Ratio " 11.73:1

6 - 10 second samples taken = 746 gr. = 1.649#
Total for 30 minutes = 49.47 #
Less sample, ------- = 1.649
Total feed, -------- = 47.821#

CONCENTRATES: Conc. -------- 7.81
TAILS: Total tails, 40.011#

PULP RATIO:

Weight of pulp in tails sample	=	20.88 #
" " ore " " "	=	1.19
		19.69
Ratio	=	16.55:1

THE RESULTS OF ANALYSIS WERE:

SAMPLE	Grade in %			% Extraction.		
	Pb.	Zn.	Fe.	Pb.	Zn.	Fe.
1st Conc.	13.85	29.1	21.0	9.84	12.60	6.11
2nd Conc.	14.80	28.5	20.2	9.97	11.65	5.60
Tails	11.30	17.7	30.3	80.19	75.75	88.19

The results obtained were surprisingly low in the extractions of lead and zinc, while the grade of concentrates were slightly higher. The quantity of $CUSO_4$ was the same, the time of agitation in test 3 was 20 minutes, while in 4 it was 50 minutes. This would hardly account for the lower extraction judging by the small scale tests. The amount of oil in this case was greater, while the length of test and impellor speed (1100 r.p.m.) were the same. This should give a higher extraction.

SMALL SCALE TESTS.

Three samples were taken from the lot of one used in test 4. The first was taken from the Huntingdon Mill discharge for screen analysis, the second taken before the addition of $CuSO_4$ or agitation in the Pachuca tank, and the third after agitation for 50 minutes with $CuSO_4$, 2#/ton. The two latter samples were kept for tests in the small machine.

SCREEN ANALYSIS:

The discharge from the Huntingdon Mill gave the following screen analysis:

MESH	GRAMS	%
plus 35	0.009	.023
48	0.010	.025
65	0.015	.038
100	0.472	1.194
150	5.751	14.560
200	4.775	12.100
minus 200	28.455	72.060
TOTAL	39.487	100.00

This amount of grinding is probably insufficient; but, it is a little better than the 5 minute grind of a 500 gram sample or the 10 minute grind in the 1000 gram sample, using the ball mill. The product of the Huntingdon Mill is more granular in appearance, however, than the ball mill product. This is readily understood, for, in the former case, the particles are discharged as soon as they will pass the 80 mesh screen, whereas, in the latter case, they are subject t o grinding for the length of time they are in the ball mill, irrespective of the size.

TEST 101 AND 102.

Another influence encountered in the large scale tests is that of oxidation, due to the aeration in the Pachuca tank. To see if this had any detrimental affect, the second sample, i.e., that taken before

agitation in the Pachuca tank, was agitated on the shaking screen apparatus, with the exclusion of air, for 50 minutes with 2#/ton of $CuSO_4$.

This sample and sample No. 3 were then floated with 2.16# of Barrett No. 4 under similar conditions in the single cell machine, the duration of the tests being 40 minutes.

TEST NO.	MODE OF AGITATION	Grade in %			% of Total		
		Pb	Zn	Fe	Pb	Zn	Fe
101	Pachuca	12.9	34.6	20.0	13.6	22.7	7.6
		13.5	31.2	21.4	32.3	46.4	28.4
		11.75	10.7	36.7	54.1	30.9	64.0
102	Shaking Screen	12.8	26.0	26.7	37.4	47.3	36.1
		12.5	16.4	26.8	62.6	52.7	63.9

The results of test 102 were not wholly reliable, as the small machine plugged during the run.

To obtain an accurate comparison of the effects of aeration tests 108 and 109 were run.

500 gram samples were ground for 20 minutes in the ball mill. For test 10 8, the pulp was aerated with 2#/ton of copper sulphate for 40 minutes in the sub-areation machine, using 2-1/2# pressure of air. The pulp ratio was 2:1. For test 109, the pulp, at a 2:1 ration was agitated for 40 minutes on the shaking screen apparatus with an equal quantity of $CuSO_4$.

Both samples were floated with 2.26#/ton of special No. 3, and conditions kept constant.

TEST NO.	Grade in %			% of Total		
	Pb	Zn	Fe	Pb	Zn	Fe
108	22.7	34.0	10.7	61.1	50.5	11.9
	14.2	30.5	22.9	31.9	37.8	21.2
	1.99	6.0	46.0	7.0	11.7	66.9
109	24.6	32.6	12.0	63.5	46.1	13.3
	12.1	33.3	20.4	29.0	43.6	20.9
	2.18	5.4	44.0	7.5	10.3	65.8

The effect of aeration is seen to decrease the grade of the lead concentrate and increase that of the zinc with a smaller percentage of lead in the first concentrate and a larger percentage in the second concentrate. The surprising part is that within practical limits of accuracy in skimming and chemical analysis, the total extractions are the same. It may be noted, though, that the differential action in test 109 is a little better. There is a possible slight oxidation of the galena, thus lowering the difference in floatability between galena and blende.

The effect of size or character of particle is striking in a comparison of tests 101 and 108. Probably character of particle is the dominating factor, because tests 1, 5 and 13 were made on ore giving approximately the same screen analysis and the extractions of lead and zinc are over 80 % in each case.

Comparing test 101 with 41, the single cell machine gives a higher total extraction than the large machine. This can only be due to the longer agitation received in the single cell machine.

The effect of adding the oil a few drops at a time was previously shown in tests 108 and 110, to increase the grade of concentrates with only a slight decrease in total extraction. The action requires somewhat longer time of agitation.

TO DETERMINE THE PERCENTAGE VALUES IN SIZES.

Samples were cut from the concentrates and tails of tests 46 and 101, for screen analysis and assay. The results are tabulated on the accompanying charts for a comparison of the work done by the continuous machine with the single cell machine. The same feed was used in each case, and the screen analysis tabulated in tables 1 and 2.

Examining tables 1 and 2, the large machine shows a fair distribution of sizes in both concentrates and tails, while the small machine shows a tendency to concentrate the fines in the first and second concentrates, while the tails show a distribution of sizes. The large machine seems to float all sizes with practically the same ease, while the small machine tends to float the small sizes first.

TABLE 3.

This table shows the assay results of each screen size in the concentrates and tails for the two machines.

The feed analysis shows a decided concentration of lead in the fine sizes, while zinc and iron run without much variation in percentages in all sizes.

The results are tabulated in tables 4 and 5 for comparison.

TABLES 4 AND 5.

The column headed "Percentage of Total", gives the percentage of the total amount of lead, zinc and iron in each size, while the column headed "Percentage Extraction" gives the percentage extraction of lead, zinc and iron in that particular size.

The large machine gives a good extraction on the coarser sizes of lead, but falls off to a very low figure in the finer sizes. The extraction of size appears to be approximately constant in all sizes, while the extraction of iron is a little higher in the fine sizes. This machine falls down on the fine sizes.

The small machine fails absolutely on the coarser size, and rises in all cases to a very good extraction on the fine sizes.

SUMMARY OF THE LARGE SCALE TESTS.

The Huntingdon Mill does not appear to be as suitable a machine for crushing prior to flotation work. Better results are obtained with the ball mill.

The effect of aeration in the Pachuca tank during agitation is of little detriment to flotation, and the tank affords a good means of agitation.

The ore should not be crushed any more than in necessary to free the minerals.

The time of agitation is not long enough in the machine for this ore. It would probably require a 16 or 20 cell machine.

Retreatment processes are necessary, as it is impossible to obtain a lead and a zinc concentrate with one passage of the ore through the machine. In all probability, re-cleaning processes are necessary also.

TABLE TEST.

One test was run on the Butchartt table to determine the action of the ore on the table. For this trial, 83.8 pounds of the ore ground to pass 40 mesh were run over the Butchartt table, set at a slope of .4. The band of galena was run into the first concentrate cone, the band that appeared to be a mixed product run into the second concentrate cone, and the remainder into the tailings launder. The results of the analysis of these samples gave:

SAMPLES	WEIGHT	Graded in %			% Extraction		
		Pb	Zn	Fe	Pb	Zn	Fe
Conc.	3.87#	38.3	9.7	24.0	20.00	2.3	3.8
Middles	12.13	12.1	17.0	34.8	19.80	12.0	17.5
Tails	67.80#	6.6	21.8	28.2	60.20	85.7	78.7

These results are interesting in that they show a good grade of lead concentrate containing a high percentage of iron, but a very low percentage of zinc compared to some of the flotation tests. The extraction is rather low. The above results are made use of frequently in practice.

Time did not permit going into a study of the table work with subsequent flotation to separate the lead from the iron, but it would no doubt bring out some important points.

GENERAL SUMMARY.

The Sullivan ore presents a very difficult subject for flotation, and a much longer period of time than is at our disposal could be spent profitably on this investigation, principally on its action in the continuous mechanical agitation machine and also in a continuous sub-aeration machine or callow cell for retreatment.

In connection with the work done, the writer would like to have been able to determine the question which is of paramount importance in a flotation test, the insoluble or the soluble portion of the oil. Of course, both parts are essential to flotation, but the point that comes up in the testing work is this. In the case of

In the case of two tests where conditions such as time of agitation amount to reagents, etcetera, are all constant with the exception of the pulp ratio; say one charge has 500 grams of ore and the second 1000 grams, what would be the correct amount of oil to add? This may seem absurd, but, if the amount of oil is doubled in the second case, the ratio of insoluble oil to ore will be approximately the same (perhaps a little greater, due to the higher concentration), but the pulp being denser will require a lesser dispersion of the oil. The soluble portion is doubled, though the amount of water in the machine is slightly less, and hence would this not have a great effect on surface tension and frothing?

If, on the other hand, the same quantity of oil is used in both cases, the surface tension depression and frothing will be approximately the same, while the insoluble portion, although decreased in quantity, does not have to be so widely dispersed due to the denser pulp.

In the tests run, the latter system was mostly used, i.e., that of keeping the piling conditions of the water constant.

In general, in the treatment of this ore with reagents, as good results were obtained when the reagent was added in the grinding circuit as when separate agitation was employed. With some reagents, such as copper sulphate, the best results were obtained by adding it directly to the flotation machine.

The mode of treatment that would prove ~~now~~ most satisfactory is that of removing the lead first with the aid of some reagent, such as sodium sulphide or sodium carbonate, obtaining a concentrate free from zinc and iron as far as possible, then treating with copper sulphate to extract the zinc. The first part of the process would probably be more successfully carried out in a sub-aeration madhine, using the mechanical agitation machine for the zinc extraction.

Good commercial results were obtained in tests 95 and 96, 116, and some of the other retreatment tests using the water gas tar mixture. Doubtless, these could be further improved by complicated retreatment and recleaning processes such as are used in practical work.

There is a great field for investigation and improvement in the smelting of these products. At present, most of the lead in a zinc concentrate can be recovered from the zinc processes, but that part of the zinc present in the lead concentrate is lost by volatilization. Surely some process will be forthcoming whereby these losses will be reduced.

ASSAYS RUN FOR SILVER.

The ore was assayed for silver, and further assays of first and second concentrates and tails of representative tests of two classes; namely those which gave a high extraction with relatively low grade concentrates and those which gave a high grade concentrate with low extraction.

Of the first class, samples from test no. 55 were assayed, and of the second class, samples from tests 39 and 40 were run.

For the assay of the original ore, two 1 gram samples were roasted and mixed with the following charger:

(1) Litharge - 2 assay tons
Soda, --- 1 " "
Flour, -- 3 grams
Borax
Glass, -- 10 "
Silica 20 "

The charge used to find the reducing power of the ore was :

(2) Ore ----- 5 grams
Litharge, 60 "
Soda, 10 "
Silica 1.5 "
Borax 10 "

The final charge used:

(3) Ore, ------ 1/2 assay ton
Litharge, 2 " "
Soda, 1 " "
Borax 10 gram
Nitre for 25 gr. button
Cover of borax

RESULTS.

Reducing power of the ore:

5 gr. ore in charge (2) gave 25.65 gr. lead,
R.P. = 5.13

ASSAYS.

SAMPLE		WGT. USED	WGT. OF LEAD	% SILVER PER TON
Original ore,		1 A.T.	2.5 mg.	
			2.46 "	2.48
Test 39	Sample 99,	1/2 A.T.	4.45	8.90
	100,	"	3.14	6.28
	101,	"	0.56	1.12
Test 40	102,	"	2.77	5.54
	103,	"	1.32	2.64
	104,	"	0.32	0.64
Test 55	153,	"	3.86	7.72
	154,	"	1.05	2.10
	155,	"	0.33	0.66

TABLE NO. 1.

Orig. ore - 500 gr. at 2.48 oz./ton Total silver = 42.55 mg.

TEST NO. 39.

1st Conc. No. 99 - 19 gr. at 8.9 oz/ton total 8.9
29.166 x 19
equals 5.8 mg.
2nd Conc. 100 - 84 " " 6.28 " " 18.1
Tails, 101 386 " " 1.12 14.82
38.72 mg

TEST NO. 40.

1st Conc. No. 102, 89 gr. at 5.54 equals 16.9
2nd Conc. 103, 97 " " 2.64 8.79
Tails, 104, 309" " 0,64 6.78
32.47

TEST NO. 55:

1st conc.	153	145 gr.	at	7.72	=	37.10
2nd conc.	154	124 "	"	2.10		8.94
Tails,	155	218 "	"	0.66		4.94
						50.98

TABLE NO. 2.

SAMPLE	% of total silver in sample	% of total Pb.	% of total Zn.	% of total Fe.
99	14.95	18.7	3.4	1.85
100	46.80	60.0	25.6	1.35
101	38.25	21.3	21.3	96.80
102	52.10	76.0	20.2	0.69
103	27.00	17.25	38.0	8.31
104	20.90	6.75	42.8	91.00
153	72.60	75.1	41.6	10.7
154	17.70	23.2	43.5	18.8
155	9.7	1.7	14.9	70.5

On examining Table 1, it appears that the ore is very spotty with reference to its silver content.

From Table 2 it may be concluded that the silver is closely associated with the lead.

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 14

DATE October 16. 1922.

ORE NO. 17.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

NOTES:

Sullivan Ore--PbS, ZnS, FeS and Gangue.

A series of Tests to determine the effect of grinding on the flotation of the ore. This 500 gr. sample was ground for five minutes, and separately agitated for 30 minutes. See grinding sheets.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.30	Charge							
12.35	B#4	10						
12.45	"	10						
12.55	"	5				concentrate	1	133
1.00	complete					tails	"	193

REAGENT	%	LBS. P.T.
NaCl		10#/ton
NaOH		4#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	conc		17.1	50.1	25.1	73.6	20.45	60.0		
30	tails.		5.73	11.05	10.6	22.05	38.0	73.3		
				61.15		95.65		133.3		

PERCENT OF TOTAL

Pb.	Zn.	FE.	
81.9	76.9	45.1	
18.1	23.1	54.9	
		.	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 2.

NOTES:

500 grams crushed in ball mill for 10 mins.

Agitated for 30 min. start 12.32
finish 1.02

DATE Oct. 16 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.05	Charge							
3.10	B #4	10						
3.20	"	10						
3.30	"	5						
3.35			Complete			Conc.	3.	221.
						Tails.	4.	244.

REAGENT	%	LBS. P.T.
NaCl		10#/ton
NaOH		4#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30	Conc.		22.4	49.5	29.8	65.9	16.6	36.7		
30	Tails.		3.7	9.03	11.6	28.3	38.8	94.75		
				58.53		94.2		131.45		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
84.6	70.0	27.9	
15.4	30.0	72.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 3.

NOTES:

500 gram sample ground in ball mill.for 15 min.
Sepately agitated for 30 min.-- start 2.50
finish 3.20

DATE oct. 16. 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.55	Charge							
4.00	B #4	10						
4.10	"	10						
4.20	"	5						
4.25	Complete					Conc.	5	152
						Tails.	6	336

REAGENT	%	LBS. P.T.
NaCl.		10#/ton
NaOH		4#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		— 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe,	WEIGHT	%	WEIGHT
30.	Conc.		31.6	48.0	25.6	38.9	13.65	20.75		
30.	Tails.		4.3	14.45	18.2	61.2	35.2	118.3		
				62.45		100.1		139.05		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
76.9	38.85	14.9	
23.1	61¼15	85.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 4.

NOTES:

500 gram sample ground for 20 min. in ball mill.

Separately Agitated for 30 min.--- start 3.30
finish 4.00

DATE Oct. 16 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.30	Charge							
4.35	B #4	10						
4.45	"	10						
4.55	"	5						
5.00	Complete					Conc.	7	139
						Tails.	8	350

REAGENT	%	LBS. P.T.
NaCl.		10#/ton
NaOH.		4#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		34.6	48.1	24.1	33.5	12.6	17.5		
30.	Tails.		4.2	14.7	18.0	63.0	34.7	123.0		
				62.8		96.5		140.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
76.5	34.7	12.45	
23.5	65.3	87.55	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 5.

NOTES:

A series of tests to determine the effect of grinding on flotation using NaOH and B #4 oil.
500 gram sample ground in Ball mill for 5 min.
Start--11.30
Finish-11.35

DATE Oct.17, 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.50	Charge							
352	NaOH		10					
3.55	B#4	10						
4.05	"	10						
4.15	"	5						
4.20	Complete					Conc.	9	263
						Tails.	10	238

REAGENT	%	LBS. P.T.
NaOH+		4#/ton
B #4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30	Conc.		22.7	59.7	26.5	69.7	17.3	45.5		
30	Tails.		602	14.3	12.3	29.3	37.8	90.0		
				74.0		99.0		135.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
80.6	70.5	33.6	
19.4	29.4	66.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 6.

NOTES:

5

500 gram sample ground in Ball mill for 10 min.
Start -- 12.00
Finish-- 12.10

DATE Oct, 17, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.30	Charge							
4.32	NaOH		10					
4.35	B #4	10						
4.45	"	10						
4.55	"	5						
5.00	Complete					Conc.	11.	194
						Tails.	12.	304

REAGENT	%	LBS. P.T.
NaOH		4#/ton
B #4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		26.1	50.6	31.0	60.0	11.1	21.5		
30.	Tails.		6.7	20.4	14.8	45.0	36.8	112.0		
				71.0		105.0		133.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
71.3	57.1	28.7	
28.7	42.9	71.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 7.

NOTES:

DATE Oct. 17, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

500 gram sample ground in ball mill for 15 min.
Start-- 4.05
Finish- 4.20

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.40	Charge							
2.42	NaOH		10					
2.45	B #4	10						
2.55	"	10						
3.05	"	5						
3.10	Complete					Conc.	13	177
						Tails	14	354

REAGENT	%	LBS. P.T.
NaOH		4#/ton
B #4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		28.2	50.0	30.9	54.7	9.55	16.9		
30.	Tails		8.1	28.7	14.7	52.0	36.0	127.3		
				78.7		106.7		144.2		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
63.5	51.4	11.7	
36.5	48.6	88.3	

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FLOTATION TEST NO. 8.

NOTES:

500 gram sample ground in ball mill for 20 min,
Start--- 4.45
Finish-- 5.05

DATE Oct. 17. 1922
ORE NO. 177
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.50	Charge							
10.52	NaOH		10					
10.53	B#4	10						
11.05	"	10						
11.13	"	5						
11.20	Complete					Conc.	15	128
						Tails.	16	371

REAGENT	%	LBS. P.T.
NaOH		4#/ton
B #4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		33.7	43.1	30.8	39.4	8.6	11.0		
30.	Tails		6.4	23.7	17.1	63.5	34.0	126.0		
				66.8		102.9		137.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
64.8	38.3	8.0	
35.2	61.7	92.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 9.

DATE Oct. 25 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

PULP TEMP. FINISH °

PULP TEMP. MEAN °

NOTES:

Grinding series similar to the preceeding one substituting Cobalt Mixture #1 for B #4 oil.

500 gram sample ground in ball mill for 5 min.

Start---3.30

Finish--3.35

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.55	Charge							
3.57	NaOH		10					
4.00	Cobalt#1	10						
4.10	"	10						
4.20	"	5						
4.25	Complete					Conc.	17.	103
						Taile.	18.	394.

REAGENT	%	LBS. P.T.
NaOH		4#/ton
Cobalt M#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		20.8	21 4	14.9	15.4	30.9	31.8		
30.	Tails.		7.7	30.3	20.3	80.0	25.9	102.0		
				51.7		95.4		133.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
41.4	16.3	23.8	
58.6	83.7	76.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	10.
DATE	Oct. 25, 1922.
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gram sample ground in ball mill for 10 min.
Start---3.55
Finish--4.05

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.45	Charge							
4.46	NaOH		10					
4.50	CobaltN	10						
5.00	"	10				1st Conc.	19.	183.
5.10	"	5						
5.15	Complete					2nd Conc.	20.	183.
						Tails.	21.	128.

REAGENT	%	LBS. P.T.
NaOH		4#/ton
Cobalt N.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st conc		18.0	32.95	26.9	49.2	21.5	39.3		
30	2ndConc.		10.4	19.0	23.0	41.1	26.7	48.8		
30	Tails		3.56	4.67	11.4	14.6	35.7	45.7		
				56.62		104.9		133.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
58.2	47.3	29.4
33.6	39.2	36.4
8.2	13.5	34.2

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 11.

NOTES:

500 gram sample ground in ball mill for 15 min.
Start -- 9.00
Finish-- 9.15

DATE Oct. 26. 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.30	Charge							
9.32	NaOH		10					
9.35	Cobalt M.	10						
9.45	"	10				1st Conc.	22.	134
9.55	"	5						
10.00	Complete					2nd Conc.	23.	239.
						Tails.	24.	122.

REAGENT	%	LBS. P.T.
NaOH		4#/ton.
Cobalt M#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15.	1st Conc		20.4	27.4	26.4	35.4	19.3	25.9		
30.	2nd Conc		11.3	27.0	22.4	53.5	27.3	65.2		
30.	Tails.		3.78	4.6	10.8	13.2	34.2	41.6		
				59.0		102.1		132.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
46.4	34.7	19.5	
45.7	52.3	49.2	
8.9	13.0	31.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 12.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 9.30
Finish- 9550

DATE Oct. 26 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.15	Charge							
11.17	NaOH		10					
11.20	Cobalt	10						
11.30	"	10				1st. Conc.	25.	106
11.40	"	5						
11.45	Complete					2nd. Conc.	26.	281.
						Tails.	27.	109.

REAGENT	%	LBS. P.T.
NaOH		4#/ton.
CObalt No1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15.	1st Conc.		28.2	29.9	26.4	28.0	14.7	15.6		
30.	2nd Conc.		8.4	23.6	19.7	55.5	28.4	79.8		
30.	Tails		4.95	5.4	13.3	14.5	30.5	33.2		
				58.9		98.0		128.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
50.8	28.6	12.1	
40.1	56.5	62.0	
9.1	14.9	25.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	13.
DATE	Oct. 26. 1922.
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES: Grinding Series as before substituting $CuSO_4$ for NaOH and using Cobalt Mixture #1 oil.

500 gram sample ground in ball mill for 5 min.

S tart-- 11.42

Finish-- 11.47

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.20	Charge							
2.22	$CuSO_4$	5	10					
2.25	Cobalt M	~~10~~				Very Little froth		
2.35	"	5						
2.45	"	5				1st. Conc.	28	186
2.55	"	5						
3.00	Complete					2nd Conc.	29	156
						Tails.	30	157

REAGENT	%	LBS. P.T.
$CuSO_4$		2# /ton.
Cobalt M#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc.		15.9	29.6	26.8	49.8	19.6	36.4		
40	2nd Conc		15.2	23.7	2666	41.5	22.5	35.1		
40	Tails.		4.15	6.5	7.25	11.4	36.2	56.8		
				59.8		102.7		128.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
49.5	48.5	28.3	
39.7	40.5	27.4	
10.8	11.0	54.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 14.

NOTES:

500 gram sample ground in ball mill for 10 min.
Start-- 2.25
Finish- 2.35

DATE Oct. 26 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.10	Charge							
3.12	$CuSO_4$		10					
3.15	Cobalt	5						
3.25	"	5				1st. Conc.	31	161
3.35	"	5						
3.45	"	5						
3.50	Complete					2nd. Conc.	32.	125
						Tails.	33.	215

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Cobalt #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st Conc		19.4	31.2	33.8	54.3	22.0	35.4		
40	2nd Conc.		14.2	17.75	29.0	36.2	16.6	20.7		
40	Tails.		3.75	8.0	7.07	15.2	39.4	84.7		
				56.95		105.7		140.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
54.7	51.3	25.1
31.2	34.3	14.7
14.1	15.4	60.2

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 15.

NOTES:

500 gram sample ground in ball mill for 15 min.
Start-- 3.30
Finish- 3.45

DATE Oct. 26, 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.55	Charge							
3.57	$CuSO_4$		10					
4.00	Cobalt	5						
4.10	"	5						
4.20	"	5				1st. Conc.	34	184
4.30	"	5						
4.35	Complete					2nd Conc.	35	109
						Tails.	36	205

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Cobalt M#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st Conc		22.1	40.7	29.0	53.3	19.9	36.6		
40	2nd Conc		12.8	13.95	30.4	33.2	10.6	11.55		
40	Tails		3.0	6.15	4.78	9.8	43.0	88.2		
				60.8		96.3		136.35		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
67.0	55.4	26.8	
23.0	34.5	8.4	
10.0	10.1	64.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 16.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start -- 9.30
Finish-- 9.50

DATE Oct. 31 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.05	Charge							
10.07	$CuSO_4$		10					
10.10	Cobalt	5						
10.20	"	5				1st Conc.	37	172
10.30	"	5						
10.40	"	5				2nd Conc.	38	110
						Tails.	39	216

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Cobalt M.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1stConc		23.6	40.6	29.1	50.0	15.0	25.8		
40	2ndConc		12.5	13.75	25.4	27.9	23.1	25.4		
40	Tails.		1.38	2.98	5.9	12.75	42.2	91.5		
				57.33		90.65		142.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
70.9	55.1	18.1	
24.0	30.8	17.8	
5.1	14.1	64.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 17.

NOTES:

500 gram sample ground in ball mill for 30 min.
Start---10.05
Finish--10.35

DATE Oct. 31 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.50	Charge							
10.52	$CuSO_4$		10					
10.55	Cobalt	5						
11.05	"	5						
11.15	"	5				1st Conc.	40	143
11.25	"	5						
11.30	Complete					2nd Conc.	41	114
						Tails.	42	243

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Cobalt 1#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		26.8	38.4	33.1	47.4	9.07	13.0		
40	2nd Conc		13.3	15.2	31.2	35.6	15.6	17.8		
40	Tails		1.08	2.63	7.16	17.4	39.1	95.1		
				56.23		100.4		125.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
68.3	47.1	10.3	
27.0	35.4	14.1	
4.7	17.5	75.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 18.

DATE Oct. 31 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

PULP TEMP. FINISH °

PULP TEMP. MEAN °

NOTES:

A series of pulp ratio tests, to determine the effect of pulp ratios on the flotation of the ore, a 20 min. grind being given in each case. Oil used was FPL #24.

250 gram sample. Start-- 11.05

Finish- 11.25

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.40	Charge							
11.45	FPL#24	5						
11.55	"	5						
12.05	"	5				1st Conc.	43	21
12.10	"	10						
12.20	Complete					2nd Conc.	44	41
						Tails.	45	187

REAGENT	%	LBS. P.T.
F.P.L.24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		39.0	6.1	21.6	4.52	9.17	1.92		
40	2nd Conc		28.0	11.5	31.6	13.0	8.77	3.6		
40	Tails.		5.13	9.6	18.2	34.0	31.8	59.5		
				27.2		51.52		65.02		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
22.4	8.78	2.95	
42.3	25.2	5.54	
35.3	66.02	91.51	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 19.

NOTES:

500 gram sample ground 20 min.
Start-- 11.40
Finish- 12.00

DATE Oct. 31, 1922
ORE NO. 177
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.22	Charge							
12.25	FPL #24	10						
12.35	"	5						
12.45	"	5				1st Conc.	46	125
12.55	"	5						
1.00	Complete					2nd Conc.	47	105
						Tails.	48	268

REAGENT	%	LBS. P.T.
F.P+L#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
23	1st Conc		32.9	41.2		53.0	9.85	12.4		
38	2nd Conc		12.1	12.7	37.2	39.0	13.7	14.4		
38	Tails		2.66	7.13	10.8	29.0	38.1	102.0		
				61.03		101.0		128.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
67.5	32.6	9.12	
20.8	38.8	11.2	
11.7	29.4	79.68	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 20.

NOTES:

1000 gram sample ground in ball mill for 20 min.
Start ---1.45
Finish---2.05

DATE Oct. 31 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.30	Charge							
2.35	FPL.#24	10						
2.45	"	5						
2.55	"	5				1st. Conc+	49	223
3.05	"	5						
3.10	Complete					2nd. Conc.	50	202
						Tails.	51	568

REAGENT	%	LBS. P.T.
FPL.#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		35.0	78.0	26.2	58.5	7.72	17.2		
40	2nd Conc		13.0	26.2	16.9	34.2	13.2	26.4		
40	Tails.		2.96	16.8	12.0	68.2	35.4	210.0		
				121.0		160.9		244.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
59.5	36.4	7.02
21.6	21.3	10.8
18.9	42.3	82.18

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 21.

NOTES:

756 gram sample ground in ball mill for 20 min.
Start-- 2.50
Finish- 3.10

DATE Oct.31, 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.15	Charge							
3.20	FPL.#24	10						
3.30	"	5						
3.40	"	5				1st. Conc.	52	136
3.50	"	5						
3.55	Comblete					2nd. Conc	53	199
						Tails	54	415

REAGENT	%	LBS. P.T.
FPL.#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1stConc		40.2	54.6	23.5	32.0	8.67	11.8		
40	2ndConc		14.0	27.8	33.1	65.6	14.0	27.7		
40	Tails		2.57	10.65	12.4	51.5	37.8	157.0		
				93.05		149¼1		196.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
58.8	22.4	6.02	
29.9	44.0	14.1	
11.3	33.6	79.88	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 22.

NOTES:

A series of Tests with Na_2S to determine the effect when used in conjunction with various oils.

500 gram sample ground for 20 min. in ball mill

Start-- 3.20

Finish- 3.40

DATE Oct. 31 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.00	Charge							
4.02	Na_2S		10					
4.05	FPL.#24	10						
4.15	"	5						
4.25	"	5				1st. Conc.	55	111
4.35	"	5						
4.40	Complete					2nd. Conc.	56	84
						Tails.	57	306

REAGENT	%	LBS. P.T.
Na_2S		2#/ton
FPL.#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		37.1	41.1	26.1	29.0	11.4	12.9		
40	2nd Conc		14.1	11.8	39.1	32.9	15.2	12.8		
40	Tails.		1.97	6.03	13.8	42.2	35.4	108.0		
				58.93		104.1		133.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
69.6	27.8	9.63
20.0	31.6	9.56
10.4	40.6	80.81

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 23¾

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 4.10
Finish- 4.30

DATE Oct. 31 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.45	Charge							
4.47	Na_2S		10					
4.50	B#4	10						
4.55	"	5						
5.10	"	5				1st. Conc.	58	83
5.20	"	5						
5.30	Complete					2nd Conc.	59	93
						Tails.	60	318

REAGENT	%	LBS. P.T.
Na_2S		2#/ton
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		41.7	34.8	27.8	23.1	7.1	5.9		
40	2nd Conc		16.3	15.15	36.0	33.5	1.35	1.25		
40	Tails.		0.89	2.83	14.3	45.5	38.0	121.0		
				52.78		102.1		128.15		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
68.0	22.6	4.6	
28.7	32.8	1.0	
3.3	44.6	94.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 24.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 9.10
Finish- 9.20

DATE Nov. 1, 19 22
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.30	Charge							
10.31	Na_2S		10					
10.35	Cobalt	10						
10.45	"	5						
10.55	"	5				1st. Conc.	61	169
11.05	"	5						
11.10	Complete					2nd. Conc.	62	114
						Tails.	63	219

REAGENT	%	LBS. P.T.
Na_2S		3#/ton
Cobalt #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	LstConc		27.6	44.7	29.5	47.8	12.5	20.2		
40	2ndConc		10.8	12.3	24.7	30.8	21.8	24.8		
40	Tails.		.69	1.51	9.1	21.7	40.6	91.0		
				58.51		100.3		136.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
76.4	47.6	14.8	
21.0	30.7	18.3	
2.6	21.7	66.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 25.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 10.55
Finish- 11.15

DATE Nov. 1, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.20	Charge							
11.22	NaOH		10					
11.25	FPL.#24	10						
11.35	"	5						
11.45	"	5				1st Conc.	64	96
11.55	"	5						
12.00	Complete					2nd Conc.	65	91
						Tails.	66	318

REAGENT	%	LBS. P.T.
NaOH		4#/ton
FPL+#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	%	WEIGHT Fe.	%	WEIGHT
25	1st Conc		39.5	37.9	25.4	24.4	6.27	6.01		
40	2nd Conc		16.6	15.1	37.8	34.4	12.3	11.3		
40	Tails.		.5	1.59	14.8	47.1	36.8	117.0		
				54.59		105.9		134.21		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
69.4	23.1	4.6	
27.6	32.5	8.3	
3.0	44.4	87.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 26.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 1.40
Finish- 2.00

DATE Nov. 7, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge							
2.52	Na_2S		10					
2.53	NaCN		10					
2.55	FPL#24	10						
3.05	"	5						
3.15	"	5				1st Conc.	67	54
3.25	"	5						
3.30	Complete					2nd Conc.	68	106
						Tails.	69	335

REAGENT	%	LBS. P.T.
Na_2S		2#/ton
NaCN		4#/ton
FPL#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		40.1	21.6	23.3	12.6	18.2	9.84		
40	2nd Conc		23.45	24.9	33.2	35.2	18.1	19.2		
40	Tails.		3.78	12.65	14.8	49.5	37.9	127.0		
				59.15		97.3		155.04		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
36.5	12.95	6.35
42.0	36.2	12.39
21.5	50.85	81.26

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 27.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 2.45
Finish- 3.05

DATE Nov. 17, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.40	Charge							
3.41	Na_2S		10					
3.41	NaOH		10					
3.45	B#4	10						
3.55	"	5						
4.05	"	5				1st. Conc.	70	75
4.15	"	5						
4.20	Complete					2nd. Conc.	71	74
						Tails.	72	356

REAGENT	%	LBS. P.T.
Na_2S		2#/ton
NaOH		4#/ton
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1stConc		40.8	30.6	29.2	16.2	9.75	6.57		
40	2ndConc		23.2	17.2	32.2	23.8	12.2	9.04		
40	Tails.		3.88	13.8	14.1	50.4	37.0	132.0		
				61.6		100.4		147.61		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
50.2	16.1	4.45
27.9	23.7	6.13
21.9	60.2	89.41

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 28.

NOTES:

A series of tests to determine the effect of SO_2 on the flotation of Sullivan ore.

500 gram sample ground for 20 min.

Start--- 9.45

Finish--10.05

DATE Nov.8, 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.12	Charge							
10.13	SO_2		10					
10.15	B#4	10						
10.25	"	5				No Froth		
10.35	"	5						
10.45	"	5						
10.55	Complete					1st. Conc.	73	40
						Tails.	74	460

REAGENT	%	LBS. P.T.
SO_2 sol.	sat.	10 cc.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
43	1st Conc		38.5	15.4	15.1	6.5	16.7	6.8		
43	Tails		9.2	42.4	20.9	96.2	28.8	133.0		
				57.8		102.7		139.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
26.6	6.4	4.9	
73.4	93.6	95.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 29.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start--- 9.45
Finish--10.05

DATE Nov.8, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.52	Charge							
10.52	SO_2		10					
11.00	Cobalt	5						
11.05	"	5				No froth		
11.15	"	5				Good froth		
11.25	"	5				1st. Conc.	75	55
11.35	"	5						
11.44	Complete					2nd. Conc.	76	151
						Tails.	77	292

REAGENT	%	LBS. P.T.
SO_2 sol	sat.	10 cc.
Cobalt #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
33	1st Conc		38.0	20.9	15.8	8.7	15.2	8.36		
48	2nd Conc		17.15	25.9	21.8	32.9	27.0	40.8		
48	Tails		4.85	14.18	20.0	58.4	32.0	93.5		
				60.98		100.0		142.66		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
34.3	8.7	5.86
42.4	32.9	28.6
23.3	58.4	75.54

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 30.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start ---11.05
Finish---11.25

DATE Nov.8, 1922
ORE NO. 177
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.45	Charge							
11.47	SO_2		20					
11.50	Cobalt	5						
11.55	"	5						
12.05	"	5				1st. Conc.	78	36
12.15	"	5						
12.25	"	5						
12.30	Complete					2nd. Conc	79	132
						Tails	80	331

REAGENT	%	LBS. P.T.
SO_2 sol	sat	20cc.
Cobalt M#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		— 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30	1st Conc		34.5	12.4	14.4	5.08	15.5	5.09		
45	2nd Conc		18.2	23.8	17.4	22.8	39.5	51.8		
45	Tails		7.47	24.7	19.9	35.5	38.7	95.0		
				60.9		93.38		151.89		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
20.4	5.4	3.6	
39.0	24.4	34.0	
40.6	70.2	62.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	31.
DATE	Nov. 8, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gram sample ground in ball mill for 20 min.

Start-- 2.25

Finish- 2.45

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge							
2.52	$CuSO_4$		10					
	H_2SO_4		5					
2.55	Cobalt	5						
3.05	"	5						
3.15	"	5				1st. Conc.	81	199
3.25	"	5						
3.30	Complete					2nd Conc.	82	117
						Tails	83	198

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
H_2SO_4		2#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1stConc		23.8	45.0	30.8	58.2	13.9	26.3		
40	2ndConc		9.3	10.9	28.6	33.5	27.4	32.1		
40	Tails		2.23	4.37	7.16	14.0	62.5	125.0		
				60.27		105.7		183.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
74.6	55.1	14.3	
18.1	31.7	17.5	
7.3	13.2	78.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 32.

NOTES:

This test was tried as a retreatment test. A concentate was made to contain the Pb. and Zn. and retreated in the following test to separate the two.

1000 grams ground in ball mill for 20 min. Start--- 3.10
Finish-- 3.30

DATE Nov. 8, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.35	Charge							
3.36	$CuSO_4$		20					
3.40	Cobalt	5						
3.50	"	5						
4.00	"	5						
4.10	"	5						
4115	Complete					1st. Conc.	(to No. 33)	
						Tails.	94	290

REAGENT	%	LBS. P.T.
$CuSO_4$		2#-ton
Cobalt M #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
40	Tails		2.42	7.1	7.72	22.4	41.6	121.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
5.7	12.15	41.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	33.
DATE	Nov. 8, 1922.
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

Retreating concentrate from test 32. sample was ground for 15 min. with NaOH & NaCl.

The concrate was washed with alcohol to remove the oil used in the previous test .

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
						On adding charge		
						to U.S. machine		
						froth overflowed		
						immediately due		
						probably to the		
						alcohol.		
						Conc.	85	535
						Tails.	86	121

REAGENT	%	LBS. P.T.
NaOH		4#/ton
NaCl		10#-ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
	Conc.		19.2	103.0	26.2	140.	25.2	135.0		
	Tails.		12.8	15.5	19.1	23.1	26.4	31.9		
(from 32.)	84.			118.5		163.1		166.9		
		94%.		125.6		185.5		287.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
82.0	75.4	47.0
12.3	12.45	11.1
5.7	12.15	41.9

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 34.

NOTES:

Repeating test No.32
1000 grams ground for 20 min.
S tart--9.35
F inish-955

DATE Nov.9, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.56	Charge							
9.57	$CuSO_4$		20					
10.00	Cobalt	5						
10.10	"	5						
10.20	"	5						
10.30	Complete					Conc.to No.35		
						Tails.	35	396
						Washed conc.with hot water & NaOH		

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Cobalt N#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
34.	Tails		3.78	14.9	9.3	36.8	40.3	159.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
13.2	22.0	56.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 35.

NOTES:

Reground concentate from 34 for 10 min. with NaCl & NaOH.
Start-- 10.50
Finish- 11.00

DATE Nov. 9, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.05	Charge							
10.07	B#4	5				Too great frothing		
						Try strong salt solution only.		
10.30						Conc.	88.	176
						Tails.	89	335

REAGENT	%	LBS. P.T.
NaOH.		4#/ton
NaCl.		10#/ton.
B# 4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
30.	Conc.		29.3	39.3	37.6	66.1	11.1	19.5		
	Tails.		17.3	58.3	19.0	63.7	31.4	105.0		
(34)	Tails			14.9		26.8		159.9		
		907		112.4		166.6		283.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
35.0	39.7	6.8	
51.8	38.3	37.0	
13.2	22.0	56.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 36.

NOTES:

To determine the effect of separate agitation with Na_2S
500 gram sample ground for 20 min. Start---9.30
Finish--9.50
Agitated for 20 min. Start--10.30
Finish-10.50

DATE Nov.13, 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.55	Charge							
11.00	B#4	10						
11.10	"	5						
11.20	"	5				1st. Conc.	90	72
11.30	"	5						
11.35	Complete					2nd. Conc.	91	101
						Tails.	92	312

REAGENT	%	LBS. P.T.
Na_2S		2#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Conc		43.5	31.3	22.0	15.9	9.15	6.6		
40	2nd Conc		17.5	17.7	35.5	35.8	15.8	16.0		
	Tails		3.78	11.8	14.9	46.5	37.0	115.4		
				60.8		98.2		138.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
51.5	18.2	4.75
29.1	36.3	11.6
19.4	47.2	83.65

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 37.

NOTES:

As before with the Addition of NaOH
500 gram sample ground for 20 min. Start--10.30
Finish-10.50
Separately Agitated for 20 min Start--11.25
Finish-11.45

DATE Nov. 13, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.45	Charge							
11.50	B#4	10						
12.00	"	5						
12.10	"	5				1st. Conc.	93	79
12.20	"	5						
12.25	Complete					2nd. Conc.	94	68
						Tails.	95	342

REAGENT	%	LBS. P.T.
Na_2S		2#/ton.
NaOH		4#/ton.
B#1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1stConc		43.8	34.6	22.4	17.8	8.3	6.55		
40	2ndConc		21.5	14.6	31.4	21.4	13.8	9.39		
40	Tails		3.1	11.6	16.8	57.5	38.1	130.0		
				60.8		96.7		145.94		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
57.0	18.4	4.5	
24.0	22.1	6.3	
19.0	59.5	89.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	38.
DATE	Nov. 13, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --11.50
Finish--12.10
Separately agitated for 20 min. Start-- 2.30
Finish- 2.50

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge							
2.55	B#4	10						
3.05	"	5						
3.15	"	5				1st. Conc.	96.	47
3.25	"	5						
3.30	Complete					2nd. Conc.	97	92
						Tails.	98	345
								484

REAGENT	%	LBS. P.T.
Na_2S		2#/ton.
H_2SO_4		2#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Con		42.9	20.2	23.9	11.2	13.4	6.3		
40	2nd Con		24.8	22.8	33.6	30.9	11.6	10.7		
40	Tails.		5.05	17.4	16.75	57.8	34.6	119.0		
				60.4		99.9		136.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
33.4	11.2	4.63	
37.3	30.9	7.87	
28.8	57.8	87.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 39.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start 2.30
Finish 2.50
Agitated 20 min. with SO_2 solution. Start 3.10
Finish 3.30

DATE Nov. 13, 1922.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.40	Charge							
3.45	B#4	10						
3.55	"	5						
4.05	"	5				1st. Conc.	99	19
4.15	"	5						
4.20	COmplete					2nd. Conc.	100	84
						Tails.	101	326
								489

REAGENT	%	LBS. P.T.
SO_2 sol.	sat.	10cc.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Conc		44.0	8.35	18.0	3.42	12.1	2.3		
40	2nd.Conc		31.7	26.65	30.9	26.0	2.07	1.74		
40	Tails		2.42	9.35	18.7	72.2	31.3	120.0		
				44.3		101.62		124.04		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
18.7	3.4	1.85	
60.0	25.6	1.38	
21.3	71.0	96.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 40.

NOTES:

500 gram sample ground for 20 min. Start --3.10
Finish--3.30
Agitated with an increased amount of Na_2S Start --3.50
Finish--4.10

DATE Nov. 13, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.25	Charge							
4.30	B#4	10						
4.40	"	5						
4.50	"	5				1st. Conc.	102	89
5.00	"	5						
5.05	Complete					2nd. Conc.	103	97
						Tails.	104	309
								495

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. Conc		38.6	34.4	23.6	21.0	1.58	1.4		
40	2nd. Conc		7.95	7.8	40.0	39.2	11.8	11.6		
40	Tails		.97	3.0	13.9	43.0	40.9	126.5		
				45.2		103.2		139.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
76.0	20.2	.69
17.25	38.0	8.31
6.75	42.8	91.0

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 41.

NOTES:

A series of tests with Na_2CO_3 used with various oils.
500 gram sample ground for 20 min.
Start --2.00
Finish--2.20

DATE Nov.20, 19 22
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.45	Charge							
2.46	Na_2CO_3		10					
2.50	B#4	10						
3.00	"	5						
3.10	"	5				1st. Conc.	105	93
3.20	"	5						
3.25	Complete					2nd. Conc.	106	70
						Tails.	107	332
								495

REAGENT	%	LBS. P.T.
Na_2CO_3	10	
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% ZN.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st Con		41.6	38.7	20.4	19.0	18.9	17.6		
40	2nd Con		16.8	11.8	31.7	22.2	15.6	10.9		
40	Tails.		.39	.96	14.0	46.5	37.9	126.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
75.0	21.7	11.4	
22.9	25.3	7.1	
2.1	53.0	81.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 42.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --3.00
Finish--3.20

DATE Nov. 21, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.35	Charge							
3.36	Na_2CO_3		10					
3.40	Cobalt	10						
3.50	"	5				1st. Conc.	108a	144
4.00	"	5				2nd. Conc.	108b	63
4.10	"	5						
4.15	Complete					3rd. Conc.	109	92
						Tails.	110	208
								507

REAGENT	%	LBS. P.T.
Na_2CO_3	10	
Cobalt #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc		29.5	42.4	23.2	33.4	16.6	23.9		
25	2nd.Conc		13.8	8.7	30.7	19.3	17.3	10.9		
40	3rd.Conc		7.03	6.46	27.1	24.9	38.5	35.6		
40	Tails		.69	1.44	6.23	12.9	44.7	93.0		
				59.1		90.5		163.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
71.9	37.0	14.6	
14.7	21.3	6.36	
11.0	27.5	21.8	
2.4	14.2	56.94	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 43.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start-- 3.40
Finish- 400-

DATE Nov. 20, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.15	Charge							
4.16	Na_2CO_3		10					
4.20	FPL#24	10						
4.30	"	5				1st. Conc.	111	109
4.40	"	5				2nd. Conc.	112	40
4.50	"	5						
4.55	Complete					3rd. Conc.	113	81
						Tails.	114	274
								504

REAGENT	%	LBS. P.T.
Na_2CO_3	10%	
FPL#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1stConc		41.0	44.7	20.9	22.8	1222	13.3		
25	2ndConc		10.1	4.04	34.9	14.0	14.0	5.6		
40	3rdConc		6.7	5.33	34.1	27.6	17.1	13.8		
40	Tails		1.88	5.34	9.5	27.0	41.5	118.0		
				59.41		91.4		150.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
75.2	25.0	8.82	
6.8	15.3	3.72	
8.98	30.2	9.26	
9.02	29.5	78.20	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 44.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start--4.15
Finish-4.35

DATE Nov.20, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
5.05	Charge							
5.06	Na_2CO_3		20					
5.10	B#4	10						
5.20	"	5				1st. Conc.	115	120
5.30	"	5				2nd. Conc.	116	39
5.40	"	5						
5.45	Complete					3rd. Conc.	117	56
						Tails.	118	287
								502

REAGENT	%	LBS. P.T.
Na_2CO_3	10%	
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc		35.0	42.0	24.9	29.9	11.5	13.8		
25	2nd.Conc		15.8	6.16	38.4	15.0	16.1	6.28		
40	3rd.Conc		6.73	3.77	40.5	22.7	18.4	10.30		
40	Tails.		.99	2.86	12.2	35.0	40.2	115.5		
				54.79		102.6		145.88		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
76.6	29.1	9.46	
11.25	14.6	4.28	
6.93	22.2	7.06	
5.22	34.1	79.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 45.

NOTES: 250 grams.

Series of Pulp Ratio tests. Samples of 500 grams were ground in the ball mill and the required amount weighed out. This all samples received the same grinding and were sized according to the grinding test sheet for a 20 min. grind.

DATE Nov.24, 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.20	Charge							
2.25	B#4	10						
2.35	"	5				1st. Conc.	119	17.5
2.45	"	5				2nd. Conc.	120	22
2.55	"	5						
3.05	Complete					3rd. Conc.	121	49
						Tails.	122	148
								242.5

REAGENT	%	LBS. P.T.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc	7.22	34.8	6.1	17.2	3.1	12.1	2.12	7.22	
25	2nd.Conc	11.51	29.6	8.29	32.4	9.08	10.8	3.02	11.5	
40	3rd.Conc	20.28	16.35	8.01	30.3	14.85	15.1	7.40	20.28	
40	Tails	61.00	.79	1.17	14.5	21.4	38.6	57.0	61.0	
				23.57		48.43		69.54		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
25.9	6.4	3.05	
35.2	18.7	4.34	
34.0	30.7	10.61	
4.9	44.2	82.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 46.

NOTES:

750 gram sample.

DATE Nov.24, 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.15	Charge							
3.20	B#4	10						
3.30	"	5				1st. Conc.	123	99
3.40	"	5				2nd. Conc.	124	46
3.50	"	5						
4.00	Complete					3rd. Conc.	125	148
						Tails.	126	451
								744

REAGENT	%	LBS. P.T.
B#5		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc	13.52	43.7	43.3	19.9	19.7	7.8	7.7		
25	2nd.Conc	6.18	25.6	11.8	31.2	14.4	11.1	5.06		
40	3rd.Conc	19.8	12.95	19.2	16.65	24.6	14.5	21.4		
40	Tails	60.5	1.19	5.36	13.95	62.9	39.9	180.0		
				79.66		121.6		214.16		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
54.5	16.2	3.6	
14.8	11.85	2.4	
24.1	20.3	10.0	
6.6	48.45	84.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 47.

NOTES:

DATE Nov, 24, 1922

ORE NO.

PULP RATIO : 1

R.P.M. IMPELLER

1000 gram sample+

Much greater froth was obtained with thicker pulp.

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.15	Charge							
4.20	B#4	10						
4.30	"	5				1st. Conc.	127	107
4.40	"	5				2nd. Conc.	128	109
4.50	"	5						
5.00	Complete					3rd. Conc.	129	191
						Tails.	130	599
								936

REAGENT	%	LBS. P.T.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Con	10.73	42.1	45.0	20.5	21.9	9.20	9.9		
25	2nd.Con	10.93	29.1	31.7	27.4	29.1	11.6	12.6		
40	3rd.Conc	19.2	12.55	24.0	35.7	68.2	18.3	35.0		
40	Tails	59.14	.79	4.65	14.3	41.2	39.5	222.0		
				105.35		106.4		270.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
42.7	13.7	3.45	
30.1	18.15	4.51	
22.8	42.6	12.55	
4.4	25.55	79.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 48.

NOTES:

500 gram sample.

DATE Nov. 25 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.55	Charge							
10.00	B#4	10						
10.10	"	5				1st. Conc.	131	47
10.20	"	5				2nd. Conc.	132	34
10.30	"	5						
10.40	Complete					3rd. Conc.	133	67
						Tails.	134	353
								501

REAGENT	%	LBS. P.T.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc	9.6	47.6	22.35	19.8	9.3	6.7	3.15		
25	2nd.Conc	6.8	34.2	11.6	27.2	9.25	8.3	2.82		
40	3rd.Conc	11.4	17.6	11.8	36.2	24.3	11.6	7.77		
40	Tails	70.6	.89	3.14	16.5	58.2	36.6	127.0		
				48.89		101.05		140.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
45.7	9.15	2.24	
23.7	9.10	2.04	
24.1	23.9	5.32	
6.5	57.2	90.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 49.

NOTES:

A series of tests using $Na_2S_2O_3$
500 gram sample ground in ball mill for 20 min.
Start --9.25
Finish--9.45

DATE Nov.30, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.50	Charge							
9.51	$Na_2S_2O_3$		10					
9.55	B#4	10						
10.05	"	5						
10.15	"	5				1st. Conc.	135	84
10.25	"	5						
10.30	Complete					2nd. Conc.	136	85
						Tails.	137	326
								496

REAGENT	%	LBS. P.T.
$Na_2S_2O_3$		2#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Conc	16.9	42.3	35.6	23.4	19.65	8.72	7.32		
40	2nd.Conc	17.1	15.1	12.8	35.8	30.4	15.3	13.0		
40	Tails	67.0	3.77	12.4	17.3	56.4	36.6	119.0		
				60.8		106.45		139.32		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
58.5	18.43	5.28
21.1	28.55	9.32
20.4	51.02	85.40

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 50.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --10.00
Finish--10.20

DATE Nov. 30 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.35	Charge							
10.36	$Na_2S_2O_3$		10					
10.40	Cobalt	10						
10.50	"	5						
11.00	"	5				1st. Conc.	138	217
11.10	"	5						
11.15	Complete					2nd. Conc.	139	94
						Tails.	140	189
								500

REAGENT	%	LBS. P.T.
$Na_2S_2O_3$		2#/ton.
Cobalt #1		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. Conc	42.4	24.7	53.6	27.4	59.5	17.6	38.2		
40	2nd. Conc	18.8	7.73	7.26	27.5	25.8	27.8	26.1		
40	Tails	37.8	1.98	3.74	9.53	18.0	48.9	78.5		
							41.5			
				64.6		103.3		142.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
83.0	57.5	26.7	
11.24	24.9	18.3	
5.76	17.6	55.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	51.
DATE	Dec. 1, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gram sample ground in ball mill for 20 min.

Start --10.40

Finish--11.00

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.15	Charge							
11.16	$Na_2S_2O_3$		10					
11.20	FPL#24	10						
11.30	"	5						
11.40	"	5				1st. Conc.	141	95
11.50	"	5						
11.55	Complete					2nd. Conc.	142	70
						Tails.	143	336
								501

REAGENT	%	LBS. P.T.
$Na_2S_2O_3$		2#/ton.
FPL#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Con	18.95	39.4	37.4	23.0	21.8	9.4	8.94		
40	2nd.Con	13.95	14.4	10.07	25.6	17.9	14.4	10.07		
40	Tails	67.10	2.92	9.72	18.1	60.8	37.6	126.3		
				57.19		100.5		145.31		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
65.3	21.7	6.08
17.6	17.8	6.92
17.1	60.5	87.0

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 52.

NOTES:

To see the effect of increasing $Na_2S_2O_3$

Start --11.30

Finish--11.50

DATE Dec.1, Nov. 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.55	Charge							
11.56	$Na_2S_2O_3$		20					
12.00	FPL#24	10						
12.10	"	5						
12.20	"	5				1st. Conc.	144	90
12.30	"	5						
12.35	Complete					2nd. Conc.	145	64
						Tails.	146	349
								503

REAGENT	%	LBS. P.T.
$Na_2S_2O_3$		4#/ton.
FPL#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Con	17.9	42.3	38.0	21.2	19.1	9.3	8.37		
40	2nd.Con	12.7	14.9	9.54	31.4	20.5	13.5	8.63		
40	Tails	69.4	3.87	13.5	17.7	61.8	36.2	126.3		
				61.04		101.4		143.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
61.9	18.8	5.84	
16.1	20.2	6.01	
22.0	61.0	88.15	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	53.
DATE	Dec.6, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES: A special oil was tried which would have properties between those of B#4 and Cobalt Mixture #1.
500 gram sample ground in ball mill for 20 min.
Start --10.00
Finish--10.20

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.45	Charge							
10.50	oil	10						
11.00	"	5						
11.10	"	5				1st. Conc.	147	109
11.20	"	5						
11.25	Complete					2nd. Conc.	148	63
						Tails.	149	320
								492

REAGENT	%	LBS. P.T.
B#4	95%	
Pine Oil	5%	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Con	22.2	36.2	39.4	24.5	26.5	10.0	10.9		
40	2nd.Conc	12.8	13.0	8.2	35.3	22.5	16.7	10.5		
40	Tails	65.0	3.11	9.95	16.8	53.8	34.8	111.0		
				57.55		102.8		132.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
68.5	25.8	8.2	
14.3	21.9	8.0	
17.2	52.3	33.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 54.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --10.55
Finish--11.15

DATE Dec. 6, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.40	Charge							
11.42	Na_2S		10					
11.45	Oil	10						
11.55	"	5						
12.05	"	5				1st. Conc.	150	114
12.15	"	5						
12.20	Complete					2nd. Conc.	151	75
						Tails	152	313

REAGENT	%	LBS. P.T.
Na_2S		2#/tpn.
Special	5% Pine oil	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. Conc	22.7	38.0	43.3	24.3	27.7	10.4	11.85		
40	2nd. Conc	13.8	12.55	9.32	34.8	26.1	17.4	13.05		
40	Tails	63.5	2.64	8.25	15.2	47.5	36.2	113.0		
				60.87		101.3		137.9		

PERCENT OF TOTAL

PB+	ZN+	FE^T	
71.2	27.3	8.54	
15.3	25.8	9.46	
13.5	46.9	82.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 55.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --11.50
Finish--12.10

DATE Dec. 6, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.05	Charge							
2.06	$CuSO_4$		10					
2.10	Oil	10						
2.20	"	5						
2.30	"	5				1st. Conc.	153	145
2.40	"	5						
2.45	Complete					2nd. Conc.	154	124
						Tails.	155	218
								487

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Special	5% Pine oil	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1stConc	29.5	30.2	43.8	29.7	43.0	10.1	14.6		
40	2ndConc	25.4	10.84	13.5	36.3	45.0	20.5	25.4		
40	Tails.	45.1	.47	1.02	7.15	15.6	43.7	95.4		
				58.32		103.6		135.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
75.1	41.6	10.7	
23.2	43.5	18.8	
1.7	14.9	70.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 56.

NOTES:

500 gram sample ground in ball mill for 20 min.
Start --2.15
Finish--2.35

DATE Dec.6, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge							
2.51	NaOH		5					
2.55	Oil	10						
3.05	"	5						
3.15	"	5				1st. Conc.	156	110
3.25	"	5						
3.30	Complete					2nd.Conc.	157	100
						Tails	158	292
								502

REAGENT	%	LBS. P.T.
NaOH		2#/ton.
Special	5% Pine Oil.	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		— 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st.Conc	21.9	37.6	41.4	24.2	26.6	11.1	12.2		
40	2nd.Conc	19.9	12.1	12.1	34.4	34.4	17.9	17.9		
40	Tails	58.2	2.45	7.1	14.2	41.5	38.1	111.2		
				60.75		102.5		141.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
66.1	25.9	8.6	
20.1	33.6	12.7	
11.8	40.5	78.7	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 57.

NOTES:

Another special oil was made up containing 10% Pine oil and the following tests run+

Start --9.05

Finish--9.25 ---500 gram sample

DATE Dec.11, 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.30	Charge							
9.35	Oil	10						
9.45	"	5				1st. Conc.	164	99
9.55	"	5				2nd. Conc.	165	57
10.05	"	5						
10.10	Complete					3rd. Conc.	166	115
						Tails.	167	235
								496

REAGENT	%	LBS. P.T.
B#4	90	
Pine Oil	10	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st.Conc	39.0	39.0	34.7	23.0	20.5	11.55	10.28		
25	2nd.Conc		20.3	11.6	31.4	17.9	18.0	10.25		
40	3rd.Conc		7.84	9.0	31.7	36.4	23.2	26.6		
40	Tails		1.22	2.8	15.0	35.3	40.7	96.0		
				58.1		110.1		143.2		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
59.6	18.6	7.21	
20.0	16.3	7.19	
15.5	33.0	18.6	
4.9	32.1	67.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 58.

NOTES:

500 grav sample ground in ball mill for 30 min.
Start --10.00
Finish -10.20

DATE Dec.11, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.25	Charge							
10.26	$CuSO_4$		10					
10.30	oil	10						
10.40	"	5				1st. Conc.	166	130
10.50	"	5						
11.00	"	5						
11.05	Complete					2nd. Conc.	169	92
						3rd. Conc.	170	90
						Tails.	171	187
								499

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Special	10%	Pine oil

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe	WEIGHT	%	WEIGHT
15	1st.Conc		33.0	42.9	28.3	36.8	10.9	14.15		
25	2nd.COnc		12.5	11.2	40.0	36.8	27.8	21.9		
40	3rd Conc		7.38	6.62	27.6	24.8	30.2	27.1		
40	Tails.		1.89	3.54	4.29	8.02	45.6	85.3		
				84.86		106.42		148.45		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
66.3	34.6	9.57	
18.2	34.6	14.7	
10.2	23.3	18.27	
5.3	7.5	57.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 59.

NOTES: 500 gram sample ground 20 min.

start 11.00

finish 11.20

DATE dec. 11, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.25	Charge							
11.26	Na_2CO_3		10					
11.30	Oil	10						
11.40	"	5				1 st. conc.	172	105
11.50	"	5				2 nd. "	173	56
12.00	"	5						
12.05	Complete					3 rd. "	174	90
						Tails	175	251
								502

REAGENT	%	LBS. P.T.
B#4	90%	
Pine Oil	10%	
Na_2CO_3		2#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	20.9	38.2	40.0	22.7	23.8	11.5	13.05		
25	2nd. C.	11.1	15.3	8.55	34.1	19.1	16.4	9.2		
40	3rd. C.	17.9	9.07	8.17	33.4	30.0	22.7	20.4		
40.	Tails	50.0	3.68	9.23	11.7	29.4	47.4	119.0		
				65.95		102.3		160.65		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
60.5	23.3	7.5	
13.0	18.7	5.7	
12.4	29.4	12.8	
14.1	28.6	74.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 60.

NOTES:

Retreatment of tails from sub-aeration machine test 44A.

Sub-aeration test used Na_2CO_3 - 20#/ton. run 18 min.

DATE Dec.11, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.00	Charge							
3.01	$CuSO_4$		10					
3.05	Oil	5						
3.15	"	5				1st. conc.	335	65
3.30	Complete					2nd. conc.	336	70
						Tails.	337	230
						Heads from sub-A.	334	116
								481

REAGENT	%	LBS. P.T.
B#4	90%	
Pine Oil	10%	
$CuSO_4$		2

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
18	Sub-A.	24.1	36.8	42.7	19.6	22.7	13.9	16.1		
15	1st. C.	12.9	6.42	4.17	44.5	28.9	15.9	11.3		
30	2nd. C	13.9	6.6	4.62	41.2	28.8	16.4	11.5		
30	Tails	47.8	2.36	5.42	8.1	18.6	47.2	109.0		
				56.91		99.0		147.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
75.0	22.9	10.9	
7.34	29.2	6.95	
8.14	29.1	8.55	
9.53	18.8	73.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 61.

DATE Dec. 11, 1922

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

NOTES:

To determine the effect of $FeCl_3$ with various oils.

500 gram sample ground 20 min. start-- 2.35

finish-- 2.55

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.00	Charge							
3.01	$FeCl_3$		10					
3.05	Oil	10						
3.15	"	5				Very little froth		
3.25	"	5						
3.35	"	5						
3.45	----					1 st. conc.	176	102
4.05	Complete					2 nd. conc.	177	130
						Tails.	178	265

REAGENT	%	LBS. P.T.
FPL.#24		
$FeCl_3$		4#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
45	1st. C.	20.5	25.3	25.8	28.1	28.8	18.0	18.3		
65	2nd. C.	26.2	13.2	17.15	29.0	37.7	23.5	30.5		
65	Tails	53.3	4.7	12.45	12.8	33.9	38.4	102.0		
				55.4		100.4		150.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
46.5	28.7	12.1
31.0	37.5	20.2
22.5	33.8	67.7

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	62.
DATE	Dec. 11, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gram sample ground 20 min. start -- 3.05
finish -- 3.25

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.15	Charge							
4.16	$FeCl_3$		10					
4.20	Oil	10						
4.30	"	5						
4.40	"	5				1st. Conc.	179	109
4.50	"	5						
4.55	Complete					2nd. Conc.	180	185
						Tails.	181	204
								498

REAGENT	%	LBS. P.T.
Cobalt#1		
$FeCl_3$		4#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	21.9	25.6	27.9	23.7	25.8	22.0	23.0		
40	2nd. C.	37.2	13.5	25.0	25.8	47.7	25.9	47.8		
40.	Tails.	40.9	4.82	9.83	12.6	26.1	39.0	79.5		
				62.73		99.6		150.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
44.5	25.9	15.3	
39.9	47.9	31.8	
15.6	26.2	52.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 63.

NOTES:

500 grams ground 20 min. start -- 4.20

finish -- 4.40

DATE Dec.14, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
5.00	Charge							
5.01	$FeCl_3$		5					
5.05	Oil	10						
5.15	"	5						
5.25	"	5				1st. Conc.	182	84
5.35	"	5						
5.40	Complete					2nd. Conc.	183	124
						Tails.	184	288
								496

REAGENT	%	LBS. P.T.
B #4	90	
Pine Oil	10	
$FeCl_3$		2#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	18.0	34.5	29.0	24.1	20.2	14.0	11.7		
40	2nd. C.	25.0	15.5	19.2	31.2	38.7	20.8	25.8		
40	Tails.	57.0	1.7	4.9	14.0	40.3	37.3	107.3		
				53.1		99.2		144.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
54.6	30.4	8.2	
36.2	39.0	17.8	
9.2	40.6	74.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	64.
DATE	Dec. 15, 1922.
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 grams ground 20 min. start -- 9.00

finish -- 9.20

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.25	Charge							
9.26	$FeCl_3$							
9.30	Oil	10						
9.40	"	5						
9.50	"	5				1st. Conc.	185	70
10.00	"	5						
10.05	Complete					2nd. Conc.	186	95
						Tails.	187	334
								499

REAGENT	%	LBS. P.T.
B #4		
$FeCl_3$		2#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	14.0	39.8	27.9	22.6	15.8	9.95	6.97		
40	2nd. C.	19.0	18.1	17.2	31.0	29.4	17.2	16.3		
40	Tails.	67.0	3.5	11.7	15.9	53.0	38.3	128.0		
				56.8		98.2		151.27		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
49.2	16.1	4.65	
30.3	29.9	10.75	
20.5	54.0	84.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 65.

NOTES:

500 grams ground 20 min. start --9.35

finish --9.55

DATE Dec. 15, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.15	Charge							
10.16	$FeCl_3$							
	$CuSO_4$							
10.20	B#4	10						
10.30	"	5						
10.40	"	5				1st. Conc.	188	108
10.50	"	5						
10.55	Complete					2nd. Conc.	189	117
						Tails	190	274
								~~4.99~~
								499

REAGENT	%	LBS. P.T.
B #4		
$FeCl_3$		1#/ton
$CuSO_4$		"

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	21.6	29.3	31.6	29.5	31.8	10.2	11.1		
40	2nd. C.	23.4	15.3	17.9	32.0	37.4	19.2	22.4		
40	Tails.	55.0	1.89	5.17	10.2	27.5	40.3	110.0		
				54.67		96.7		143.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
57.8	32.9	7.8	
32.8	38.6	15.6	
9.4	28.5	76.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	66.
DATE	Dec. 6, 1922
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

1500 gram sample to accompany pulp ratio tests.

Ground three 500 gr. samples 20 min. each.

start -- 2.55 3.20 3.41

finish -- 3.15 3.40 4.01

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.05	Charge							
4.20	Oil	10						
4.30	"	5				1st. Conc.	159	164
4.40	"	5				2nd. Conc.	160	77
4.50	"	5				3rd. Conc.	161	81
4.55	Complete					4th. Conc.	162	303
						Tails	163	873
								1498

REAGENT	%	LBS. P.T.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	10.9	44.7	73.4	19.0	31.2	11.75	19.2		
25	2nd. C.	5.14	35.5	27.4	21.4	16.5	12.5	9.62		
35	3rd. C.	5.4	25.3	20.5	27.8	22.5	15.3	12.4		
40	4th. C.	20.26	11.9	36.1	30.7	93.0	20.8	63.0		
40	Tails	58.3	2.36	20.6	17.0	148.0	33.6	293.0		
				178.0		311.2		397.22		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
41.2	10.0	4.86	
15.4	5.3	2.42	
11.5	7.23	3.12	
20.3	29.9	15.9	
11.6	47.57	73.7	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 67.

DATE Dec. 18, 1922.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

PULP TEMP. FINISH °

PULP TEMP. MEAN °

NOTES:

Pulp ratio test for 1250 grams, ground in three lots.

Start	9.25	9.47	10.15
finish	9.45	10.07	10.25

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.05	Charge							
11.10	Oil	10						
11.20	"	5				1st. Conc.	195	302
11.30	"	5				2nd. Conc.	196	127
11.40	"	5						
11.45	Complete					3rd. Conc.	197	304
						Tails.	198	605
								1238

REAGENT	%	LBS. P.T.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	16.3	39.6	80.0	20.8	42.2	11.6	23.5		
25	2nd. C.	10.3	21.1	26.7	29.3	37.2	17.7	22.4		
40	3rd. C.	24.5	9.44	38.6	26.2	79.2	23.9	72.5		
40	Tails	48.9	0.66	4.0	11.7	70.9	41.7	281.0		
				139.3		229.5		399.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
57.5	18.4	5.88	
19.2	16.2	5.61	
20.5	34.6	18.1	
2.8	30.8	70.41	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 68.

NOTES:

500 grams ground 20 min. start -- 9.30
finish -- 9.50

DATE Dec. 18, 1922
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.05	Charge							
10.10	Oil	10						
10.20	"	5				1st. Conc.	191	62
10.30	"	5				2nd. Conc.	192	45
10.40	"	5						
10.45	Complete					3rd. Conc.	193	110
						Tails	194	277
								494

REAGENT	%	LBS. P.T.
Special #3		
(B#4	98	
Pine	2	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	12.6	48.2	29.7	18.5	11.5	8.8	5.45		
25	2nd. C.	9.1	25.3	11.4	29.8	13.4	15.25	6.90		
40	-Tails	22.3	10.6	11.0	34.6	38.0	23.8	26.3		
40	Tails	56.0	0.94	2.6	12.5	34.6	43.5	121.0		
				54.7		97.5		159.65		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
54.3	11.8	3.37	
20.8	13.7	4.33	
20.1	39.0	16.5	
4.8	35.5	75.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 69.

NOTES:

To attempt a preferential roasting of the galena.
1000 gr. sample ground for 35 min. and roasted.

One-half the sample was then ground 20 min. for this test.

DATE Jan. 18, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.30	Charge							
9.32	NaOH		10					
9.35	Oil	10						
9.45	"	10						
9.55	"	5						
10.05	"	5						
10.15	Complete					Conc.	199	10
						Tails	200	326
								336

REAGENT	%	LBS. P.T.
NaOH		4#/ton
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
45	Conc.	2.98	17.7	1.77	20.5	2.05	29.3	2.93		
45	Tails.	97.02	11.2	36.5	17.1	55.8	33.5	109.1		
				38.27		57.85		112.03		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
4.62	3.55	2.62	
95.38	96.45	97.38	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 71.

NOTES:

Roasted ore ground 20 min. start -- 10.00
finish -- 10.20

DATE Jan. 18, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER

PULP TEMP.	
START	°
FINISH	°
MEAN	°

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.25	Charge							
10.26	$CuSO_4$		10					
10.27	NaOH		10					
10.30	Oil	10						
1040	"	10						
10.50	"	5						
11.00	"	5						
11.10	COmplete					Conc.	201	12
						Tails	202	327
								339

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
NaOH		4#/ton.
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
45	Conc.	3.54	15.45	1.85	17.1	2.05	31.2	3.75		
45	Tails	96.46	13.1	43.5	17.4	59.0	33.9	115.0		
				45.35		61.05		118.75		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
4.08	3.36	3.16	
95.92	96.64	96.84	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	72.
DATE	Jan. 22, 1923.
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

1000 grams ground 25 min. start -- 9.30
finish -- 9.50

To determine the effect of Xylidin mixture -- 60% X-cake
40% Xylidin

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.00	Charge							
10.05	Oil	10						
10.15	"	10						
10.25	"	10				Lst. Conc.	203	126
10.40	-----					2nd Conc.	204	98
10.41	NaOH		10					
10.45	Complete					3rd. Conc.	205	36
						Tails.	206	711
								971

REAGENT	%	LBS. P.T.
Xylidine	40	
X-cake	60	

SCREEN ANALYSIS OF FEED			
GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. Conc	13.0	41.6	52.3	16.5	20.8	13.1	16.5		
40	2nd. C.	10.1	22.4	22.0	26.2	25.6	18.5	18.1		
45	3rd. C.	3.7	1..5	4.86	22.4	8.06	15.9	5.7		
45	Tails	73.2	6.89	49.0	19.0	135.0	30.6	218.0		
				128.16		189.46		258.3		

PERCENT OF TOTAL			
Pb.	Zn.	Fe.	
40.8	11.0	6.4	
17.5	13.5	7.0	
3.8	4.25	2.2	
37.9	71.25	84.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 73.

NOTES:

1000 gr. ground 30 min.

Start - 9.20

finish - 9.40

DATE Jan. 22, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.50	Charge							
10.51	$CuSO_4$		20					
10.55	Oil	10						
11.05	"	5				1st. Conc.	207	186
11.15	"	5						
11.25	"	5						
11.40	Complete					2nd. Conc.	208	482.
						Tails	209	339
								1007

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp.#3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	18.45	32.8	61.0	24.8	41.2	11.2	20.8		
50	2nd. C.	47.9	13.8	66.6	31.2	151.0	19.5	94.0		
50	Tails	33.65	1.4	4.75	33.2	112.5	45.6	155.0		
				132.35		304.7		269.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
46.1	13.6	7.4	
5014	49.5	35.2	
3.5	36.9	57.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 74.

NOTES:

1000 gr. ground 30 min. and agitated 30 min. with $CuSO_4$.

This test was later cut out as the sample had been dried in the steam cabinet.

DATE Jan. 22, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.40	Charge							
11.45	Oil	10						
11.55	"	5				1st. Conc.	210	50
12.05	"	5						
12.15	"	5						
12.30	Complete					2nd. Conc.	211	205
						Tails.	212	713
								967

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe	WEIGHT	%	WEIGHT
15	1st. C.	5.17	24.3	12.15	24.9	12.45	15.5	7.75		
50	2nd. C.	21.4	18.1	37.1	36.9	75.6	11.4	23.4		
50	Tails	33.43	10.0	71.2	16.6	118.0	29.1	207.0		
				120.45		206.05		238.15		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
10.0	6.4	3.38	
30.8	36.3	9.82	
59.2	57.3	86.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 75.

NOTES:

1000 gr. ground 30 min. with 2#/ton of $CuSO_4$ in the mill.

Start -- 2.45

finish -- 3.05

DATE Jan. 22, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.20	Charge							
3.25	Oil	10						
3.35	"	5				1st. Conc.	213	165
3.45	"	5						
3.55	"	5						
4.00	Complete					2nd. Conc.	214	482.
						Tails.	215	360
								1007.

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	16.4	30.5	50.3	25.9	42.7	14.5	23.9		
40	2nd. C.	47.9	17.0	82.0	26.9	130.0	23.8	115.0		
40	Tails	35.7	12.28	8.2	7.37	26.5	49.5	178.0		
				140.5		199.2		316.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
35.8	21.1	7.6	
58.4	66.1	36.3	
5.8	12.8	56.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 76.

NOTES:

1000 gr. ground with 4 #/ton $CuSO_4$

Start -- 3.25

finsh -- 3.45

DATE Jan. 22, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.15	Charge							
4.20	Oil	10						
4.30	"	5				1st. Conc.	216	133
4.40	"	5						
4.50	"	5						
5.05	Complete					2nd. Conc.	217	550
						Tails	318	324
								1007

REAGENT	%	LBS. P.T.
$CuSO_4$		4#/ton
SP.#3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	13.2	27.4	36.4	24.2	32.2	16.1	21.4		
50	2nd. C.	54.5	16.0	88.0	26.7	147.0	22.4	123.0		
50	Tails	32.3	3.46	11.2	4.0	13.0	36.5	118.0		
				135.6		192.2		262.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
26.9	16.75	8.0	
65.0	76.5	47.0	
8.1	6.75	45.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 77.

DATE Jan. 25, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

NOTES:

1000 gr. ground with 2#/ton of $CuSO_4$ and 25 drops of oil.

Start -- 9.07
finish -- 9.37

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.40	Charge							
9.50						1st. Conc.	219	215
10.20	Complete					2nd. Conc.	220	395.
						Tails	221	394
								1004

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
10	1st. C.	21.4	26.45	56.8	20.4	43.3	24.95	55.6		
30	2nd. C.	39.3	14.7	58.0	26.6	105.0	26.2	103.0		
30	Tails	39.3	3.45	13.6	14.3	56.3	34.9	138.0		
				128.4		205.1		294.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
44.2	21.4	18.2	
45.2	51.1	35.0	
10.6	27.5	46.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 78.

NOTES:

1000 grams ground with 25 drops ofoil for 30 min.
start --9.40
finish --10.00

DATE Jan. 25, 1923.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.25	Charge							
10.26	$CuSO_4$		20					
10.35	------					1st. Conc.	222	322
1005	Complete					2nd. Conc.	223	365
						Tails	224	314
								1001

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton
Sp #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
10	1st. C.	32.2	26.2	84.3	16.5	53.2	26.5	85.3		
30	2nd. C.	36.4	12.4	45.3	31.4	115.0	26.0	95.0		
30	Tails	31.4	2.36	7.4	11.5	36.1	37.2	117.0		
				137.0		204.3		297.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
61.3	26.0	28.7	
33.3	56.3	31.9	
5.4	17.7	39.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 79.

NOTES:

500 gr. ground 20 min. start -- 10.30
finish -- 10.50

DATE Jan. 25, 1923.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.05	Charge							
11.06	KCr_2O_7		10					
11.10	B#4	10						
11.20	"	5				Very little froth.		
11.30	"	5				1st. Conc.	225	40
11.40	"	5						
11.45	Complete					2nd. Conc.	226	92
						Tails.	227	370
								502

REAGENT	%	LBS. P.T.
KCr_2O_7		2#/ton
B #4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	7.96	17.0	6.8	39.4	15.76	15.8	6.32		
40	2nd. C.	20.4	14.3	13.2	21.9	20.4	32.1	29.5		
40	Tails	71.64	9.45	35.0	13.5	50.0	36.9	136.00		
				55.0		85.86		171.82		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
12.4	18.3	3.68
24.0	23.4	17.2
63.6	58.3	80.92

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 80.

NOTES:

500 gr. ground for 20 min. Start -- 11.10
finish -- 11.30

DATE Jan. 25, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.00	Charge							
12.01	Na_2HPO_4		10					
12.05	Oil	10						
12.15	"	5				Good lead froth	228	59
12.25	"	5						
12.35	"	5						
12.45	Complete					2nd. Conc.	229	153
						Tails.	230	292
								504

REAGENT	%	LBS. P.T.
Na_2HPO_4		2#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	11.7	40.6	24.0	3.8	14.0	8.3	4.9		
45	2nd. Conc	30.4	17.9	27.4	33.4	33.4	51.1	16.4	25.1	
45	Tails	57.9	3.96	11.6	13.8	40.3	43.4	127.0		
				63.0		105.4		157.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
38.1	13.3	3.13	
43.5	48.5	16.00	
18.4	38.2	80.88	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	81.
DATE	Jan. 25, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

1000 gr. ground with Na_2PO_4 for 30 min.

Start -- 1.30

finish -- 2.00

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.10	Charge							
2.15	Oil	10						
2.25	"	5				1st. Conc.	231	186
2.35	"	5						
2.45	"	5						
2.55	Complete					2nd. Conc	232	262
						Tails.	233	552
								1000

REAGENT	%	LBS. P.T.
Na_2HPO_4		2#/ton
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	18.6	42.8	79.5	21.9	40.8	11.6	21.6		
45	2nd. C.	26.2	13.2	34.6	35.0	91.8	20.3	53.1		
45	Tails.	55.2	2.36	13.0	17.0	94.0	38.0	210.0		
				127.1		226.6		284.7		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
62.5	18.0	7.2	
27.2	40.6	22.8	
10.3	41.4	70.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 82.

NOTES:

1000 gr. ground with Na_2S for 30 min. start -- 2.25

finish -- 2.55

DATE Jan. 25. 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.56	Charge							
3.01	Oil	10						
3.11	"	5				1st. Conc.	234	145
3.21	"	5						
3.31	"	5						
3.41	Complete					2nd. Conc.	235	270
						Tails	236	587
								1002

REAGENT	%	LBS. P.T.
Na_2S		2#/ton
Sp. #3		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	14.48	~~48.3~~ 49.5	70.0	19.8	28.7	20.7	30.0		
45	2nd. C.	26.98	14.9	40.2	33.6	90.6	16.5	44.5		
45	Tails.	58.54	2.76	16.2	15.0	88.2	37.5	220.0		
				126.4		207.5		294.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
55.5	13.7	10.2	
31.9	43.7	14.4	
12.6	42.6	75.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	83.
DATE	Jan. 31, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground for 20 min. start -- 9.20
finish -- 9.40

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.45	Charge							
9.50	Oil	10						
10.00	"	5						
10.10	"	5				1st. Conc.	237	154
10.20	"	5						
10125	Complete					2nd. Conc.	238	111
						Tails.	239	234
								499

REAGENT	%	LBS. P.T.
Xylidin.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	15.4	30.9	47.6	25.9	39.9	12.1	18.6		
40	2nd. C.	11.1	8.16	9.05	34.4	38.2	20.6	22.9		
40	Tails.	47.0	1.67	3.91	10.5	20.6	42.6	97.4		
				60.56		98.7		138.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
78.6	40.5	13.4	
14.9	38.7	16.5	
6.5	20.8	70.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 84.

NOTES:

500 gr. ground 20 min. start -- 9.47
finish --10.07
Agitated for 30 min. with NaCl.
start --10.25
finish --10.55

DATE Jan. 31 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.20	Charge							
11.25	Oil	10						
11.35	"	5				1st. Conc.	240	77
11.45	"	5				2nd. Conc.	241	73
11.55	"	5						
12.00	Complete					3rd. Conc.	242	101
						Tails.	243	240
								491

REAGENT	%	LBS. P.T.
NaCl.		8#/ton
Xylidin		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT .
15	1st. C.	25.7	44.8	34.5	20.1	15.5	9.7	7.5		
25	2nd. C.	14.8	19.1	14.0	35.2	25.8	13.9	10.1		
40	3rd. C.	20.6	7.18	7.2	35.2	35.6	21.2	21.4		
40	Tails.	48.9	1.97	4.7	8.66	20.8	45.0	108.0		
				60.4		97.7		147.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
57.1	15.9	5.1	
28.2	26.4	6.8	
11.9	36.4	14.6	
7.8	21.3	73.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 85.

NOTES:

500 gr. ground 20 min. start -- 10.18
finish -- 10.38

DATE Jan. 31, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.40	Charge							
10.42	Na_2CO_3		10					
10.45	Oil	10						
10.55	"	5				1st. Conc.	244	89
11.05	"	5				2nd. Conc.	245	57
11.15	"	5						
11.20	Complete					3rd. Conc.	246	102
						Tails.	247	255
								503

REAGENT	%	LBS. P.T.
Na_2CO_3		4#/ton
Xylidin		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	17.7	44.5	39.6	21.4	19.0	9.2	8.2		
25	2nd. C.	11.3	16.9	9.62	35.8	20.4	14.7	8.48		
40	3rd. C.	20.3	7.5	7.65	36.6	37.4	20.9	21.3		
40	Tails.	50.7	2.06	5.26	10.7	37.3	43.3	111.0		
				62.13		114.1		148.98		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
63.8	16.7	5.5	
15.5	18.1	5.7	
12.2	32.7	14.3	
8.5	32.5	74.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	86.
DATE	Jan. 31 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground for 20 min. start -- 10.45
finish -- 11.05

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.00	Charge							
12.01	Na_2HPO_4		10					
12.05	Oil	10						
12.15	"	5				1st. Conc.	248	49
12.25	"	5				2nd. Conc.	249	74
12.35	"	5						
12.40	Complete					3rd. Conc.	250	90
						Tails.	251	285
								498

REAGENT	%	LBS. P.T.
Na_2HPO_4		2#/ton.
Xylidin.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	9.83	42.5	20.8	21.9	10.7	8.5	4.16		
25	2nd. C.	14.88	26.9	19.9	31.1	23.0	11.4	8.44		
40	3rd. C.	18.09	10.8	9.73	35.2	31.7	19.8	17.8		
40	Tails.	57.2	3.64	1014	13.4	38.2	44.9	128.0		
				60.83		103.6		158.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
34.2	10.3	2.62	
32.8	22.2	5.33	
15.9	30.6	11.2	
17.1	36.9	80.85	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 87.

NOTES:

To determine the effect of ammonium chloride.

500 gr. ground 20 min. start -- 9.45

finish --10.05

DATE Jan.31, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.15	Charge							
10.16	NH_4Cl		10					
10.20	Oil	10						
10.30	"	5				1st. Conc.	252	65
10.40	"	5						
10.50	"	5						
10.55	Complete					2nd. Conc.	253	142
						Tails.	254	289
								496

REAGENT	%	LBS. P.T.
NH_4Cl		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	13.1	46.5	30.2	21.8	14.2	10.7	6.95		
40	2nd. C.	28.6	16.2	23.0	35.4	50.2	20.7	29.4		
40	Tails.	58.3	2.26	6.53	14.7	42.5	56.9	164.0		
				59.73		106.9		200.35		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
48.0	13.3	3.47	
36.6	47.0	14.7	
15.4	39.7	81.83	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 88.

NOTES:

500 gr. ground for 20 min. start -- 10.15

finish -- 10.35

DATE Feb. 12, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.00	Charge							
11.01	NH_4Cl							
11.05	Oil	10						
11.15	"	5				1st. Conc.	255	108
11.25	"	5						
11.35	"	5						
11.40	Complete					2nd. Conc.	256	170
						Tails.	257	222

REAGENT	%	LBS. P.T.
NH_4Cl		2#/ton
Xylidin.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15.	1st. C.	21.6	39.8	43.0	24.8	26.8	12.8	13.8		
40	2nd. C.	34.0	10.3	17.5	35.9	61.0	20.4	34.7		
40	Tails	44.4	1.69	3.75	6.7	14.9	53.1	118.0		
				64.25		102.7		166.5		

PERCENT OF TOTAL

Pb.	ZN.	Fe.	
67.0	26.1	8.3	
27.3	59.4	20.9	
5.7	14.5	70.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 89.

NOTES:

500 gr. ground 20 min. start -- 10.40
finish -- 11.00

DATE Feb. 12, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.40	Charge							
11.41	NH_4Cl		20					
11.45	Oil	10						
11.55	"	5				1st. Conc.	258	105
12.05	"	5						
12.15	"	5						
12.20	Complete					2nd. Conc.	259	166
						Tails.	260	229
								500

REAGENT	%	LBS. P.T.
NH_4Cl		4#/ton
Xylidin.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	21.0	39.4	41.4	23.8	25.0	11.1	11.7		
40	2nd. C.	33.3	9.25	15.4	38.3	63.6	21.5	35.7		
40	Tails.	45.7	1.28	2.93	7.75	17.7	49.9	114.0		
				59.73		106.3		161.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe	
69.5	23.5	7.25	
25.8	60.0	22.15	
4.7	16.5	70.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	90.
DATE	Feb. 12, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground for 20 min. Start -- 2.40
finish -- 3.00

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.05	Charge							
3.06	NH_4Cl		10					
3.10	Oil	10						
3.20	"	5				1st. Conc.	261	58
3.30	"	5						
3.40	"	5						
3.45	Complete					2nd. Conc.	262	101.
						Tails.	263	337
								496

REAGENT	%	LBS. P.T.
NH_4Cl		2#/ton.
B#4.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	11.7	45.7	26.6	21.7	12.6	10.2	5.92		
40	2nd. C.	20.4	21.6	21.8	35.1	35.4	14.9	15.0		
40	Tails.	67.9	3.74	12.6	15.9	53.5	39.5	133.0		
				61.0		101.5		153.92		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
43.6	12.4	3.75	
35.8	34.9	9.75	
20.6	52.7	86.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 91.

NOTES:

1000 gr. ground with NH_4Cl in the mill for 30 min.
Start -- 3.30
Finish -- 4.00

DATE Feb. 12, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.05	Charge							
4.10	Oil	10						
4.20	"	5				1st. Conc.	264	125
4.30	"	5						
4.40	"	5						
4.45	Complete					2nd. Conc.	265	280
						Tails.	266	595
								1000

REAGENT	%	LBS. P.T.
NH_4Cl		2#/ton.
Xylidin		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	12.5	48.0	60.0	~~21.8~~	27.3	11.1	13.9		
40	2nd. C.	28.0	15.2	42.6	36.8	103.0	18.4	51.5		
40	Tails	59.5	3.24	18.6	12.2	72.5	51.7	308.0		
				121.2		202.8		373.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
49.5	13.4	3.73	
35.2	50.9	13.67	
15.3	35.7	82.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 92.

NOTES:

1000 gr. ground 25 min. start -- 9.50
finish --10.15
~~Tails~~ to be retreated in test 93.
Tails " " " " " 94.

DATE Feb. 18, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.25	Charge							
10.26	$CuSO_4$		20					
10.30	Oil	10						
10.40	"	5						
10.50	"	5						
10.60	"	5						
11.05	Complete					Conc. to 93.		609
						Tails. to 94.		377
								986

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
40	Conc.	61.7	20.0	122.9	31.6	192.6	25.2	154.6		
40	Tails.	38.3	0.55	2.47	3.88	14.64	54.4	205.0		
				124.37		207.24		359.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
98.02	93.0	43.0	
1.98	7.0	57.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 93.

NOTES:

Retreat concentrates from 92.

Ground 10 min. start -- 11.20

finish -- 11.30

DATE Feb. 18, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.30	Charge							
12.10	Complete					Conc.	267	376
						Tails.	268	233
								609

REAGENT	%	LBS. P.T.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
40	Conc.	38.2	23.7	89.0	38.8	146.0	14.5	54.5		
40	Tails.	23.6	14.1	32.9	20.0	46.6	43.0	100.1		
				121.9		192.6		154.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
71.5	70.5	15.2	
26.5	22.5	27.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 98.

NOTES:

Retreat tails from test 91.

DATE Feb. 18, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.25	Charge							
12.26	KCr_2O_7							
12.30	Oil	10						
12.40	"	5				1st. Conc.	269	30
12.55	Complete					2nd. Conc.	270	20
						Tails.	271	327
								377

REAGENT	%	LBS. P.T.
KCr_2O_7		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	3.03	3.98	1.19	15.6	4.68	45.6	13.7		
40	2nd. C.	2.04	3.30	0.66	12.3	2.46	51.4	10.3		
40	Tails.	33.13	0.19	0.62	2.3	7.5	55.3	181.0		
				2.47		14.64		205.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
0.95	2.32	3.82	
0.53	1.19	2.78	
0.50	3.49	50.40	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	95 A.
DATE	Feb. 19, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

Calculated from the following tests.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT

REAGENT	%	LBS. P.T.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
Lead	conc.	20.8	43.5	89.1	21.7	10.3	10.3	21.1		
Zinc	conc.	37.9	8.48	31.8	41.4	155.1	19.97	74.8		
Tails.		41.3	0.29	1.18	3.3	13.4	52.1	211.9		
				122.08		213.0		307.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
73.0	20.9	6.86	
26.1	72.81	24.34	
0.9	6.29	68.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 95.

NOTES:

1000 gr. ground for 25 min. start -- 2.25
finish -- 2.50

DATE Feb. 19, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.55	Charge							
2.56	Na_2S		20					
3.00	Oil	5						
3.10	"	5						
3.20	Complete					Conc.	272	205
						Tails.to 96	~~273~~	781
								986

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	% Insol.	WEIGHT
25	conc.	20.8	43.5	89.1	21.7	44.5	10.3	21.1	1.8	3.7
25	Tails.	79.2	4.2	32.98	21.6	168.5	36.6	286.7	~~3.5~~	
				122.08		213.0		307.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	Insol.
73.0	20.9	6.86	4.9
27.0	79.1	93.14	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 96.

NOTES:

Retreat tails from test 95.

DATE Feb. 19, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.30	Charge							
3.31	$CuSO_4$							
3.35	Oil	10						
3.45	"	5				1st. Conc.	273	242
3.55	"	5						
4.00	Complete					2nd. Conc.	274	133
						Tails.	275	406
								781

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	% Insol.	WEIGHT
15	1st. C.	24.4	10.4	25.2	44.0	106.5	18.5	44.7	3.5	8.5
30	2nd. C.	13.5	4.95	6.6	36.6	48.6	22.6	30.1	9.8	13.0
30	Tails	41.3	0.29	1.18	3.3	13.4	52.1	211.9	12.4	50.3
				32.98		168.5		286.7		71.8

PERCENT OF TOTAL

Pb.	Zn.	Fe	Insol.
20.7	50.0	14.5	11.4
5.4	22.81	9.84	17.2
0.9	6.29	68.8	66.5
27.0	79.1	93.14	95.1

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 97.

NOTES:

To determine the efficiency of reagents on their second passage through the machine. For this purpose the filtrate from the tails of test 91 was used.
1000 gr. ground 25 min. start -- 3.30
finish -- 3.55

DATE Feb. 19, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.10	Charge							
4.15	Oil	10						
4.25	"	5				1st. conc.	276	341
4.35	"	5						
4.45	"	5						
4.50	Complete					2nd. conc.	277	301
						Tails	278	360
								1002

REAGENT	%	LBS. P.T.
$CuSO_4$		
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	34.0	29.1	99.2	24.0	81.9	18.0	61.4		
40	2nd. C.	30.0	5.5	16.5	30.2	91.0	30.2	91.0		
40	Tails.	36.0	0.29	1.04	11.2	40.3	43.0	155.0		
				116.74		213.2		307.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
85.0	38.4	20.0	
14.2	42.7	29.4	
0.8	18.9	50.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 98.

NOTES:

500 gr. ground for 20 min. start -- 3.15
finish -- 3.35

DATE Feb. 22, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
'								
3.50	Charge							
3.51	Na_2SiO_3		20					
3.55	Oil	10						
4.05	"	5				1st. Conc.	279	62
4.15	"	5						
4.25	"	5						
4.30	Complete					2nd. Conc.	280	109
						Tails.	281	332
								503

REAGENT	%	LBS. P.T.
Na_2SiO_3		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	12.4	40.6	25.2	21.4	13.3	10.2	6.33		
40	2nd. C.	21.6	19.6	21.4	29.8	32.5	16.9	18.4		
40	Tails.	66.0	4.55	15.1	12.2	40.5	37.9	125.9		
				61.7		86.3		150.63		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
40.8	15.4	4.2	
34.7	37.7	12.2	
24.5	46.9	83.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 99.

NOTES:

500 gr ground with Na_2SiO_3 for 20 min. start -- 3.45
finish -- 4.05

DATE Feb. 22, 1923.
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.30	Charge							
4.35	Oil	10						
4.45	"	5				1st. Conc.	282	72
4.55	"	5				Pb. froth		
5.05	"	5				contiued .		
5.10	Complete					2nd. Conc.	283	117
						Tails.	284	307
								496

REAGENT	%	LBS. P.T.
Na_2SiO_3		2#/ton.
FPL.#24		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	14.4	44.1	40.6	20.3	18.7	8.8	8.1		
40	2nd. C.	23.6	17.5	20.5	36.3	42.4	15.7	18.4		
40	Tails.	62.0	2.62	8.4	13.9	42.7	48.7	149.5		
				69.5		103.8		176.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
58.4	18.0	4.6	
29.5	40.8	10.4	
12.1	41.2	85.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 100.

NOTES:

To determine the effect of adding the oil to the machine before theore.

500 gr. ground for 20 min. start -- 4.35

finish -- 4.55

DATE Feb. 22, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
5.15	Oil	25						
5.15	Charge							
5.16	"							
5.30						1st. Conc.	285	134
5.55	Complete					2nd. Conc.	286	72
						Tails.	287	296
								502

REAGENT	%	LBS. P.T.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	26.7	32.4	43.4	22.2	29.7	13.6	18.2		
40	2nd. C.	14.3	12.9	9.3	33.1	23.8	15.4	11.1		
40	Tails.	59.0	1.16	3.4	14.5	43.0	40.5	120.0		
				56.1		96.5		149.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
77.5	30.8	12.3	
15.9	24.7	7.4	
6.6	44.5	80.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 101.

NOTES:

To make a comparison between the 8-cell and the single-cell machine. Sample taken from the Pachuca tank after agitating with $CuSO_4$.

DATE Mar. 13, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
9.55	Charge							
10.00	Oil	10						
10.10	"	5				1st. Conc.	288	108
10.20	"	5						
10.30	"	5						
10.35	Complete					2nd Conc.	289	245
						Tails.	290	476
								829

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
B#4.		
B#4.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	13.02	12.9	13.9	34.6	37.4	20.0	21.6		
40	2nd. C.	29.55	13.5	33.1	31.2	76.4	21.4	52.4		
40	Tails.	57.43	11.75	55.9	10.7	50.9	36.7	175.0		
				102.9		164.7		249.0		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
13.6	22.7	7.6	
32.3	46.4	28.4	
54.1	30.9	64.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 102.

NOTES:

As in 101, but sample taken from Pachuca before agitation.
Agitated on shaking screen for 50 min. with $CuSO_4$.

DATE Mar. 13 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.00	Charge							
11.05	Oil	10						
11.15	"	5						
11.25	"	5						
11.35	"	5						
11.40	Complete					lst. Conc.	291	275
						Tails.	292	486
								761

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
40	lst. C.	36.3	12.8	35.2	26.0	71.5	26.7	73.4		
40	Tails	63.6	13.15	59.0	16.4	79.7	26.8	130.2		
				94.2		151.2		203.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
37.4	47.3	36.1	
62.6	52.7	63.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	103.
DATE	Mar. 13, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground for 20 min. with acid. start -- 11.20
finish -- 11.40

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.50	Charge							
11.55	Oil	5				very little froth		
12.05	"	5				Better froth.		
12.15	"	5				1st. Conc.	293	221
12.25	"	5						
12.30	Complete					2nd. Conc.	294	160
						Tails.	295	115
								496

REAGENT	%	LBS. P.T.
H_2SO_4		4#/ton.
Eucalyptus		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	44.5	17.7	39.1	22.9	50.6	25.9	57.3		
35	2nd. C.	32.3	10.4	16.65	21.1	33.8	29.7	47.5		
35	Tails.	23.2	3.88	4.45	13.6	15.6	29.6	34.0		
				60.2		100.0		138.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
65.0	50.6	41.3	
27.7	33.8	34.9	
7.3	15.6	23.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 104.

NOTES:

500 gr. ground for 20 min. start -- 1.50
finish -- 2.10

DATE Mar. 17, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.15	Charge							
2.20	oil	5						
2.30	"	5				1st. Conc.	296	47
2.40	"	5				Pb. still appears.		
2.50	"	5						
2.55	Complete					2nd. Conc.	297	178
						Tails.	298	273
								498

REAGENT	%	LBS. P.T.
Cresol.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	9.4	42.2	19.85	18.4	8.65	11.6	5.45		
40	2nd. C.	35.8	18.9	33.6	32.9	58.6	17.0	30.3		
40	Tails.	54.8	2.46	6.23	14.1	38.6	38.9	106.2		
				59.68		105.85		141.95		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
33.2	8.2	3.8	
56.3	55.4	21.4	
10.5	36.4	74.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 105.

NOTES:

500 gr. ground 20 min. start -- 2.13
finish -- 2.33

DATE Mar. 17, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.00	Charge							
3.05	Oil	10						
3.15	"	5				1st. Conc.	299	83
3.25	"	5						
3.35	"	5						
3.40	Complete					2nd. Conc.	300	141
						Tails.	301	278
								502

REAGENT	%	LBS. P.T.
Cresol	5%	
FPL#24	95%	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	16.5	38.8	32.2	23.7	19.7	9.5	7.9		
40	2nd. C	28.1	14.7	20.9	36.8	51.8	17.0	23.0		
40	Tails.	55.4	2.84	7.9	13.3	37.0	40.0	111.0		
				61.0		108.5		141.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
52.7	18.3	5.6	
34.3	47.7	16.2	
13.0	34.1	78.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 106.

NOTES:

500 gr. ground for 20 min. start --2.50
finish --3.10

DATE Mar. 17, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.45	Charge							
3.50	Oil	10				Froth too great		
3.60	"	5				1st. Conc.	302	329
4.10	Discontinued					2nd. Conc.	303	76
						Tails.	304	98
								503

REAGENT	%	LBS. P.T.
Oil of Tar	50	
FPL #24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	65.4	15.1	49.7	23.7	78.0	25.1	82.6		
25	2nd. C.	15.1	6.72	5.1	18.5	14.1	36.7	27.9		
25	Tails	19.5	4.36	4.3	11.2	11.0	37.0	36.3		
				59.1		103.1		146.8		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
84.0	75.6	56.3	
8.6	13.7	19.0	
7.4	10.7	24.7	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 107.

NOTES:

500 gr. ground 20 min. Start -- 3.20
finish -- 3.40

DATE Mar. 17 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.15	Charge							
	Na_2S		20					
4.20	Oil	5				Too much froth		
4.30	"	2				1st. Conc.	305	168
4.40	"	2						
4.50	"	2						
4.55	Complete					2nd. Conc.	306	122
						Tails.	307	209
								499

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
Eucalyptus		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe	WEIGHT	%	WEIGHT
15	1st. C.	33.5	21.9	36.8	27.1	45.5	19.0	31.9		
40	2nd. Conc	24.3	12.5	15.3	30.9	37.7	22.7	27.7		
40	Tails.	41.2	3.13	6.5	11.7	24.5	39.7	83.0		
				58.6		107.7		142.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
62.8	42.3	22.4	
26.1	35.0	19.4	
11.1	22.7	58.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 108.

DATE Mar. 19, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

NOTES:

To determine the effect of agitating with and without air.
In this test 500 gr. ground for 20 min. and agitated in the sub-aeration machine, 2½ # air, for 40 min. with $CuSO_4$.
Start -- 10.05
finsh -- 10.45

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.50	Charge							
10.55	Oil	10						
11.05	"	5				1st. Conc.	308	157
11.15	"	5						
11.25	"	5						
11.30	Complete					2nd. Conc.	309	1315
						Tails.	310	206
								494

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	31.8	22.7	35.6	34.0	53.4	10.7	16.8		
40	2nd. C.	26.5	14.2	18.6	30.5	39.9	22.9	30.0		
40	Tails.	41.7	1.99	4.1	6.0	12.4	46.0	94.6		
				58.3		105.7		141.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
61.1	50.5	11.9	
31.9	37.8	21.2	
7.0	11.7	66.9	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 109.

NOTES:

To accompany test 108.
500 gr. ground for 20,min. and agitated on shaking screen for40 min. Start --10.43
finish --11.23 2:1 pulp ineach case.

DATE Mar. 19, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.30	Charge							
11.35	Oil	10						
11.45	"	5				1st. Conc.	311	153
11.55	"	5						
12.05	"	5						
12.10	Complete					2nd. Conc.	312	142
						Tails.	313	205
								500

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp.#3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	30.6	24.6	37.7	32.6	49.9	12.0	18.4		
40	2nd. C.	28.4	12.1	17.2	33.3	47.3	20.4	29.0		
40	Tails	41.0	2.18	4.5	5.4	11.1	44.4	91.0		
				59.4		108.3		138.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
63.5	46.1	13.3	
29.0	43.6	20.9	
7.5	10.3	65.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	110.
DATE	Mar.19. 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground 20 min. and agitated with $CuSO_4$ in the Sub-aeration machine for 40 min. The oil was added during the test one drop at a time.

Grinding start--- 10.45 agitating -- 11.30

finish -- 11.05 -- 12.10

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.15	Charge	to						
12.20	Commenced	and	the Oil					
12.30		(10)				1st. Conc.	314	45
12.55	Complete	(25)				2nd. Conc.	315	230
						Tails.	316	231
								506

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	8.8	28.9	13.0	30.7	13.8	9.7	4.4		
40	2nd. C.	45.5	17.5	40.2	34.5	79.3	13.7	31.5		
40	Tails.	45.7	2.0	4.6	5.7	13.2	45.7	105.5		
				57.8		106.3		141.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
22.5	12.9	3.1	
69.5	74.5	22.3	
8.0	12.6	74.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 111.

NOTES:

500 gr. ground 20 min. start -- 3.45
finish -- 4.05

DATE Mar. 20, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.10	Charge							
4.15	Oil	10						
4.25	"	5				1st. Conc.	317	25
4.35	"	5				Light froth.		
4.45	"	5						
4.50	Complete					2nd. Conc.	318	49
						Tails.	319	422
								496

REAGENT	%	LBS. P.T.
Water gas-tar.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	5.1	53.2	13.3	6.0	1.5	9.6	1.9		
40	2nd. C.	9.9	41.1	20.2	21.5	10.5	9.2	4.5		
40	Tails.	85.0	5.77	24.4	21.1	89.1	31.8	134.0		
				57.9		101.1		140.4		

PERCENT OF TOTAL

Pb.	Zn.	Fe.
23.0	1.47	1.35
34.9	10.39	3.20
42.1	88.14	95.45

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 112.

NOTES:

500 gr. ground for 20 min. start -- 2.29
finish -- 2.49

Water gas tar tends to form a skin over the spitz-kasten.

DATE Mar. 22, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge							
2.55	Oil	10						
3.05	"	5				1st. Conc.	320	53
3.15	"	5						
3.25	"	5						
3.30	Complete					2nd. Conc.	321	80
						Tails.	322	365
								498

REAGENT	%	LBS. P.T.
W.G.T.	50	
FPL.#24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	10.6	53.0	28.1	17.0	9.0	7.4	3.9		
40	2nd. C.	16.1	23.3	18.7	34.3	27.4	13.7	11.0		
40	Tails.	73.3	3.4	12.4	19.5	71.2	39.4	144.0		
				59.2		107.6		158.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
47.5	8.4	2.6	
31.6	25.4	6.9	
20.9	66.2	90.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 113.

NOTES:

500 gr. ground with Na_2CO_3 for 20 min. start -- 3.00
finish -- 3.20

DATE Mar. 19, 1923.

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.30	Charge							
3.35	Oil	5						
3.45	"	5				1st. Conc.	323	60
3.55	"	5				2nd. Conc.	324	48
4.05	"	5						
4.10	Complete					3rd. Conc.	325	54
						Tails.	326	335
								497

REAGENT	%	LBS. P.T.
Na_2CO_3		8#/ton.
W.G.T.	50	
FPL #24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	12.0	53.1	31.8	17.5	10.5	7.3	4.4		
25	2nd. C.	9.7	28.8	13.8	31.5	15.1	12.3	5.9		
40	3rd. C.	10.9	13.3	7.2	39.9	21.6	15.3	8.3		
40	Tails.	67.4	1.58	5.3	19.0	63.6	38.2	128.0		
				58.1		110.8		146.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
54.8	9.4	3.0	
22.9	13.6	4.0	
13.2	19.5	5.7	
9.1	57.5	87.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 114.

NOTES:

500 gr. ground with Na_2S for 20 min. start -- 3.45
finish -- 4.05

DATE Mar. 22, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.10	Charge							
4.15	Oil	10						
4.25	"	5				1st. Conc.	327	27
4.35	"	5				2nd. Conc.	328	39
4.45	"	5						
4.50	Complete					3rd. Conc.	329	66
						Tails.	330	369.
								501

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
W.G.T.	50	
FPL.#24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	5.4	56.8	15.3	14.4	3.9	7.6	2.05		
25	2nd. C.	7.8	43.2	16.9	22.5	8.8	10.5	4.1		
40	3rd. C.	13.2	19.6	13.0	35.0	23.1	14.3	9.45		
40	Tails.	73.6	3.96	14.6	18.8	69.4	36.0	133.0		
				59.8		105.2		148.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
25.6	3.7	1.4	
28.3	8.3	2.8	
21.7	21.9	6.4	
24.4	66.1	89.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	115.
DATE	Mar. 26, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground 20 min. with Na_2SiO_3 start -- 9.32
finish -- 9.52

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.00	Charge							
10.05	Oil	10						
10.15	"	5						
10.25	H_2SO_4		10			1st. Conc.	231	30
10.30	Oil	5				2nd. Conc.	232	37
10.40	"	5						
10.50	"	5						
11.00	Complete					3rd. Conc.	233	63
						Tails.	234	356
								486

REAGENT	%	LBS. P.T.
Na_2SiO_3		15#/ton
Sp. #3.		
H_2SO_4		4#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
25	1st. C.	6.2	27.8	8.3	28.3	8.5	7.6	2.3		
30	2nd. C.	7.6	29.4	10.9	28.5	10.5	14.3	5.3		
60	3rd. C.	13.0	21.0	13.3	30.7	19.3	20.7	13.0		
60	Tails.	73.2	9.3	33.1	18.0	65.0	34.8	124.0		
				65.6		102.3		144.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
13.3	8.3	1.6	
16.5	10.3	3.8	
20.1	18.8	8.8	
50.1	63.6	85.8	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 116.

NOTES:

500 gr. ground for 20 min. with Na_2CO_3 start -- 10.30
finish -- 10.50

DATE Mar. 26. 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.00	Charge							
11.05	Oil	3						
11.07	"	3					Total	504
2 drops every three min.								
11.19	Oil	(14)				1st. Conc.	335	85
11.22	"	2						
11.25	$CuSO_4$		10			2nd. Conc.	336	34
11.30	Oil	3						
11.32	"	3						
11.40	------					3rd. Conc.	337	119
11.45	"	2						
11.50	"	2						
11.55	Complete					4th. Conc.	338	43
						Tails.	339	223

REAGENT	%	LBS. P.T.
Na_2CO_3		8#/ton.
T.G.T.	50	
FPL. 124	50	
$CuSO_4$		2#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	% Insol.	WEIGHT
19	1st.C.	16.9	47.8	41.5	15.8	13.5	8.4	7.1	3.6	3.06
25	2nd. Conc	6.7	27.4	9.3	19.1	6.5	12.5	4.2	6.2	2.11
40	3rd.C.	23.6	8.5	10.1	35.8	42.6	13.8	16.4	7.1	8.45
55	4th.C.	8.5	5.5	2.4	43.7	18.8	18.9	8.1	11.7	5.04
55	Tails.	44.3	1.2	2.7	5.3	11.6	47.5	106.0	6.0	13.4
				66.0		92.9		141.8		32.06

PERCENT OF TOTAL

Pb.	Zn.	Fe.	Insol.
63.0	14.4	5.0	9.3
14.0	7.0	3.0	6.7
15.3	45.8	11.6	26.4
3.6	20.3	5.7	15.7
4.1	12.5	74.7	41.9

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	117 A.
DATE	Mar. 26, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

A summary of the following retreatment tests.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT

REAGENT	%	LBS. P.T.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
	Conc.	10.9	45.7	24.7	22.1	11.9	6.0	3.2		
	"	3.4	27.8	4.7	17.1	2.9	28.6	4.9		
	"	7.0	23.2	8.1	37.8	13.2	11.4	4.0		
	"	15.5	13.9	10.7	35.0	27.0	19.6	15.1		
	"	9.5	7.1	3.3	39.1	18.4	15.3	8.6		
	"	12.9	4.9	3.1	18.0	11.5	40.7	26.0		
	Tails	40.8	2.1	4.1	11.7	23.8	42.2	85.7		
				58.7		108.7		147.5		

PERCENT OF TOTAL			
Pb.	Zn.	Fe.	
42.0	11.0	2.2	
8.0	2.6	3.3	
13.9	12.1	2.7	
18.2	24.8	10.2	
5.6	17.0	5.7	
5.3	10.6	17.6	
7.0	21.9	58.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 117.

NOTES:

500 gr. ground for 20 min. and agitated with NaCl & NaOH for 30 min. start -- 3.25 finish -- 3.44

DATE Mar. 26, 1923

ORE NO. 177

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
3.55	Charge							
4.00	Oil	5						
4.05	"	5						
4.10	Xylidin	3				1st. Conc.	to 118	
4.15	"	3						
4.25	-----					2nd. Conc.	to 119	
4.26	Pine	1						
4.36	Complete					3rd. Conc.	to 120	
						Tails.	347	203

REAGENT	%	LBS. P.T.
NaCl		10#/ton
NaOH		4#/ton.
W.G.T.	50	
FPL. #24	50	
Xylidin		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	14.3	41.4	29.4	22.1	11.9	6.0	3.2		
30	2nd. C.	22.5	16.8	18.8	35.8	40.2	17.0	19.1		
41	3rd. C.	22.3	5.8	6.4	26.9	29.9	31.2	34.6		
41	Tails	40.9	2.0	4.1	11.7	23.8	42.2	85.7		
				58.7		108.7		147.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
50.0	13.6	5.5	
32.1	36.9	12.9	
10.9	27.6	23.3	
7.0	21.9	58.3	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 118.

NOTES:

Heads from test 117 retreated in the sub-aeration machine.

DATE Mar. 26, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.20	Charge							
4.30	Complete					Conc.	340	54
						Tails.	341	17

REAGENT	%	LBS. P.T.
Na_2CO_3		8#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
10	Conc.	76.0	45.7	24.7	22.1	11.9	6.0	3.2		
10	Tails.	24.0	27.8	4.7	17.1	2.9	28.6	4.9		
				29.4		14.8		8.1		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
84.0	80.4	39.5	
16.0	19.6	60.5	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	119.
DATE	Mar. 26, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

Retreating 2nd concentrate fom test 117.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.45	Charge							
4.46	Na_2S							
4.50	Oil	10				No lead froth.		
4.55	"	10						
5.00	"	5						
5.05	Complete					Conc.	342	35
						Tails.	343	77

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
W.G.T.	50	
FPL.#24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
20	Conc.	31.2	23.2	8.1	37.8	13.2	11.4	4.0		
20	Tails	68.8	13.9	10.7	35.0	27.0	19.6	15.1		
				18.8		40.2		19.1		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
43.1	32.8	20.9	
56.9	67.2	79.1	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 120.

NOTES:

Retreating th 3rd concentrates from test 117.

DATE Mar. 26. 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
5.10	Charge							
5.15	Oil	10						
5.17	"	5						
5.25	"	5						
5.30	Complete					Conc.	344	47
						Tails.	345	64

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
Sp. #3.		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
20	Conc.	42.3	7.1	3.3	39.1	18.4	18.3	8.6		
20	Tails.	57.7	4.9	3.1	18.0	11.5	40.7	26.0		
				6.4		29.9		34.6		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
51.5	61.5	29.8	
48.5	38.5	70.2	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 121.

NOTES:

500 gr. ground for 20 min. with Na_2CO_3 start -- 2.30
finish -- 2.50

DATE April 5, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
2.50	Charge						Total	502
2.55	Oil	3						
2.57	"	3						
3.00	"	2						
3.03	"	2						
3.06	"	2						
3.10	"	2				1st. Conc.	348	92
3.14	$CuSO_4$					2nd. Conc.	349	22
3.19	Oil	3						
3.30	"	2						
3.35	"	2				3rd. Conc.	350	140
3.38	B#4	3				4th. Conc.	351	24
3.50	Complete						352	224

REAGENT	%	LBS. P.T.
Na_2CO_3		8#/ton.
W.G.T.	50	
FPL. #24	50	
$CuSO_4$		1#/ton

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	18.3	44.8	41.2	20.4	18.7	9.0	8.3		
24	2nd. C.	4.4	23.0	5.6	31.4	6.9	13.9	3.1		
48	3rd. C.	27.9	7.7	10.8	41.0	57.4	15.7	22.0		
60	4th. C.	4.8	4.9	1.2	36.6	8.8	19.6	4.7		
60	Tails.	44.6	0.6	1.3	5.0	11.2	48.4	108.4		
				60.1		103.0		146.5		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
68.3	18.1	5.7	
9.3	6.7	2.1	
18.0	55.7	1500	
2.2	8.5	3.2	
2.2	11.0	74.0	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	122.
DATE	April 5, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	1760.
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

Treating as in test 121 but with a higher impeller speed
1000 gr. ground 30 min. start -- 3.47
finish -- 3.17

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
4.25	Charge							
4.26	Na_2CO_3							
4.30	Oil	3						
4.34	"	3						
4.38	"	3						
4.39	$CuSO_4$					1st. Conc.	353	150
4.43	Oil	2						
4.47	"	2						
4.55	"	2						
5.00	"	2						
5.05	Complete					2nd. Conc.	354	335
						Tails	355	510
								995

REAGENT	%	LBS. P.T.
Na_2CO_3		8#/ton
W.G.T.	50	
FPL.#24	50	
$CuSO_4$		1#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	% Insol.	WEIGHT
13	1st. C.	15.3	50.6	75.9	17.3	25.8	7.8	11.7	3.7	4.05
40	2nd. C.	33.5	9.6	32.2	42.0	141.0	13.2	44.2	10.6	31.15
40	Tails.	51.2	1.8	9.2	7.7	39.3	44.8	228.1	7.2	36.7
				117.3		206.1		284.0		71.9

PERCENT OF TOTAL			
Pb.	Zn.	Fe.	Insol.
64.8	12.5	4.3	5.6
27.4	68.5	15.5	43.3
7.8	19.0	80.2	51.1

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 123.

NOTES:

To determine the effect of speed. Compare with test 112.
500 gr. ground for 20 min. start -- 4.31
finish -- 4.51

DATE April 5, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER 1801
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
5.10	Charge							
5.15	Oil	10						
5.25	"	5				1st. Conc.	356	85
5.35	"	5						
5.45	"	5						
5.50	Complete					2nd. Conc.	357	165
						Tails.	358	252
								502

REAGENT	%	LBS. P.T.
W.G.T.	50	
FPL.#24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	17.1	44.0	37.4	21.7	18.4	9.8	8.3		
40	2nd. C.	32.8	11.1	18.3	36.8	60.6	17.5	28.8		
40	Tails.	50.1	1.1	2.8	9.5	23.9	43.2	109.0		
				58.5		102.9		146.1		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
63.9	17.9	5.7	
31.3	59.0	19.7	
4.8	23.1	74.6	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	124.
DATE	April 11, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	1700.
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

To duplicate test 40 at a high speed.
500 gr. ground for 20 min. and agitated 20 min. with Na_2S.
Grinding start -- 9.25 Agitating 9.50
finish -- 9.40 10.10

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.10	Charge							
10.15	B#4	10						
10.25	"	5				1st. Conc.	359	84
10.35	"	5				2nd. Conc.	360	42
10.45	"	5						
10.50	Complete					3rd. Conc.	361	86
						Tails.	362	275
								487

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
B#4		

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. C.	17.2	47.9	40.3	16.8	14.1	9.7	8.1		
25	2nd. C.	8.6	25.2	10.6	32.8	13.8	15.1	6.3		
40	3rd. C.	17.6	12.7	10.9	37.3	32.1	18.3	15.7		
40	Tails.	56.6	0.6	1.6	15.2	41.8	39.6	109.0		
				63.4		101.8		139.1		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
63.2	13.8	5.8	
16.7	13.6	4.5	
17.2	31.5	11.3	
2.9	41.1	82.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	125.
DATE	April 11. 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	1700.
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

500 gr. ground for 20 min. with Na_2S start -- 10.00
finish -- 10.20

To duplicate test 114 at high speed.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
10.50	Charge							
10.55	Oil	10						
11.05	"	5				1st. Conc.	363	67
11.15	"	5				2nd. Conc.	364	42
11.25	"	5						
11.30	Complete					3rd. Conc.	365	80
						Tails.	366	268
								457

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
W.G.T.	50	
FPL. #24	50	

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
15	1st. Conc	14.6	41.7	28.0	21.5	14.4	12.3	8.2		
25	2nd. C.	9.2	22.5	9.5	34.1	14.3	15.2	6.4		
40	3rd. C.	17.6	8.6	6.9	38.4	27.9	18.5	14.8		
40	Tails.	58.6	0.7	1.9	13.8	37.0	39.8	106.9		
				47.3		93.6		136.3		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
59.3	15.4	6.0	
20.1	15.3	4.7	
16.6	29.8	10.9	
4.0	39.5	78.4	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 126.

NOTES:

500 gr. ground for30 min. with Na_2CO_3 start -- 10.50

finish -- 11.20

Skimmed according to the appearance of the froth.

DATE April 11, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER 1700

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.45	Charge							
11.50	Oil	2					Total	497
(2 drops every 3 min.)								
12.05	"	(12)				1st. Conc.	367	72
12.06	$CuSO_4$		5			2nd. Conc.	368	24
12.10	Oil	2						
(as before)								
12.25		(20)				3rd. Conc.	369	105
12.26	$CuSO_4$		5					
(Sp. #3 now used)								
12.39								
12.45	Complete					4th. Conc.	370	75
						Tails.	371.	221

REAGENT	%	LBS. P.T.
Na_2CO_3		2#/ton.
W.G.T.	50	
FPL.#24.	50	
$CuSO_4$		2#/ton.

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
17	1st. C.	14.6	49.5	35.6	18.1	13.0	8.2	5.9		
21	2nd. C.	4.8	27.0	6.5	34.4	8.3	11.2	2.7		
40	3rd. C.	21.1	9.3	9.8	41.8	43.9	13.3	14.0		
60	4th. C.	15.1	5.5	4.1	34.7	26.0	19.8	14.8		
60	Tails.	44.4	0.6	1.3	5.7	12.6	47.2	104.5		
				57.3		103.8		131.9		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
62.1	12.5	4.5	
11.4	8.0	2.0	
17.1	42.3	10.6	
7.2	25.0	11.2	
2.2	12.2	71.7	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 1 B.

NOTES: Sullivan ore, ground to pass -0.125 in. in rolls, then fed to Huntingdon mill with 80 mesh screens.
Transfer to pachuca at 10.10. Agitated with Na_2S, start 10.20 finish 11.10
Started feed at 11.12 , rate- 2.38#/min.

DATE Mar. 1, 1923
ORE NO. 177.
PULP RATIO : 1
R.P.M. IMPELLER
PULP TEMP. START °
FINISH °
MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.19	Start							
11.24		Samples of	feed & tails	taken every 5 min.				
11.44	Ended					Feed pulp		57.52#
						1st. conc.		2.72
25.						2 "		3.15
						3 "		2.29
						4 "		1.35
						5 "		0.975
						6 "		1.61
						7 "		1.49
						Tails.		43.93

REAGENT	%	LBS. P.T.
Na_2S		4#/ton.
B#4 (54 dr/min.)		3.8

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
feed			10.3	5.92	20.2	11.63	26.4	15.2		
25	1		24.6	.670	21.4	.582	19.4	.528		
	2		22.2	1699	23.1	.728	19.9	.627		
	3		19.0	.435	24.3	.556	19.4	.444		
	4		15.9	.214	24.4	.329	17.65	.238		
	5		15.0	.146	24.1	.235	23.4	.228		
	6		12.4	.200	22.8	.367	25.0	.403		
	7		11.75	.175	20.5	.305	23.7	.353		
	Tails		9.40	4.130	18.9	8.305	23.7	11.87		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
10.05	5.10	3.6	
10.49	6.38	4.27	
6.52	4.87	3.03	
3.21	2.88	1.62	
2.19	2.06	1.55	
3.00	3.22	2.75	
2.62	2.67	2.40	
62.00	72.80	68.10	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO.	3 B.
DATE	Mar. 2, 1923
ORE NO.	177.
PULP RATIO	: 1
R.P.M. IMPELLER	
PULP TEMP. START	°
PULP TEMP. FINISH	°
PULP TEMP. MEAN	°

NOTES:

Retreating tails from test 2b.
Transfer at 9.55 and added $CuSO_4$ at 10.20
Started feed at 11.00. Time of agitation -40 min.

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
11.06	Start							
Feed and tails samples taken for 10 sec. at 5 min. intervals								
11.34	Finish							
28.						Feed. (pulp-20.44#)		53.035
						1st. Conc.		13.56
						2nd. Conc.		11.00
						Tails.		28.475

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
B#4		4.5

SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
	Feed		10.05	5.40	19.1	10.13	27.2	14.43		
	1st. C.		14.2	1.935	27.3	3.72	22.0	2.98		
	2nd. C.		12.4	1.312	21.5	2.36	24.8	2.73		
	Tails.		6.35	1.81	8.87	2.495	33.8	9.61		
				5.057		8.575		15.32		

PERCENT OF TOTAL			
Pb.	Zn..	Fe.	
38.3	43.3	19.5	
25.9	27.6	17.8	
35.8	29.1	62.7	

ORE DRESSING LABORATORY, MINING DEPARTMENT, McGILL UNIVERSITY.

FLOTATION TEST NO. 4 B.

NOTES:

Crushed as before. Samples extracted from pachuca tank before and after agitation to test in small machine.

Agitated 50 min. with $CuSO_4$.

DATE Mar. 10, 1923

ORE NO. 177.

PULP RATIO : 1

R.P.M. IMPELLER

PULP TEMP. START °

FINISH °

MEAN °

TIME H. M.	REAGENT	DROPS	C. C.	WEIGHT	R.P.M.	NOTES	SAMP. No's	WEIGHT
12.38	Start							
feed	and tails samples taken as before.							
1.08	Finish							
						Feed		47.82
30.						1st. Conc.		4.0
						2nd. Conc.		3.81
						Tails.		40.01

REAGENT	%	LBS. P.T.
$CuSO_4$		2#/ton.
B#4 (60 dr/min.)		6.2

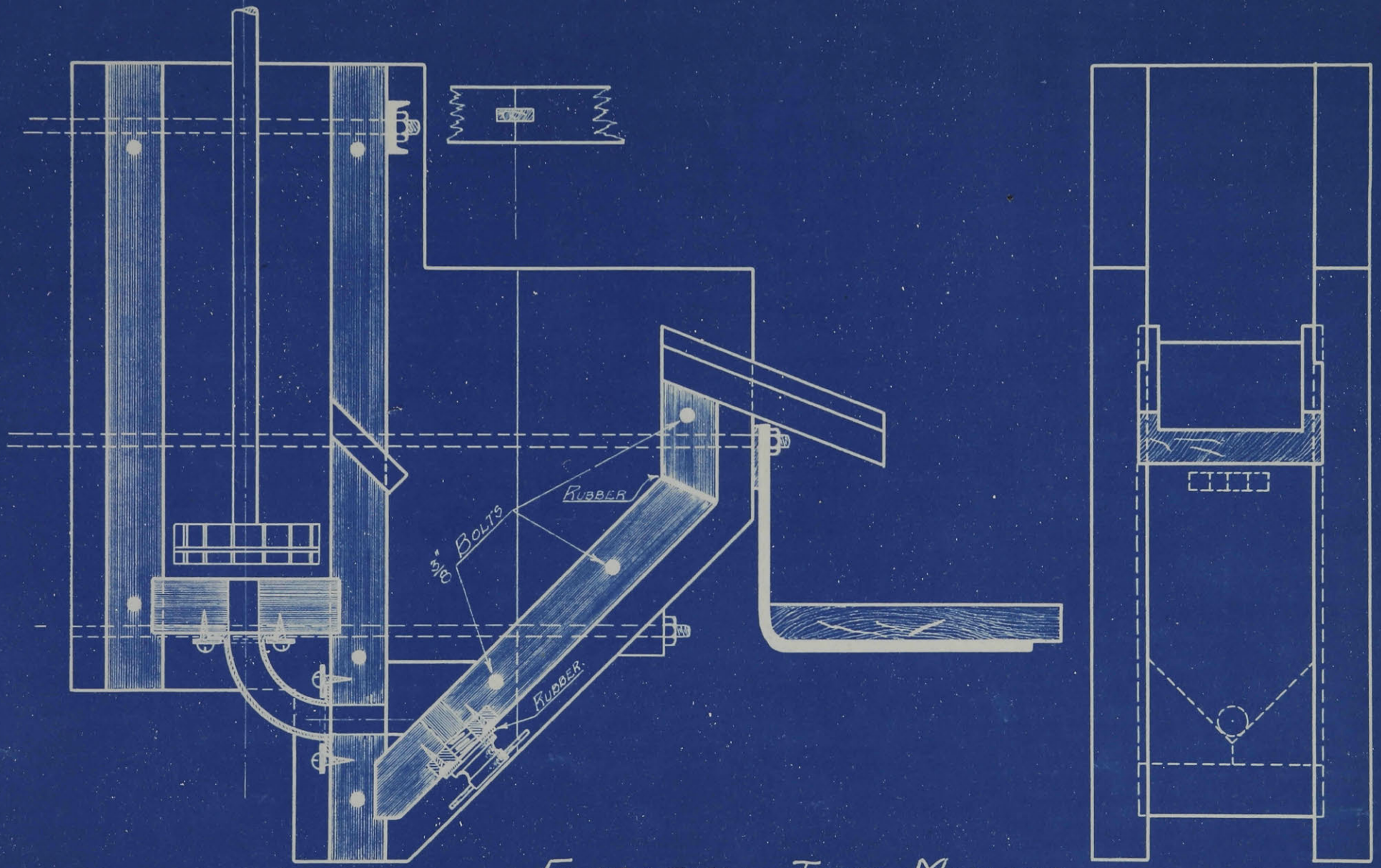
SCREEN ANALYSIS OF FEED

GRADE	%	GRADE	%
+ 20		+ 100	
28		150	
35		200	
48		− 200	
65		TOTAL	

TIME MIN.	PRODUCT	% WEIGHT	% Pb.	WEIGHT	% Zn.	WEIGHT	% Fe.	WEIGHT	%	WEIGHT
	Feed		11.5	5.50	19.7	9.42	26.3	12.58		
	1st. C.	8.38	13.85	0.554	29.1	1.164	21.0	0.840		
	2nd. C.	7.98	14.80	0.563	28.5	1.087	20.2	1769		
	Tails	83.64	11.30	4.530	17.7	7.090	30.3	12.150		
				5.647		9.341		13.759		

PERCENT OF TOTAL

Pb.	Zn.	Fe.	
9.84	12.60	6.11	
9.97	11.65	5.60	
80.19	75.75	88.19	



FLOTATION TEST MACHINE

MINERALS SEPARATION TYPE

ORE DRESSING LAB. McGILL UNIVERSITY.

Scale – 3 in. = 1 Foot.

C.L.D.