

UNITED STATES PATENT OFFICE

RHETHERFORD B. MARTIN, OF ROSELLE, NEW JERSEY

CONCENTRATION OF ORES

No Drawing.

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This invention relates to improvements in the concentration of ore, and more particularly to an improved method of preparing the ore for concentration by flotation or water gravity methods.

Heretofore the contacting of the selective agents with the ore particles preliminary to froth flotation or other concentration methods has been effected by mixing the agents with the ore in the form of a freely flowing pulp. It is common flotation practice to apply the agents to the ore while grinding to the final size in a ball mill. In all these cases the water present amounts to 35% to 350% of the weight of the ore.

I have found that by regulating the water content of the ore to an amount just sufficient to wet the surfaces of all the ore particles and mixing the agents therewith by tumbling in a revolving cylinder or equivalent apparatus, the quantity of agents required is very much decreased. At the same time, I have obtained equal or better results in the subsequent concentration than where the ordinary method of contacting the agents with the ore was practiced.

The amount of water required depends on the degree of fineness to which the ore is ground. I have found that about 15% of water by weight is sufficient to thoroughly wet all the surfaces of ore particles ground to pass a 6-mesh sieve, while 20% to 25% of water is required to thoroughly wet the surfaces of ore particles ground to pass a 48-mesh sieve. A preliminary trial will indicate the amount of water necessary for any particular ore. The quantity should be sufficient to thoroughly wet the surfaces of all the ore particles without an excess which will settle out of the ore on standing.

When the mineral is to be finally separated from the gangue by the froth flotation process, the ore should be ground to at least pass a 48-mesh sieve, as is usual in flotation operations. The customary selective agents may be employed, dependent on the character of the ore. The quantity required, however, will be less than that usually required for froth flotation operations. The mixing of the wetted ore with the selective agents

should be carried on until complete contact of the mineral with the agents is obtained. Water is then added to the material to form a freely flowing pulp, which may be treated by any method of froth flotation for the concentration of the mineral.

When the mineral is to be finally separated from the gangue by gravity water concentration, the quantity and character of the agents and the time of mixing should be so adjusted that the mineral particles are agglomerated.

When treating an ore containing sulfide minerals, it is desirable to continue the mixing until the sulfides are agglomerated into shotlike granules which, by reason of their greater gravity and bulk when compared to the individual gangue particles, may readily be separated by gravity water concentration. It is desirable in this case that the ore be ground to at least pass a 48-mesh sieve.

When treating a non-metallic ore, such as a phosphate ore, the mixing should only be continued to the point where the mineral particles are agglomerated into floccules or featherlike masses. Such floccules sink less rapidly in water than the gangue particles and separation may be readily made by gravity water concentration. In this case the ore need only be ground to such a degree of fineness that the mineral particles are substantially free from attached gangue particles.

The following is an example of one method of carrying out this invention in the treatment of phosphate ore:

2000 grams of Florida phosphate ore screenings containing 55.8% bone phosphate of lime was ground with 500 cc. of water to pass a 48-mesh sieve. The ore was then deslimed by washing. The fine material removed amounted to 290 grams and contained 63.9% bone phosphate of lime. The slime material is of sufficiently high grade to warrant further treatment for the recovery of its phosphoric acid content. The water content of the deslimed material was regulated by decantation to contain 20% of water by weight, which was just enough water to thoroughly wet all the ore particles. Soluble soap at

the rate of two pounds per ton and sodium silicate at the rate of one-half pound per ton were added to the wetted ore. The ore, water, soap and silicate were then tumbled in a slowly rotating cylinder for ten minutes, at the end of which time crude petroleum oil was added at the rate of five pounds per ton of ore. The tumbling was then continued for ten minutes. To the ore thus agglomerated, water was added to form a freely flowing pulp. The pulp was then fed to a small Wilfley concentrating table. The gangue material was discharged at what under the usual conditions of ore treatment is the concentrate end of the table and the agglomerate phosphate concentrate relatively free from gangue was discharged at what under the usual conditions of ore treatment is the tailing side of the table. 1137 grams of concentrate was produced, containing 73.4% bone phosphate of lime. The tailings weighed 385 grams and contained only .94% bone phosphate of lime.

The recovery of the bone phosphate of lime in the concentrate was 74.7% of the phosphate in the original ore and 89.6% of the phosphate in the ore actually subjected to agglomeration.

In another test, the ore was partially ground and deslimed. Water was added to the deslimed product to make the water content 40% by weight. The pulp so formed was ground in a ball mill, together with the following agents in amounts per ton of ore: 8 pounds of soluble soap; 2 pounds of sodium silicate and 30 pounds of crude petroleum. Previous experiments had shown that these amounts were the minimum for satisfactory results. The grinding and contacting period was 20 minutes. At the end of this time the ore was sufficiently fine to just pass a 48-mesh sieve and the phosphate minerals were well agglomerated. The agglomerated ore was then fed to a small Wilfley concentrating table as described above. The recovery of phosphate and the grade of the concentrate produced were substantially the same as in the case where tumbling the wetted ore with the agents out of the presence of a grinding medium was employed. It will be seen from this example that the use of the known method of contacting ore with selective agents required four times as much soap, four times as much sodium silicate and six times as much crude petroleum as that required when practicing the method of this invention.

I claim:

1. In a process of ore concentration, the step of mixing the ore with selective agents which comprises regulating the water content of the ore to the amount necessary to wet the surfaces of all the ore particles without having an excess present which will settle out on long standing and tumbling such wetted ore with the selective agents.

2. In a process of ore concentration, the steps which comprise grinding the ore, adding water sufficient to thoroughly wet the surfaces of all the ore particles without an excess which will settle out on standing, then tumbling the wetted ore with selective agents until the mineral particles have become thoroughly contacted therewith.

3. In a process of ore concentration, the steps which comprise grinding the ore, adding water sufficient to thoroughly wet the surfaces of all the ore particles without an excess which will settle out on standing, then tumbling the wetted ore with selective agents until the mineral particles are agglomerated.

4. In a process of ore concentration, the steps which comprise grinding the ore, adding water sufficient thoroughly to wet the surfaces of all the ore particles without excess which will settle out of the ore on standing, and then mixing the wetted ore with a soluble soap, an oil and an alkaline salt until the mineral particles are agglomerated into flocculent bodies.

5. In a process of ore concentration, the steps which comprise grinding the ore, adding water sufficient thoroughly to wet the surfaces of all the ore particles without an excess which will settle out of the ore on standing, then tumbling the wetted ore with a soluble soap and an alkaline salt followed by tumbling with a selective oil until the mineral particles are agglomerated into flocculent bodies.

In testimony whereof, I have signed my name to this specification this 11th day of September, 1929.

RHETHERFORD B. MARTIN.