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CONCENTRATION OF MINERALS

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This invention relates to the concentration of minerals and has for an object the provision of an improved process for concentrating minerals by froth flotation. More particularly, the invention contemplates the provision of an improved method for controlling the extraction of valuable minerals and grade of concentrate produced.

In froth flotation processes, it is customary to conduct one flotation operation for the purpose of obtaining a rougher concentrate and then subject the rougher concentrate to a second flotation operation for the purpose of obtaining a concentrate containing a higher percentage of the valuable mineral, the tailings from the second operation being mixed with the feed treated during the first operation.

The tailings from the first or rougher operation may be wasted, so it is important that the operation be so conducted that maximum extraction be accomplished. Since the rougher concentrates are retreated, grade of concentrate may be sacrificed in favor of extraction in the rougher operation. The tailings from the second or cleaner operation are retreated in the rougher operation, so extraction may be sacrificed in favor of grade of concentrate in the cleaner operation.

I have discovered that improved results may be obtained by controlling the densities of the pulps employed in the rougher and cleaner operations. I have found that grade of concentrate obtained improves and extraction becomes poorer as pulp density increases. I, therefore, propose to employ a pulp of relatively low density in conducting the rougher operation and a pulp of relatively high density in conducting the cleaner operation. I have discovered that improved extractions and improved grades of concentrates are obtained when pulps containing not more than about forty percent solids, by weight, are employed in the rougher operations and when pulps of greater densities than the pulps employed in the rougher operations are employed in the cleaner operations. I have also discovered that improved grades of concentrates may be obtained by regrinding the rougher concentrates before subjecting them to the cleaner operation.

The relative pulp densities employed in the rougher and cleaner operations in the treatment of any particular ore will be determined by the natures of the minerals in the ore. In treating ores containing minerals having relatively low specific gravities, pulps containing relatively low percentages of solids, by weight, may be employed.

The following table illustrates the results obtained in treating reground rougher zinc concentrates obtained by treating United Verde mine ore in which zinc is present in the form of marmatite:—

Cleaner feed percent solids	Concentrates percent Zn	Extraction (percent)
10	31.5	76.5
20	27.5	82.5
30	27.0	85.5
40	29.5	85.5
45	31.5	84.8
50	32.5	83.5
55	33.5	82.5

The above results were obtained by varying the pulp density and maintaining other conditions constant. The cleaner circuit was operating on a reground rougher concentrate assaying about 16% Zn. The cleaner tailings were returned continuously to the head of the rougher circuit.

The results obtained show that cleaner operations employing pulps containing about ten percent or less of solids produce concentrates corresponding in grade to those produced when pulps containing about forty-five percent solids are employed. The extraction, however, is better when the higher density pulps are used, and I, therefore, prefer to employ such pulps in cleaner operations.

A complete process of the invention for treating an ore of the type of United Verde mine ore involves grinding of the ore to a suitable particle size, treatment of the ground product in a pulp containing not more than about forty percent solids with the addition of suitable flotation agents to produce a rougher concentrate, thickening of the rougher concentrate to obtain a pulp containing not less than about forty percent solids, treatment of the thickened pulp with the addition of suitable flotation agents to produce a cleaner concentrate and a cleaner tailing, and return of the cleaner tailing to the rougher circuit.

The rougher concentrate may be reground before being subjected to the cleaner operation. Regrinding is preferably conducted after the rougher concentrate pulp has been thickened. Thickening or dewatering of the rougher concentrate may be conducted in any suitable manner.