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FLOTATION OF MINERALS

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This invention relates to the treatment of ores, metallurgical products and like heterogeneous materials containing compounds of the useful or more or less valuable metals and has for its object to provide improvements in the separation of the compounds in question by flotation and particularly by froth flotation from the less valuable components of the materials treated.

Hitherto many proposals have been made for the wet concentration of ores involving the addition to the liquid in which the ore is suspended of a frothing agent. Other agents have likewise been added to the frothing agent, e. g. promoters, depressors, regulators, activators, dispersers, etc.,—these latter named agents being used to aid the flotation agent in separating the mineral particles from the gangue and to enable more perfect selection or differentiation between the mineral components of the mixture. My invention is primarily directed to the flotation agent with which the other above named agents may be employed if found desirable.

Gaudin, Haynes, and Haas (Technical Paper No. 7, Mining & Metallurgical Investigations, University of Utah, 1930) have conducted a number of investigations on frothing agents and state: "The quality most sought for in frothing agents is the production of a foam, barren yet able to support a mineral load and of sufficient brittleness to break down rapidly after the supply of bubbles is exhausted." Many of the frothing agents now being commercially employed, such, for example, as pine oil, creosole, eucalyptus oil, etc., are capable of developing a sufficient froth to separate the mineral particles from the gangue but, due to the relatively tough and permanent nature of the froth formed, considerable difficulty is encountered in collapsing the froth in order to separate the mineral particles therefrom.

An object of the present invention is to provide a new and improved frothing agent which does not have the inherent disadvantages of the frothing agents now being employed. Another object of the present invention is to provide a frothing agent which will develop a brittle and impermanent froth of sufficient buoyancy to float the mineral particles and yet of such an impermanent nature that upon removal from the agitating apparatus it rapidly and completely collapses, thus affording easy separation of the mineral particles therefrom. A still further object of the invention is to provide a new and improved frothing agent comprising a mixture of oxygenated organic compounds obtained from the catalytic hydrogenation of carbon oxide under elevated pressure. Other objects will hereinafter appear.

My invention is based upon the discovery that the flotation operation can, in many cases, be improved by the addition to the ore or mineral pulp of oxygenated organic compounds obtained by the catalytic hydrogenation of carbon monoxide under elevated temperatures and pressures as the flotation agent. My flotation agent may be used alone for the treatment of many ores while in the treatment of others it is advantageous to use it in conjunction with the other agents usually employed in like processes.

Furthermore, if other flotation agents are used, such as pine oil, eucalyptus oil, or any flotation agent which develops a permanent froth that does not collapse as rapidly as desired, after removal with the mineral particles separated from the gangue from the flotation chamber, the addition of my flotation agent to this stable froth will hasten its collapse. When using my flotation agent in this manner it may be added prior to, during, or subsequent to the flotation operation.

My preferred frothing agent is derived from the following source. In the catalytic hydrogenation of carbon oxide under elevated temperatures and pressures a variety of straight and branch chained organic compounds containing oxygen are made. These organic compounds have a boiling point ranging from about 50° C. to a temperature of 250° C. and higher.

Various methods have been proposed for the manufacture of these oxygenated organic compounds, for example a method for their synthesis is described in the U. S. Patent of Roger Williams No. 1,820,417. The fractions of the oxygenated organic compounds obtained by the process of the Williams patent or like processes, which I prefer to use, are those boiling from a temperature of approximately 130° C. up.

The oxygenated organic compounds boiling from 130° C. up have been fractionated systematically into a series of fractions, namely 130 to 147; 147 to 157; 157 to 195; 195 to 240; and 240 up. As would be expected these various fractions differ somewhat in their flotation ability. Consequently, when treating a given ore concentrate under particular conditions and with a specific machine and circuit water, one fraction will usually be found to have advantages over the others due to its ability to form a froth most suitable for those conditions. It will be understood, however, that the fractions differ from each other

in their flotation ability in degree rather than one being highly suitable while another being absolutely unsuited for a particular operation.

The fraction to be used may be incorporated with the ore or mineral pulp in any suitable manner which will ensure its uniform incorporation and dissemination thruout the pulp. It may thus be incorporated by adding to the grinding mill, in which the ore is ground, or it may be added after the grinding operation and during or prior to the flotation operation. The flotation operation can be carried out in any suitable apparatus, such as an ordinary Callow cell, or in apparatus where the air is incorporated in the ore pulp by mechanical agitation.

The following is given by way of example of the process but it will be understood that I am not limited by the details thereof. One hundred parts by weight of lead-zinc ore slimes (sulphide) containing 20% of metal are treated alone or after being admixed with ½% of iron ore with approximately 2 parts by weight of the oxygenated organic compounds boiling from 130° C. up. After thorough mixing the magma is passed into an apparatus where air is incorporated with the ore pulp by mechanical agitation. There then takes place a complete separation of the crude iron ore and gangue, on the one hand, and of the sulphide ores, on the other, inasmuch as these ores rise to the surface while the iron ore and the gangue sink to the bottom of the apparatus. The refuse is continually removed from the bottom and the floating ores are collected from the top upon strainers. The froth and entangled mineral particles overflow from the zone of agitation to the launder of the flotation machine wherein a rapid and thorough collapse of the froth occurs which facilitates further treatment of the mineral particles.

It is sometimes advisable to provide a selective ore collecting agent to supplement the action of the oxygenated organic compounds employed, as these compounds appear to be essentially frothing agents. Where, however, the ore pulp contains an appropriate selective or collecting agent, or inherently requires the addition of no such agent, but is efficient in frothing qualities, the addition of my improved frothing agent in a manner similar to that above described, imparts the desired frothing qualities and provides bubbles in a sufficient quantity and of a sufficient persistency to overflow into the launder of the flotation machine, thereby mechanically facilitating the removal of the mineral concentrate.

In some cases where it is advantageous to employ the higher boiling fractions of my flotation agent, I have found it advisable to incorporate therewith a solubilizing or disseminating agent, particularly when the frothing agent is added directly to the flotation machine. These solubilizers should preferably be not only miscible with the higher boiling fractions but also miscible with water in order to aid in the dispersion of the flotation agent. The lower boiling alcohols such as methanol and ethanol and, in some instances, the lower boiling fractions of the oxygenated organic compounds above described, are examples of suitable solubilizers.

Any improvement in the process or products disclosed in the above specification and described in the claims will come within the scope of this invention without sacrificing any of the advantages that may be derived therefrom.

I claim:

1. The method of effecting the concentration of minerals by froth-flotation, which comprises adding to the mineral pulp a small amount of the oxygenated organic compounds boiling above 130° C., the compounds having been obtained by the catalytic hydrogenation of carbon oxides under high pressure and subjecting the resulting mixture to a flotation operation.

2. The method of effecting the concentration of minerals by froth-flotation, which comprises adding to the mineral a small amount of the oxygenated organic compounds boiling above 130° C., the compounds having been obtained by the catalytic hydrogenation of carbon oxides under high pressure, and a solubilizer therefor, and subjecting the resulting mixture to a flotation operation.

3. The method of effecting the concentration of minerals by froth-flotation, which comprises adding to the mineral pulp a small amount of the oxygenated organic compounds having a boiling range from approximately 240° C. up, and which were obtained by the catalytic hydrogenation of carbon oxides under high pressure and a solubilizer comprising the oxygenated organic compounds having a boiling range from approximately 130° C. to approximately 195° C. which also was obtained by the catalytic hydrogenation of carbon oxides under elevated pressure, and subjecting the resulting mixture to a flotation operation.

4. In a process of effecting the concentration of minerals by froth-flotation which involves the separation of mineral particles from the gangue by the froth formed as the result of the addition to the ore of a flotation agent and subsequent removal of the mineral particle and froth from the zone of flotation for final segregation of the mineral particles, the step which comprises employing in the process a fraction of the oxygenated organic compounds boiling above 130° C. obtained by the catalytic hydrogenation of carbon oxide under elevated pressures.

5. The method of effecting the concentration of minerals by froth-flotation, which comprises adding to the mineral pulp approximately 2% by weight of the oxygenated organic compounds boiling above 130° C., the compounds having been obtained by the catalytic hydrogenation of carbon oxide under high pressure, and subjecting the resulting mixture to a flotation operation.

6. In a process of effecting the concentration of minerals by flotation, which involves the separation of mineral particles from the gangue by the froth formed as the result of the addition to the ore of a flotation agent and subsequent removal of the mineral particles and froth from the zone of flotation for final segregation of the mineral particles, the step which comprises employing in the process approximately 2% by weight of a fraction of the oxygenated organic compounds boiling above 130° C. and obtained by the catalytic hydrogenation of carbon oxide under elevated pressures.

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