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SEPARATION OF MATERIALS OF DIFFERENT
SPECIFIC GRAVITIES AND MEDIA THERE-
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My invention is concerned with the separation of granular materials having different specific gravities and particularly relates to materials which have unusually satisfactory properties as media for such purposes.

In accordance with the prior art, heavy substances in a state of fine division, have been suspended in water so as to simulate a heavy liquid and the resulting suspensions have been used for the beneficiation of such ores as those of zinc, coal, iron and the like. Among the substances employed for this purpose have been galena, magnetite, and ferro-silicon. The use of each of these substances has definite disadvantages which have militated against their more extended use. Thus, for example, galena is difficult to recover since it is used in extremely finely divided form and, accordingly, its use has proven quite costly. Magnetite and ferro-silicon, while relatively easily recoverable for reuse by means of magnetic separators, have a relatively low specific gravity which limits their use to a relatively few ores. These and other media which have heretofore been employed offer other disadvantages with which those versed in the art are fully familiar and which require no elaboration.

In accordance with my present invention, media which can readily be converted into a state of fine division and are easily suspended in water in order to simulate heavy liquids are produced in a relatively simple and inexpensive manner. They may be made in a strongly ferro-magnetic condition and possess comparatively high specific gravities, generally in the range from about 6.5 or somewhat less to about 8.2 or somewhat more. Their magnetic susceptibility and coercive force may be varied from rather low values to those comparable with iron or steel or with the best magnetic alloys. They may also be prepared in the form of solid lumps or in almost any state of division down to the finest powder.

The primary advantages of the media produced in accordance with my invention over such materials as have heretofore been suggested for use as heavy suspension media for ore beneficiation are the combination of high specific gravity, which makes for applicability to a wide variety of ores, and of high magnetic susceptibility so that the recovery of said media for reuse by means of magnetic separators may be readily and inexpensively accomplished.

The essential elements comprising the media of my invention are lead or a source of lead such

as galena, and ferro-magnetic material such as metallic iron, nickel, cobalt or their oxides and alloys or the like. In certain cases, sulphur is a desirable constituent.

The following examples are illustrative of the preparation of media falling within the scope of my invention. It will be understood that various changes may be made therein with respect to the proportions, temperatures and time of heating, and the like, without departing from the principles of my invention:

Example 1

Equal parts by weight of pulverized galena (200 mesh) and finely comminuted sponge iron (100 mesh) were mixed together and heated at 750 degrees C. for 5 minutes in a closed crucible. The resulting product, of compact character, was easily pulverized, 90% thereof being strongly magnetic and 10% weakly magnetic. The specific gravity of the strongly magnetic portion was 7.283 and said material was resistant to the action of repeated wetting and drying in air.

Example 2

2 parts by weight of pulverized galena (200 mesh) were mixed with 1 part by weight of sponge iron (6 mesh) and the mixture was heated at 650 degrees C. for 5 minutes. The magnetic portion consisted of 6 mesh pieces coated with lead globules. The specific gravity of this material was 7.14.

Example 3

2 parts by weight of powdered galena and one part by weight of powdered iron were mixed together and heated at 500 degrees C. for 5 minutes. Approximately 73% of the resulting product was strongly magnetic and had a specific gravity of 8.12.

Example 4

2 parts by weight of finely divided galena (200 mesh) and 3 parts by weight of magnetite (100 mesh) were mixed together and heated at 800 degrees C. for 5 minutes. The resulting product, which had a specific gravity of 6.50, could be broken up easily into strongly magnetic particles.

Example 5

A mixture of 8 parts by weight of powdered iron, 7 parts by weight of lead, and 1 part by weight of sulphur, were heated at 750 degrees C. for 5 minutes. The resulting product was strongly magnetic.

Example 6

18 grams of sponge iron were maintained for about 5 minutes in contact with 1000 cc. of a hot acid brine solution of lead sulphate whereupon metallic lead was precipitated on the surface of the iron. The acid brine solution of lead sulphate contained 14 grams per liter of lead as lead sulphate, 1.1 grams per liter of sulphuric acid, and the solution was substantially saturated with sodium chloride. The lead-coated iron particles, comprising about 40% lead and about 60% iron, were removed from the solution, dried, and heated in a closed crucible for about 5 minutes at a temperature of approximately 350 degrees C. The resulting material possessed a high magnetic susceptibility and was resistant to the action of repeated wetting and drying in air.

In general, in its broader aspects, the invention comprises the heating together, at suitably elevated temperatures, of lead or a lead compound such as galena with any material having suitable magnetic characteristics and appropriate specific gravity so that a heavy magnetic material results. In a more limited aspect of the invention, as described in Example 6 hereinabove, the invention contemplates the utilization of any magnetic material which can have deposited upon its surface a layer of lead and then be heated, particularly in the absence of air, to produce a heavy magnetic material which is resistant to the action of, or does not deteriorate by, repeated wetting and drying.

The proportions of ingredients comprising the media of my invention are, of course, subject to variation, as the examples hereinabove show. If too little lead or galena is used, the resulting product is less resistant to corrosion or repeated wetting and drying; and, if too little iron or other ferro-magnetic material is employed less of the final product is magnetic. Thus, for example, with equal parts by weight of lead and iron, 90% of the final product is strongly magnetic. With two parts of lead to one part of iron, by weight, 73% of the final product is strongly magnetic. With two parts of iron and 1 part of lead, by weight, about 99% of the final product is strongly magnetic. In the light of these facts, those skilled in the art will be properly guided in the practice of the invention.

The following examples are illustrative of the use of the media of my invention for bringing about separations of the character described hereinabove:

Example 7

A hematite iron, in which the gangue was a hard, silicious material, was crushed to $\frac{1}{2}$ inch size. The "heavy liquid" was prepared by mixing 100 mesh heavy magnetic material, produced as described in Example 1, with water to form a heavy suspension having an effective specific gravity of 3.3. The original ore contained 47.6% iron. The concentrate obtained assayed 57.2% iron, the recovery being 93.4%.

Example 8

A silicious lead ore was treated generally as described in Example 7, the liquid suspension in this case being adjusted to an effective specific

gravity of 2.7, the heavy magnetic material utilized being produced in accordance with Example 4. The original ore, which contained 5% lead, was crushed to $\frac{3}{4}$ inch size. The concentrate assayed 75% lead, the tails 0.72% lead, and the recovery was 92%.

Example 9

A zinc ore with dolomite gangue (5.4% zinc) was separated by means of an aqueous suspension of the product of Example 6, the heavy magnetic medium having a specific gravity of 8.2, and the aqueous suspension being adjusted to an effective specific gravity of 2.9. The concentrate obtained assayed 60.8% zinc, the tailings 0.8% zinc, and the recovery was 86%.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A medium for the separation of granular materials of different specific gravities, comprising a magnetic material in finely divided form and having a specific gravity of at least about 6.5, said magnetic material containing at least largely lead, iron and sulphur.

2. A medium for the separation of granular materials of different specific gravities, comprising a magnetic material in finely divided form and having a specific gravity of at least about 6.5, said magnetic material containing at least largely magnetic iron oxide and a solid lead material.

3. A medium for the separation of granular materials of different specific gravities, comprising a magnetic material in finely divided form and having a specific gravity of at least about 6.5, said magnetic material containing at least largely lead, a ferro-magnetic substance and sulphur.

4. A process for the preparation of a medium for the separation of granular substances of different specific gravities, which comprises mixing substantial amounts of galena and a magnetic material, heating the resulting mixture to a temperature between about 450 degrees C. and about 1000 degrees C. and converting the medium to a finely divided form.

5. The process of claim 4 wherein said magnetic material comprises sponge iron.

6. The process of claim 4 wherein said magnetic material comprises a magnetic oxide.

7. A process for the preparation of a medium for the separation of granular substances of different specific gravities, which comprises mixing substantial proportions of a solid lead material, a magnetic substance, and sulphur, heating the resulting mixture to a temperature within the range of about 450 degrees C. to about 1000 degrees C. and converting the medium to a finely divided form.

8. In the process of preparing a medium, in finely divided form, for the separation of granular substances of different specific gravities from each other, the steps of contacting sponge iron with an acid brine solution of lead sulphate whereby a substantial proportion of lead is deposited on said sponge iron, and then heating the resulting lead-coated sponge iron to a temperature of at least about the melting point of lead.

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