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SELECTIVE FLOTATION OF MINERALS.

No Drawing.

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This invention relates to the selective flotation of minerals, especially the sulfid ores and is based upon the use of cresylic acid as a solvent for and as a supplemental flotation agent with thio-carbanilid. The use of thio-carbanilid in the concentration of sulfid ores by the flotation process is well known. It has been used with marked success on copper ores as well as complex lead-zinc-iron ores, both as a dry agent, that is, according to the common practice by feeding the dry thio-carbanilid to the ore grinding mill and also as a wet agent, that is, in combination with an organic solvent such as the common flotation oils and oil mixtures. Due to its low solubility in water, it is much more effective as a wet agent than as a dry agent. In the use of thio-carbanilid as a wet agent, the solvent used may be either one which will directly assist the flotation operation or it may be one which itself has no flotation properties. Thus the solvent may have selective flotation qualities or it may be a frothing agent or both. The most commonly used solvent for thio-carbanilid is ortho-toluidine, the usual mixture or solution used containing about 80 percent of the ortho-toluidine and 20 percent of thio-carbanilid. However even with this comparatively dilute solution it is necessary to heat and maintain its temperature at about 45° C. in order to hold the thio-carbanilid in solution. This temperature requirement is highly objectionable due to the volatility of the ortho-toluidine which is lost by volatilization and the vapors of which moreover are highly inflammable. The ortho-toluidine itself is effective only as a frothing agent, and when used in excess gives a spongy froth which is not desirable for the best flotation results since it tends to contaminate the concentrate with insoluble material. Another objection to the use of ortho-toluidine is its cost, the available supply being fairly limited.

We have now found that cresylic acid is an excellent solvent for and supplemental flotation agent with thio-carbanilid. Cresylic acid is a well-known flotation agent having desirable selective flotation properties as well as some frothing value, and is moreover a relatively inexpensive agent in that it is effective when used in very small amounts in a flotation circuit.

We have found that thio-carbanilid is soluble in cresylic acid and that the result-

ing solution is very effective as a flotation agent. Owing to its highly selective qualities, it is particularly valuable as an agent for the treatment of lead-zinc-iron ores, especially in a selective circuit. We have further found that the solubility of the thio-carbanilid in the cresylic acid can be materially increased by the addition of a small amount of ortho-toluidine to the mixture. Thus, a mixture or solution of 20 parts by weight of ortho-toluidine and 60 parts by weight of cresylic acid and 20 parts by weight of thio-carbanilid will hold the thio-carbanilid in solution indefinitely at 30° C., and for 24 hours at 20° C. In general, both cresylic acid alone and a mixture of cresylic acid and ortho-toluidine have the advantage over ortho-toluidine alone as solvents for thio-carbanilid in that they will hold more of the thio-carbanilid in solution at a given temperature. This greater solubility of the thio-carbanilid in cresylic acid or in a mixture of cresylic acid and ortho-toluidine makes possible the employment of lower temperatures which in turn reduces the fire hazard and the danger to the health of workmen due to poisonous fumes, and furthermore avoids the loss of solvent by volatilization and thus insures the retention of the thio-carbanilid in solution. The lower cost of the cresylic acid as compared with ortho-toluidine also is a direct economic advantage.

As previously stated, thio-carbanilid is more effective when used as a wet agent, that is, in solution than when used as a dry agent, that is, added to the ore pulp in its dry state in the ball mill. Due to the increased amount of thio-carbanilid which may be retained in solution in cresylic acid or in a mixture of cresylic acid and ortho-toluidine and due to the less violent frothing characteristics of cresylic acid or a mixture of cresylic acid and ortho-toluidine as compared to ortho-toluidine alone, it is possible to use all of the thio-carbanilid required for the flotation in the form of a solution, thus entirely dispensing with the customary supplemental addition of dry thio-carbanilid to the ore pulp in the ball mill. This results in a direct saving of thio-carbanilid.

The principal advantage in the use of cresylic acid as the solvent for the thio-carbanilid is the improved metallurgical results obtainable.

The improved metallurgical results are illustrated by the following tables:

I. Using a solution of 20 parts of thio-carbanilid in a mixture of 60 parts of cresylic acid and 20 parts of ortho-toluidine.

	Weight	Assays						
		Per cent zinc	Per cent lead	Per cent copper	Oz. silver	Oz. gold	Per cent iron	Per cent insol.
Ore-----	100	10.8	2.6	0.29	5.5	.009	3.1	-----
Zinc conct..	18.9	53.3	5.8	0.75	18.8	.030	3.9	5.2
Lead conct..	1.6	6.5	68.0	3.10	66.9	.050	2.1	0.5
Tailing-----	79.3	0.7	0.25	0.07	1.0	.003	2.5	-----

II. Using thio-carbanilid in its natural state added to the ball mill with thio-carbanilid in solution in ortho-toluidine.

	Weight	Assays						
		Per cent zinc	Per cent lead	Per cent copper	Oz. silver	Oz. gold	Per cent iron	Per cent insol.
Ore-----	100	10.8	2.6	0.29	5.5	.009	3.1	-----
Zinc conct..	19.9	49.5	6.5	0.80	18.5	.029	5.1	5.5
Lead conct..	1.6	8.5	65.0	3.66	62.0	.050	2.3	0.5
Tailing-----	78.5	0.9	0.26	0.06	0.9	.003	2.1	-----

The metallurgical advantages indicated by the foregoing tables are as follows:

(a) A decrease in the loss of zinc and lead in the tailings or in the discard.

(b) Increased recovery of zinc and lead in the concentrates.

(c) Increased concentration of zinc and lead in the concentrates.

(d) Increased recovery of zinc in the subsequent treatment of the concentrate due to the lower iron content thereof.

The scope of the invention is indicated in the appended claims.

We claim:

1. As a flotation agent a solution comprising cresylic acid and thio-carbanilid.

2. As a flotation agent a solution comprising cresylic acid, thio-carbanilid and ortho-toluidine.

3. As a flotation agent a mixture of about 20 parts by weight of ortho-toluidine, 20 parts by weight of thio-carbanilid and 60 parts by weight of cresylic acid.

In testimony whereof, we affix our signatures.

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