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## FROTH FLOTATION OF MONAZITE FROM HEAVY GRAVITY MINERALS

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The present invention relates to a froth flotation treatment of ores or ore products containing phosphorus bearing minerals and heavy gravity minerals.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the processes and steps pointed out in the appended claims.

An object of this invention is to obtain heavy gravity minerals free of any phosphorus containing minerals by a froth flotation treatment of an ore containing said heavy gravity minerals and phosphorus containing minerals whereby the phosphorus containing minerals go into a froth and the heavy gravity minerals remain in the froth tailing.

A further object of this invention is to provide a process for froth flotation treatment of ores in which valuable phosphorus bearing minerals may be concentrated in a flotation froth so that they may ultimately be removed in a substantially free state.

The invention consists in the novel steps, processes, combinations and improvements herein shown and described.

The invention in general is directed to forming a froth whereby the phosphorus bearing minerals go into a flotation froth and valuable heavy gravity minerals remain in the froth tailing. In this way, substantially pure heavy gravity minerals are obtained without the use of costly chemical methods in order to produce readily saleable products. This is accomplished by adding a cationic reagent of the amine type and starch or equivalent starchy material to an acid pulp of an ore containing phosphorus bearing minerals and heavy gravity minerals, said acid pulp having been placed in a cell of a conventional flotator. A froth is formed when air is agitated through the mixture with the phosphorus bearing materials going into the froth and the heavy gravity minerals remaining in the froth tailing. The phosphorus bearing materials are skimmed off at the top by skimmers or the like.

More specifically, the invention is directed to separating a phosphorus bearing material such as monazite from heavy gravity minerals such as wolframite, rutile and cassiterite. This is accomplished in the manner described above, that

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is, a cationic agent of the amine type and starch or equivalent starchy material are added to an acid pulp of an ore containing monozite and a heavy gravity metal such as wolframite, rutile and cassiterite, said acid pulp having been placed in a cell of a conventional flotator. The acid pulp is formed by adding water to an ore concentrate to form a pulp and then adding the acid. There is nothing critical as to the amount of water added in forming the pulp. High dilution favors selectivity in the separation of the phosphate minerals from the non-phosphate minerals, whereas high percent of solids in the flotation pulp favors recovery of phosphate minerals and economy of reagents. A suitable range of dilutions would be from 15% solids to 35% solids. A froth is formed when air is agitated through the mixture with the monazite going into the froth and skimmed off at the top of the cell and the wolframite, rutile or cassiterite remaining in the froth tailing.

The cationic amine acts both as a frothing agent and a flotation agent or collection promoter. An additional fortifying frothing agent such as pine oil is usually added to obtain a more desirable froth than when the cationic amine is the sole frothing agent. When the cationic amine is added without any starch, the phosphate minerals, such as monazite, separate from the heavy minerals in the froth but the separation is incomplete and difficult to control. The addition of a boiled starch or starchy product to the amine flotation agent in an acid circuit makes the separation of the phosphate minerals, such as monazite, from wolframite, rutile, cassiterite and the like, highly selective and constitutes a discovery of considerable economic value.

Illustrative examples of the cationic amine flotation agents are higher aliphatic amines, such as lauryl amine, hexadecyl amine, dodecyl amine, short chain amines such as triethanol amine; amine salts which may be used include lauryl amine hydrochloride, hexadecyl amine hydrochloride, and dodecyl amine hydrochloride; quaternary ammonium salts of the higher aliphatic series may be used such as cetyl trimethyl ammonium bromide, lauryl triethyl ammonium chloride, octadecyl trimethyl ammonium chloride; amine-fatty acid condensation products may be used such as Armac C (Coco Amine Acetate) and Armac S (Soy Amine Acetate) made by Armour &