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PROCESS FOR FROTH FLOTATION DRESSING

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The invention concerns a process for the froth flotation dressing of material containing various components of varying wettability, and espeically of complex ores, coal slimes and other coal-containing products.

The purpose of the invention is the improvement and simplification of the known flotation process, especially in the sense of a reduction in the quantities of flotation-reagents required and also of a reduction in the size of the equipment.

In the known froth flotation process, the minerals or the like which are to be separated are mixed with water, each litre containing usually between 100 and 300 grammes of solid material and forming the so-called "flotation pulp." This is added to the flotation cells and to it are added fixed quantities of flotation reagents of various types, such as collecting, frothing and regulating agents.

By means of strong agitation by agiting mechanisms or by air the pulp is well stirred and at the same time aerated, i. e. very fine air bubbles are produced by the stirring or blowing.

The separation results from the fact that the flotation reagents combine with the various components of the material, such as ores or minerals, and affect differentially the reaction to air and water of the surfaces of the particles, so that it is possible to lift definite fractions in the froth to the surface of the pulp and to remove them, either together, singly or in succession. For this purpose the quantities of flotation reagents used in relation to the amounts of pulp are relatively small, for example, given often an addition of only 200–300 grammes of flotation reagents for every 5 to 10 cubic metres of pulp. In consequence, the effect of the reagent is very limited, as in such a quantity of pulp it can only impinge more or less by chance on the ores, minerals or the like to be collected. Its effect is further weakened by other circumstances caused by the properties of the pulp.

The obvious possibility of overcoming these disadvantages by increasing the concentration of flotation reagents would mean in general an economically unfavourable increase in the amount of these used. A further disadvantage of the known processes is that in producing the required degree of separation, a very large number of flotation cells is necessary in order to rework the pulp continuously, which leads to expensive installations of comparatively large size.

The invention provides a froth flotation process which, with comparatively low expenditure of flotation reagents and furthermore a smaller number of flotation cells, or even in certain conditions a complete absence of these cells, permits the attainment of equal or in certain circumstances even more favourable results.

The basis of the process is that the raw material for flotation and the flotation reagents are brought together in such manner that a forced action between the reagents and the raw material is caused. It consists in that after the flotation reagents are added to the material for flotation the mixture of raw material and agents is subjected

to a forcing treatment in which it is at presures other than atmospheric, and the material which has been so treated or the pulp produced therefrom is then separated by aeration on the froth flotation principle. For this purpose pneumatic flotation cells are preferably used.

It is especially advantageous if the mixture to be separated is very finely ground and is subjected to the forced treatment in a condition in which it is capable of flowing, i. e. in the form of thicker or thinner pulp, and in this state is either subjected to static presure differences in containers, preferably with simultaneous agitating and shaking motion, or more advantageously is forced through narrow cross-sections, for example slits, nozzles or the like. In the case of material containing little water, being for example in a crumbly or pasty condition, the forcing treatment may consist of a thorough kneading in a kneading machine, mixing pump, kneading pump or the like. In such cases the requisite amount of water must be added to the mixture at a later stage, either in the agitator or in the flotation cells themselves.

The pressure arising in this treatment, which in certain cases can be a negative pressure, causes with certainty a combination between the required minerals or the like to be collected and the flotation reagents, and a detachment of the layer of water from the surfaces.

As an alternative to the above method the forcing treatment may be achieved by causing the mixture in pulp form to impinge on baffle-plates. This method can also be combined with the forcing of the pulp through narrow cross-sections as a final step to further improving the effect of the first treatment.

It may be found advantageous if the flotation reagent and/or the pulp are heated before the forcing treatment.

Material treated in the manner described need only be aerated in the usual way to achieve a separation into concentrate rising with the froth, and waste or gangue.

The forcing treatment will usually take place before introdution of the material into the flotation cells. It is however possible to combine the two directly, by forcing the pulp into the cells through narrow cross-sections. This may take place for example in an axial direction through the agitator, and for this purpose an apparatus working on the principle of a baffle-plate mill may for example be placed under the agitator.

In a special embodiment of the new process, the mixture of raw material and flotation reagents, when submitted to the forcing treatment, in addition to the reagents already present contains air or gaseous material or else gaseous material which itself will act as a reagent, the air or gas being added in very finely divided form.

By this method a froth containing the concentrate will already have been produced before the forcing treatment, so that in some cases it will be possible to omit any further separation treatment, and only be necessary to lead the pulp, after forcing treatment with simulltaneous aeration, into receiving vessels; the concentrate can then be removed directly from the surface of the pulp by suitable scraping-off means, such as for example froth-scrapers, froth bucket-conveyors, discharge bands and the like.

For carrying out the aeration process during the course of the forcing treatment, the latter is advantageously performed, especially with the more watery mixtures, by so-called Pallmann baffle-plate mills or similarly working pumps or apparatus with pressure nozzles. Baffle plate mills are well known as disintegrators, and generally provide a confined zone between a rotating and a stationary plate in which is disposed a counter-rotating impeller, the feed being axial and the discharge being through constrictions, such as slits or apertures, between the peripheries of the plates. The material is subjected to intensive turbulence in the confined zone and is then forced through the peripheral apertures, which provides shearing and fric-

tional forces due to the developed pressure, and the sudden release thereof.

With the use of such machines a suitable flotation froth is created immediately, and the concentrates rise directly into the froth as soon as the pulp leaves the machine.

It has been demonstrated, for example, that with this method, using only a small quantity of flotation reagents, coal which could otherwise scarcely be floated, passes immediately into the froth concentrate and with only one or two repetitions of the operations pure waste material is discharged.

In certain circumstances a single pressure treatment in a baffle-plate mill of the type mentioned will suffice to separate all the coal or the like as a froth concentrate, so that it is only necessary to transfer the treated material into a settling tank and remove the rising froth concentrate.

A further special advantage of this procedure is that with the baffle-plate mill disintegration of the material takes place simultaneously with the forcing treatment.

It may be preferable to allow the treated pulp to impinge on a liquid surface. In certain cases this enables flotation cells to be completely dispensed with, or to be used only for the subsequent collection of any valuable components remaining in the pulp.

In addition to those already described, the new process has a further advantage of fundamental importance based on the complete wetting achieved.

It is furthermore possible to replace the comparatively expensive flotation reagents used in the known flotation processes by using for this purpose less expensive and much more easily obtainable bituminous materials, such as high boiling point hydrocarbons of high pour point, for example fuel oils and even tar, pitch, distillation residue and the like, all materials which do not normally form flotation froth.

When, in accordance with one of its special features, the new process is carried out at a suitably raised temperature, bituminous materials can be used which at normal temperatures are not liquid.

The use of said low-grade materials as flotation agents also enables the new process to proceed by mere aeration of the pulp, which may follow the forcing treatment, or may with special advantage be performed simultaneously with it, to achieve an ideal flotation effect and excellent separation. When aeration is performed in the same machine as the pre-treatment, for example in a baffle-plate mill of the known "Pallmann Mill" construction, the pulp need only be transferred to a suitable apparatus, such as a flotation machine, agitator or even a settling tank and the concentrate removed therefrom. If required, additional aeration can be carried out in these apparatus, or alternatively the entire aeration process may be performed therein.

The possibility of using low-grade oils and the like as flotation reagents instead of expensive special oils and reagents in this new process, with an oil-film completely covering the particles to be raised into the concentrate makes the flotation principle applicable to coarser material, the pure components of which would not rise into the concentrate under the influence of known flotation agents. It has been found that even such particles of material when treated in accordance with the invention will readily float to the surface. The consequent increase in the applicability of the froth flotation process is an advance of very considerable importance.

Initial concentrates of high water content whose ash content as in all flotation processes is influenced by the number of waste particles in extremely fine, highly dispersed form contained therein, can be very easily removed from these very fine waste particles, with simultaneous extraction of water, by filtering or centrifuging, so that the very fine waste particles which are not covered with an oil film will very readily pass through the filter apertures and be removed, while, for example, in the case of

coal, the extremely small coal particles will agglomerate and thus remain in the concentrate without passing through the fabric of the filters or centrifuges. No such method of water removal is possible with normal flotation of concentrates, as tests have shown, and it only becomes possible with this new type of forcing treatment of the material with the flotation reagents.

When used in the dressing of coal, the new process has further marked advantages, especially with non-coking types of coal. It has been shown that the coal concentrate obtained, with the particles covered in ideal manner by hydrocarbons, will readily form briquettes, and in some instances without any further addition of binding material and without even being dried. The water in the concentrate has no adverse effects, since it cannot wet the oil-covered particles.

The concentrate can thus be used in mixture with coarser briquetting coal as a carrier for bonding agents.

The low-ash, oil-containing concentrates of the new process can be used with especial advantage for slow-reaction cokes.

A particularly interesting possible use of the new process is the production of very pure coal, using only a very small addition of oil and reagents. In consequence, only small quantities of the purer components float, which can then be further enriched by repeated flotation, with perhaps intermediate very fine grinding of the concentrates.

Reworking of the concentrate arising from the first stage is obviously possible, either in flotation cells or with simultaneous forcing treatment. This is of special importance in producing pure concentrates from heavily contaminated coal sludges because the separation of the clay which is deleterious to flotation is rapidly effected, and the concentrates having little or no clay content can then easily be purified by further flotation.

We claim:

1. A process for the froth flotation dressing of solid materials containing components of varying wettability, which comprises mixing said materials with water and a flotation agent to produce a flowable mixture, subjecting the mixture to a forcing treatment by pressing through narrow cross-sections such as slits and nozzles to produce an essential unaerated mixture of flotation agent wetted components and water wetted components, and thereafter separating the respective components by aeration in a froth flotation zone.

2. A process according to claim 1 in which the mixture is subjected to the forced treatment by being pressed through narrow cross-sections into the froth flotation zone.

3. A process for the froth flotation dressing of solid materials containing components of varying wettability, which comprises mixing said materials with water and a flotation agent to produce a flowable pulp, subjecting the pulp to intensive turbulence in a confined zone while aerating the pulp therein by admission of air in a finely divided state, pressing the aerated pulp from said zone through constrictions to produce therein flotation agent wetted components and water wetted components, and thereafter separating the respective components of the aerated pulp in another treating zone.

4. A process according to claim 3 in which the aerated pulp is passed to a separation zone, and the froth containing the flotation agent wetted components is directly removed from the surface of the pulp.

5. A process according to claim 3 in which the pulp is subjected to the intensive turbulence, aeration and pressing in a baffle plate mill.

6. A process according to claim 3 in which the aerated pulp is passed to a froth flotation zone in which it is subjected to further aeration, and thereafter the froth containing the flotation agent wetted components is removed.

7. A process according to claim 1 in which the flotation agent is oil, and defrothed oil-wetted concentrate is filtered from the water and the fines of the water-wetted component are simultaneously removed.

8. A process according to claim 1 in which the flotation agent is oil and the oil wetted component is coal, and the separated coal is briquetted using the adhering oil as a binding agent.

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