CLOSED WET GRINDING CIRCUITS

Elie Condolios, Grenoble, France, assignor to Societe Grenobloise d'Etudes et d'Applications Hydrauliques (SOGREAH), Grenoble, France, a corporation of France

Filed Sept. 2, 1967, Ser. No. 669,612
Claims priority, application France, Oct. 6, 1966, 4,992

Int. Cl. B02c 1/00, 11/08, 17/02
U.S. Cl. 241—20 4 Claims

ABSTRACT OF THE DISCLOSURE

The material delivered by a grinding mill to a classifier is diluted to bring it to optimum concentration for classification, and then the classified fine material to be further treated and the classified coarser material to be reground are separately thickened to the requisite concentrations for such operations.

This invention relates to improvements in closed wet grinding circuits.

When the end product from a rod or ball wet grinding circuit is to be finer than a given size, the system is usually run as a closed circuit with a classifier at the grinding mill delivery to separate out the fine material of the required size and to return any coarser particles to the mill for regrinding. Experience has shown that some of the fine material also goes back to the mill, thereby unnecessarily overloading the mill and appreciably reducing its output capacity.

It has been found that such recirculation of fine material is due to the fact that the high concentrations of material which are required for satisfactory grinding do not suit the classifier which can only operate efficiently at moderate concentrations, with the result that the classifier sorts the material imperfectly. On the other hand, the moderate concentrations which are suitable for the classifier are unsuitable for the grinding process, which needs a very highly concentrated product if the grinding process is to take place efficiently. Further, such moderate classifier concentrations are also unsuitable for subsequent treatment of the classified fine material, as in a flotation circuit feed.

The primary purpose of this invention is to improve such closed grinding circuits so as to assure complete treatment conditions.

In accordance with the invention this improvement is obtained by separately and independently controlling the feed concentration to the mill, the classifier operating concentration, and the fine material concentration at the classifier circuit delivery. This control is exercised so that

1. The material in the classifier is diluted to bring it to optimum classifier operation concentration;

2. The coarse material discharged from the classifier for regrinding is thickened to give it the concentration required for optimum mill operation; and

3. The fine ground material discharged from the classifier for further treatment is thickened to give it the requisite concentration for such treatment.

It has been found that when the aforesaid control is exercised on a closed grinding circuit there results such efficient classification that substantially all fine material is fed back to the mill, thereby avoiding unnecessary overloads on the mill. Such control also ensures that the concentration of the material fed back into the mill can be selected to enable the latter to operate at its maximum efficiency, and that the fine ground material is produced at the desired concentration for efficient treatment there-
of. Studies and tests have shown that if all these conditions are satisfied, a much higher output of fine ground material of the requisite size and concentration can be achieved.

A better understanding of the invention and its advantages will be obtained from a consideration of the following description when read in connection with the accompanying drawings which show schematically a closed circuit grinding system embodying the invention.

In the drawing, the numeral 1 generally designates a grinding mill into which the raw material is fed by adjustable feed means 2 of known construction, and into which the granular material for regrinding is fed through a conduit 3 provided with a control valve 15. The ground material is discharged by the grinding mill 1 into a conduit 4 which conducts such material to a classifier 5 of known construction. The classifier 5 sorts and delivers the fine material of the requisite size to a conduit 6 and discharges the coarser granular material for regrounding into a conduit 7. Water at a controlled rate is fed to the classifier 5 from an outside supply 14, through a control valve 16 and conduit 8, to dilute the material in the classifier down to the concentration required for optimum operating efficiency of such device. As an alternative in certain types of classifiers, the water diluent may be added to the material as it discharges from the grinding mill outlet and before it enters the classifier.

The fine classified material is delivered by the conduit 6 to a thickener device 9 of known construction capable of thickening the liquid mixture thereof to the concentration required for subsequent processing thereof. The thickened mixture of fine material of the desired size is discharged from the thickener 9 at a controlled rate through a conduit 10 provided with a valve 17 and to suitable processing apparatus, such as a flotation circuit feed 18. The water discharged from the thickener 9 can also be recirculated back into the system by way of a conduit 12 to the valve 16 and used as part of the dilution water for the classifier.

The coarser material discharged into the conduit 7 is delivered by the latter to a second thickener device 11 of known construction capable of thickening the liquid mixture thereof to ensure that the mixture of raw material fed into the mill at 2 and the material fed into the latter at 3 for regrinding is at the concentration required for optimum mill operation. The water discharging from the thickener 11 can also be recirculated back into the system as dilution water for the classifier by way of a conduit 13 connecting such device 11 to the valve 16.

By way of example, following is a description of the operation of an installation of the type depicted in the drawing. Let it be assumed that the grinding mill operates at its peak output capacity when it is supplied with material at a concentration of, say, 65% by weight of material. The dry material is fed to the mill at a given rate through the feed means 2. The coarser classified material to be regrind is fed to the mill through the conduit 3 at a rate of about 1/7 times the rate of feed of the dry raw material. The thickener 11 in the recirculation circuit therefore, has to be adjusted to discharge material at a concentration of around 50% in order that the mill will receive a product at a concentration of around 65%.

The ground material delivered by the mill to the conduit 4 is at the same concentration i.e. 65%, which is too high for the classifier 5 to operate at maximum efficiency. Because of this, water is fed through the conduit 8 to the classifier at sufficient rate to reduce the concentration of the material delivered by the mill 1 to the concentration, say about 20%, by weight, of solids, at which the particular classifier has been found to operate at optimum efficiency to effect excellent sizing and with prac-
3,503,560

3. A total absence of fine material mixed in with the coarser classified granular material delivered to the conduit 7.

The classifier granular material is discharged by the classifier into the conduit 7 at a concentration of about 25%, by weight, of solids. As such material passes through the thickener 11 its concentration is increased to about 50% before it enters the mill 1.

The fine material delivered by the classifier 5 to the conduit 6 is at a concentration of about 15%, by weight, of solids. The concentration of this material is increased to about 40% in the thickener 9 to make it suitable for subsequent treatment in suitable apparatus 18, such as for example, a flotation circuit.

It has been found that a grinding circuit such as above described can process 8 metric tons of ore hourly and recirculate 9.6 metric ton i.e. 1.2 times its hourly output. On the other hand, a conventional installation of the same power, with only one mill and one classifier in its circuit, has an hourly processing capacity of only 5 metric tons of ore and recirculates as much as 18.5 metric tons, i.e., 3.7 times its hourly output. It will thus be seen that with the use of an installation embodying the invention, there is a gain of over 50%.

It will be understood that the invention is not limited to the above example, and that it is intended to cover any alternative lay outs coming within the scope of the appended claims. It will be understood also, that the optimum concentration rates for the mill and classifier products will be calculated according to the various types of equipment used and the materials being processed.

What is claimed is:

1. The method of wet grinding solid material which comprises feeding coarse material to a mill so that its concentration, by weight, in the mill is high enough for efficient grinding thereof, then diluting the highly concentrated ground product from the mill to bring it to optimum classifier operation concentration and in such diluted condition separating the fine ground granular material from the coarser particles thereof, separately thickening the separated coarser classified material to increase its concentration materially, and then feeding the thickened coarser classified material and raw material in such proportion into the mill as to obtain in the mill the desired high concentration of such material.

2. The method of wet grinding solid material which comprises feeding coarse material to a mill so that its concentration, by weight, in the mill is high enough for efficient grinding thereof, then diluting the highly concentrated ground product from the mill to bring it to optimum classifier operation concentration and in such diluted condition separating the fine ground granular material from the coarser particles thereof, and separately thickening the separated fine material discharged from the classifier to increase its concentration materially.

3. In a closed circuit for wet grinding solid material, a grinding mill, means for feeding coarse material to be ground to said mill in a concentration, by weight, high enough for efficient grinding by said mill, means for diluting the highly concentrated ground product discharged from said mill to bring it to optimum classifier operation concentration, classifier means for separating from the diluted mixture and separately discharging the from the fine ground granular material and the coarser particles of such material, and means for thickening the separated coarser classified material to increase its concentration materially, said feeding means including means for feeding the thickened coarser classified material and raw material in such proportion into the mill as to obtain in the mill the desired high concentration of such material.

4. In a closed circuit as defined in claim 3, in which said diluting means comprises means for conducting the liquid extracted by said thickener means to said classifier means.

References Cited

UNITED STATES PATENTS

2,125,663 8/1938 Wuenisch 241—34
2,499,347 3/1950 Adams 241—34
3,145,935 8/1964 Wilson 241—24
3,352,499 11/1967 Campbell 241—34

GERALD A. DOST, Primary Examiner
U.S. Cl. X.R.

241—61, 80