United States Patent

Miller

[15] **3,696,923**

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[54] **METHOD FOR RECOVERING FINE COAL AND COAL-CONTAINING PARTICLES IN A COAL RECOVERY CIRCUIT**

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Related U.S. Application Data

[63] Continuation of Ser. No. 703,362, Feb. 6, 1968, abandoned, and a continuation of Ser. No. 861,908, Sept. 29, 1969, abandoned.

[52] **U.S. Cl.** **209/12,** 209/166, 210/44, 210/73

[51] **Int. Cl.** **B03b 7/00**

[58] **Field of Search** 209/12, 17, 166; 210/44, 73, 210/195, 220, 221

[56] **References Cited**

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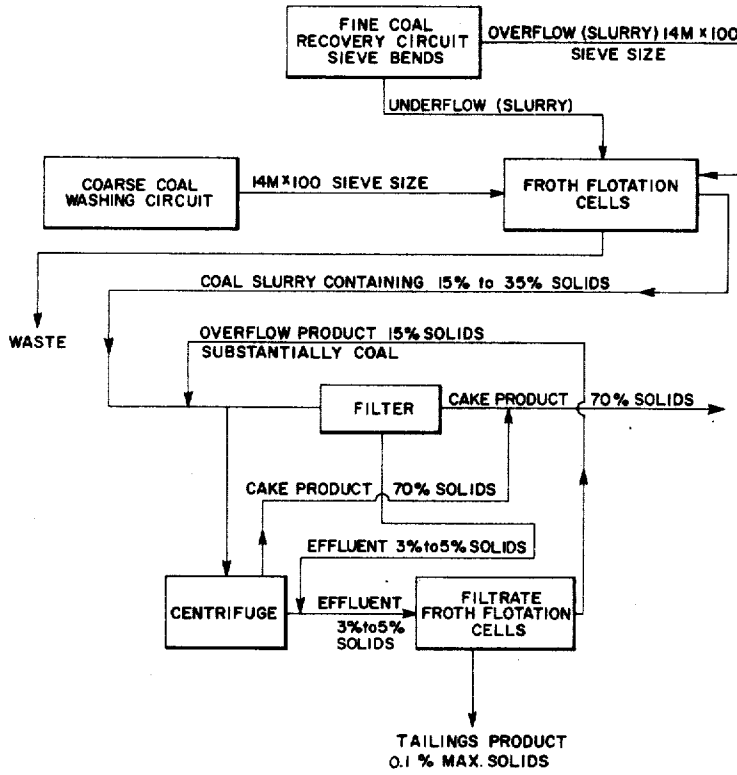
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[57] **ABSTRACT**

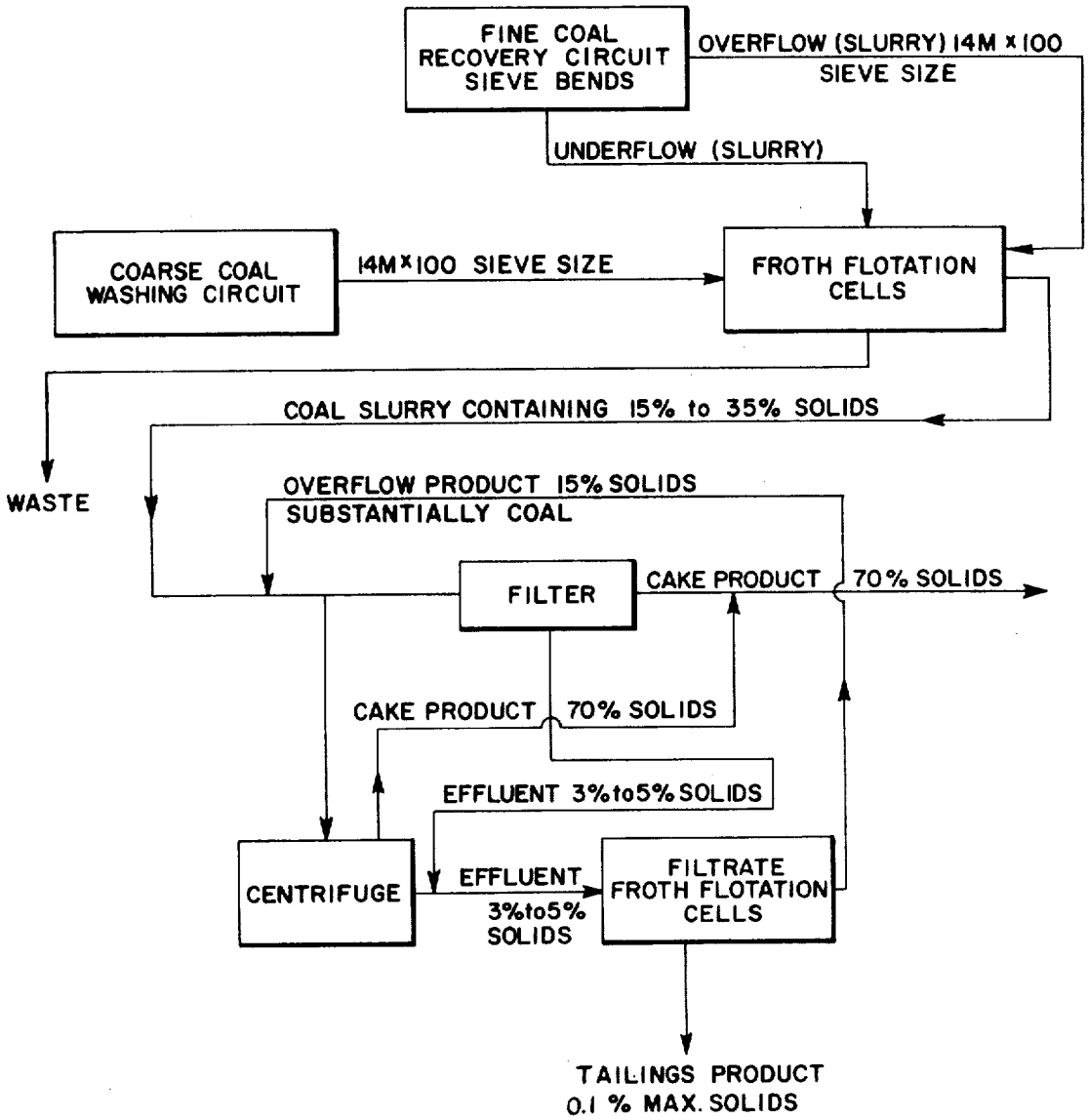
Improved method of treating a fine coal slurry from a coarse coal washing circuit and/or a slurry from a fine coal recovery circuit wherein the slurries are passed to a first froth-flotation step to recover a substantial portion of the fine particles of coal therein as a froth product, dewatering the froth product to obtain a cake product containing usable coal and an effluent containing substantially all finely divided coal particles. The effluent is passed to a second series of froth-flotation cells wherein the fine particles of coal are removed as a second froth product and substantially clean water is recovered as the tailings product. The second froth product is returned to the recovery circuit wherein the fine particles of coal are recovered. The tailings product may be recycled if desired.

1 Claim, 1 Drawing Figure



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3,696,923



INVENTOR

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METHOD FOR RECOVERING FINE COAL AND COAL-CONTAINING PARTICLES IN A COAL RECOVERY CIRCUIT

CROSS-REFERENCES TO RELATED APPLICATIONS

This is a continuing application of my original application Ser. No. 703,362 filed Feb. 6, 1968 entitled "-Method for Recovering Fine Coal-Containing Particles in a Fine Coal Recovery Circuit," now abandoned and my continuing application Ser. No. 861,908 entitled "Improved Method for Recovering Fine Coal-Containing Particles In a Coal Recovery Circuit" filed Sept. 29, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

Raw coal for processing into coke for use in metallurgical smelting furnaces is crushed and washed in apparatus to remove impurities and to obtain coal which is low in sulfur and ash content. It is a fairly simple matter to remove the coarse particles of coal from the wash water. However, the wash water slurry usually contains relatively fine coal and clay particles, e.g. smaller than 100 mesh Tyler Sieve size, which are difficult to remove from the wash water.

The wash water slurry may be passed to a fine coal recovery circuit which may be froth-flotation cells for removal of a portion of the coal particles. The waste slurry from the recovery circuit is passed to a static thickener to allow the remaining solids in the slurry to "settle-out" for discharge as waste.

The particles which contain very little if any coal "-settle-out" in the static thickener. The overflow water is cleansed sufficiently to allow its use as "make-up" water in the coarse coal washing circuit or to be passed to adjacent environments.

The froth product from the coal recovery circuit is dewatered in dewatering apparatus to remove coal therefrom as a cake product. The effluent from the dewatering apparatus contains fine coal and coal-containing particles. The amount of the fine coal and coal-containing particles in the effluent makes the effluent unfit for use as "make-up" water in a coarse coal washing circuit. Nor can the effluent be passed to waste since the environment into which it is discharged would be contaminated thereby. Therefore, the fine coal and coal-containing particles must be removed from the effluent. Because these particles are coal or contain coal, they will tend to float in the water. As a result, if the effluent is passed to a static thickener, the particles will float in the overflow water thereby contaminating the same. The overflow water cannot then be used as "-make-up" water in the coarse coal washing circuit nor can the overflow water be passed to waste. Prior practices have been directed to the use of larger static thickeners and lengthy periods of settling. However, this procedure is expensive and is self-defeating since the particles float in the overflow water.

It is therefore the object of this invention to provide an improved method for removing and recovering fine coal and coal-containing particles from a coal slurry whereby a substantial portion of the fine coal and coal-containing particles are recovered as usable coal and the water is sufficiently clarified for reuse in coarse coal washing circuits or for disposal in adjacent environments as a waste product without contaminating same.

SUMMARY OF THE INVENTION

The invention is directed to an improved method for removing and recovering fine coal and coal-containing particles from a coal slurry and clarifying the tailings product sufficiently for reuse in a coal washing circuit or for disposal in adjacent environments without contaminating same.

The improved method of the invention for removing and recovering fine coal and coal-containing particles in a coal slurry includes treating the coal slurry in a coal cleaning system, which includes froth-flotation cells, to obtain a first froth product containing fine coal and coal-containing particles and a first tailings product containing gangue materials. The first tailings product is passed to waste. The first froth product is passed to at least one dewatering apparatus to recover the fine coal and coal-containing particles as a substantially dry cake product. A first effluent from the dewatering apparatus is substantially water containing a small percentage of coal and coal-containing particles. The first effluent is treated in a solids recovery system which includes froth-flotation cells to remove a substantial portion of the fine coal and coal-containing particles as a second froth product. The second froth product is recycled to the dewatering apparatus to recover the fine coal and coal-containing particles. A second tailings product from the solids recovery system is recycled in the coarse coal or fine coal washing circuit or is passed to waste in adjacent environments without contaminating same.

DESCRIPTION OF THE DRAWING

The drawing is a schematic of a coal cleaning flotation system shown as froth-flotation cells and a solids recovery flotation system shown as filtrate froth-flotation cells wherein gangue materials are separated from fine coal and coal-containing particles in a coal slurry. The fine coal and coal-containing particles are removed from the slurry and recovered as a usable product. A tailings product produced in the method is water suitable for reuse in a coarse coal washing circuit or for disposal in adjacent environments.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawing, raw coal is washed and screened in a coarse coal washing circuit and/or in a fine coal recovery circuit. The coal from these circuits contains gangue materials and must be beneficiated so that the fine coal and coal-containing particles in the resultant slurry can be recovered as a usable product. While I have shown the slurries from the above mentioned circuits as containing particles having a size of about 14m × 100 Tyler Sieve, it must be understood that this is only by way of example and that the particles may be any sizes smaller than about 14 m Tyler Sieve. Each of the slurries from the above circuits can be treated separately or combined.

The slurry or slurries from the above-mentioned circuits are treated in a coal cleaning flotation system which includes froth-flotation cells. A suitable flotation and/or frothing agent, such as MIBC (methyl iso-butyl carbinol), sodium xanthate, pine oil or fuel oil is added to the flotation cells to float the fine coal and coal-containing particles. It is preferred to use MIBC as the

frothing agent. It has been found that about 0.1 pound to about 0.4 pound of a flotation and/or frothing agent per ton of coal is used to float substantially all the fine coal and coal-containing particles. The gangue materials are not affected by the flotation or forthing agent and sink in the flotation cells.

The froth product produced in the coal-cleaning flotation system contains about 15 percent to about 35 percent solids. The froth product is dewatered in at least one dewatering device, such as a vacuum filter or a centrifuge. A cake product containing about 70 percent solids is formed in the dewatering apparatus. The cake product is recovered as usable coal.

The gangue materials from the coal cleaning flotation system are passed to waste.

The effluent from the dewatering apparatus is a slurry containing about 3 to 5 percent solids which are substantially all fine coal and coal-containing particles. A portion of the flotation and/or frothing agent added in the coal cleaning flotation system adheres to the surface of the fine coal and coal-containing particles and is present in the effluent slurry. The effluent is passed to a solids recovery flotation system which includes froth-flotation cells. An additional amount of a frothing agent can be added to the slurry in the flotation cells. Up to about 0.1 pound of frothing agent per ton of coal is added to float the fine coal and coal-containing particles. Substantially all the fine coal and coal-containing particles in the effluent are floated and removed as a froth product. As in the coal cleaning flotation system, the frothing agent may be MIBC, sodium xanthate or pine oil but it is preferred to use MIBC. The froth product from the solids recovery flotation system contains about 15 percent solids. The froth product is recycled to the dewatering apparatus wherein the fine coal and coal-containing particles are recovered as a usable product.

The tailings product from the solids recovery flotation system is substantially clarified water containing not more than about 0.1 percent solids. The tailings product is used as "make-up" water in the coarse coal washing circuit replacing a portion of fresh water normally used in the circuit. Of course, the tailings product can be disposed of in adjacent environments without contaminating same.

In a specific example of the improved method, the overflow slurry from sieve bends in a fine coal recovery circuit was passed to a coal cleaning flotation system. About 0.2 pound of MIBC per ton of coal was added to the flotation cells in the system. A froth product containing 35 percent solids in the form of fine coal and coal-containing particles was produced in the flotation cells. The froth product was dewatered in a vacuum filter. Usable coal in the form of a cake containing 72 percent solids was recovered in the vacuum filter. The effluent from the vacuum filter containing 3 percent solids was passed to a solids recovery flotation system including froth-flotation cells. About 0.1 pound of MIBC per ton of coal was added to the flotation cells. The froth product produced in the flotation cells contained 13 percent solids. The froth product was recycled to the dewatering apparatus. The tailings product produced in the solids recovery system was substantially clarified water containing 0.09 percent solids. The water was recycled in the coarse coal washing circuit.

I claim:

1. In a method for treating a coal slurry comprising substantially all fine coal and coal-containing particles smaller than about 14 mesh and the remainder water in a coal washing circuit, in which said slurry is treated in a coal cleaning flotation system to separate gangue materials as a tailings product and to obtain a froth product containing about 15 to 35 percent fine coal and coal-containing particles, said froth product is passed to at least one dewatering device to recover a substantial portion of said fine coal and coal-containing particles as a cake product and an effluent containing water and about 3 percent to about 5 percent fine coal and coal-containing particles, the improvement comprising passing said effluent to a solids recovery system including froth-flotation cells to recover substantially all the fine coal and coal-containing particles therein as a froth product and a clarified water as a tailings product containing not more than 0.10 percent solids.

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