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DRYING OF FINELY-DIVIDED CARBONIZED FUEL.

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This invention consists in improvements in or relating to the drying of finely divided carbonized fuel, whether artificially or naturally carbonized, such as coal.

In our previous United States Patent Application Serial No. 404,106 we have described various process of producing agglomerates from impure coal, coal dumps and the like adapted for the making of briquettes. We have now found that particles of coal and the like can be flocculated under such conditions as to facilitate the separation of water therefrom without the production of briquettes under water-expelling pressure.

We have found that various agents such as certain oils, tars and other hydrocarbons or carbonaceous liquids which are incapable of forming briquettes of the carbonized materials such as coal under the conditions hereinafter described have the properties.

(1) of coating the coal particles, and (2) of causing the coal particles, when so coated, to flocculate together.

We have further found that this flocculating effect occurs with very small quantities of the agents referred to when the coal particles are agitated with the flocculating agent in sufficient water to make a mobile pulp, preferably with aeration. The quantities of the reagents may be very small, (from 3 to 10% of the weight of the coal, for example) sufficient only to coat the coal particles with a thin film of the agent like a varnish, and quite insufficient to fill the interstitial spaces between the flocculated particles. The floccules include in the interstitial spaces a large proportion of water, but owing to the fact that the surfaces of the particles have become repellent of the water, it is possible to remove contained water by filtration or draining, preferably assisted by pressure, and thus the drying of the particles becomes a simple matter.

The removal of the water associated with the coated and flocculated particles may be assisted by pressure, but it is to be understood that it is not an object of the present invention to convert the materials into briquettes, and the coating and flocculating agent does not perform the function of a binding medium to form briquettes.

The present invention offers particular advantages when the coal particles are subsequently to be made into coke because the volatile materials in the flocculating agent are distilled in the coking operation and may therefore be recovered. Moreover, the presence of the flocculating agent assists the coking of special types of coal which would otherwise be unsuitable for making into coke.

The quantity of the flocculating agent employed should be sufficient to produce the flocculation at the temperature of the circuit water. It may be reduced by using a heated circuit, but preferably the treatment is carried out at atmospheric temperature. From 3 to 5% has been found sufficient when using as agent a product such as anthracene oil, and coal-tar, coal-tar oil and other reagents may be employed in like proportion.

The following examples illustrate various proceedures in accordance with the invention:—

Example I.

Coal from a Durham colliery was ground to pass a screen of 0.4 mm. aperture. The ground coal was concentrated by flotation, using 0.23 kilos. cresol and 0.06 kilos. kerosene oil per ton of coal. The concentrates removed had a water-solid ratio of 1.3:1.

The concentrates with their associated water were placed in a vessel of square horizontal section and were agitated by an impeller rotating with a peripheral velocity of about 200 metres per minute. By-product coke-oven coal-tar was added during the agitation, the quantity of tar amounting to 4% of the weight of the dry concentrates. The test was carried out at room temperature. The coal became intensely flocculated and readily separable from the water. Removal of the bulk of the water was effected by draining; it could be assisted if desired by subjecting the flocculated coal to compression. Under a pressure of 310 kilos per square cm. the coal became substantially free from water, so much so that on drying it

in a water oven at a temperature of 100° C. for a period of 3½ hours, the weight diminished by 2.7%, which indicates the reduction in water content.

The coal was thus formed into a cake which, however, could be easily crumbled between the fingers. It will be understood that it is not essential to compress the coal into cakes in this way although this may be done both to assist removal of the water and to facilitate handling of the treated material.

Example II.

Coal from Powell Duffryn collieries was ground to pass a screen with an aperture of 0.4 mm. The coal was concentrated by flotation using 0.3 kilos. cresol and 0.23 kilos. kerosene oil per ton of coal, in which operation the ash content was reduced from 15% to 5%.

The concentrates removed had a water-solid ratio of 1.33 : 1.

The concentrates with their associated water were transferred to a vessel in which they were agitated as in Example I, and during the agitation the coal-tar product known as anthracene oil was added, the quantity of oil amounting to 3% of the weight of the dry concentrates. This operation was carried out at room temperature. An intense flocculation was produced, and when some of the wet flocculated coal was placed on a screen having 24 apertures per lineal centimetre, clear water ran through, and the greater part of the contained water drained away.

When the wet flocculated coal was placed in a mould having slits for egress of water and subjected to a pressure of 80 kilos. per square cm., some further water exuded and a cake was formed which contained 12% water.

A pressure of 160 kilos. per square cm. produced a cake containing 9% of water. In either case the cake crumbled easily in the fingers.

It is possible to effect not only the flocculation of the coal particles and the removal of the water therefrom, but also, in the same operation, it is possible to effect the separation of the gangue and other ash-forming materials from the coal particles.

Thus, according to this invention, the finely divided coal particles, mixed with gangue or other ash-forming materials, are suspended in sufficient water to make a mobile pulp. This pulp is then subjected to agitation (preferably with aeration) with a flocculating agent of the kind hereinbefore described in quantity insufficient to form an amalgam in which the interstitial spaces between the particles would be filled with the agent but sufficient to coat the coal particles and flocculate them in water, the gangue particles not being so coated or flocculated, the gangue, with the water, being separated from the coal by draining or filtration, with or without pressure, but without the production of briquettes.

Example III.

Waste coal or duff from the Powell Duffryn mine in South Wales and containing 23.04% of ash was made up into a mobile pulp with an equal weight of water, and the pulp was agitated with the addition of 4.75% of by-product coke-oven coal-tar measured on the weight of the crude coal so as to produce flocculation. The wet flocculated coal was then transferred to a press and subjected to a pressure of 310 kilos., per square cm., thereby extruding the water which carried the great proportion of the gangue. The resulting cake contained only 13% of ash and 5.56% of moisture. This test was carried out at normal atmospheric temperature.

Again the process of flocculating the coal particles may be carried out in such a way that the coal particles are coated and flocculated and separated in the form of a float supported by bubbles, while the gangue remains in the water.

Example IV.

The same material as in Example 3, viz, pulverized waste coal or duff from the Powell Duffryn mine in South Wales, was mixed with its own weight of water to form a mobile pulp. There was added to this pulp the following reagents:—4.7% by-product coke-oven coal-tar, 0.075% cresol, 0.075% paraffin oil (these percentages being measured on the weight of crude coal).

After agitation and aeration the flocculated coal, separated as a float supported by bubbles and was removed and subjected to a pressure of 310 kilos. per square cm. The resulting cake contained only 5.76% of ash and 3.87% of moisture.

This test was carried out at normal temperature.

Having thus described certain embodiments of our invention, we claim:—

1. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a suitable flocculating agent having the characteristics of a frothing agent and a coating oil under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

2. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely

divided carbonized fuel with a suitable flocculating agent containing a soluble frothing agent and a coating oil under such conditions that the fuel is flocculated and coated with a water-repellant coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

3. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a few per cent of a coal tar under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

4. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with about three per cent of a flocculating agent under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and subjecting it to a water-expelling pressure.

5. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a suitable flocculating agent under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under a pressure of the order of magnitude of a ton per square inch.

6. A process for producing carbonized fuel in finely divided form which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a few per cent of a coal tar under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under a pressure of the order of magnitude of a ton per square inch.

7. A process for producing carbonized fuel in finely divided form relatively free from ash, which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a suitable flocculating agent under such conditions that the fuel is flocculated and coated with a water repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure, whereby the fuel is obtained relatively dry and relatively free from ash.

8. A process for producing carbonized fuel in finely divided form relatively free from ash, which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a few per cent of a coal tar product under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure, whereby the fuel is obtained relatively dry and relatively free from ash.

9. A process for producing carbonized fuel in finely divided form relatively free from ash, which consists in agitating a mobile pulp of suitably finely divided carbonized fuel with a few per cent of a coal tar under such conditions that the fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure, whereby the fuel is obtained relatively dry and relatively free from ash.

10. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent to produce a concentrate relatively free from ash, agitating a mobile pulp of the concentrate with a few per cent of a suitable flocculating agent under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

11. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent including a soluble element to produce a concentrate, agitating a mobile pulp of the concentrate with a suitable flocculating agent under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

12. A process for producing carbonized

fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent containing a few per cent of a coal tar under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

13. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent containing a few per cent of a coal tar and an oily substance under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating and draining the flocculated fuel.

14. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-repelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure.

15. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a few per cent of a coal tar product under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure.

16. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a few per cent of a coal tar under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under water-expelling pressure.

17. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent containing a few per cent of a coal tar under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under a pressure of the order of magnitude of a ton per square inch.

18. A process for producing carbonized fuel in finely divided form relatively free from ash which consists in subjecting suitably finely divided impure carbonized fuel to froth-flotation concentration with a frothing agent containing a few per cent of a coal tar product under such conditions that the carbonized fuel is flocculated and coated with a water-repellent coating having so little adhesiveness as not to cause the fuel to form into briquettes under water-expelling pressure, and separating the flocculated fuel and draining it under a pressure of the order of magnitude of a ton per square inch.

In testimony whereof we have signed our names to this specification.

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