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TREATMENT OF FINELY-DIVIDED COAL AND THE PRODUCTION OF BRIQUETTES.

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To all whom it may concern:

Be it known that we, EDWIN EDSER, a subject of the King of England, and WALTER HENRY BEASLEY, a subject of the King of England, both residing at London, England, have invented certain new and useful Improvements in the Treatment of Finely-Divided Coal and the Production of Briquettes, of which the following is a specification.

This invention consists in improvements in or relating to the treatment of finely divided coal and the production of briquettes.

The invention arises out of that described in United States patent specification Ser. No. 404106. With many coals, the process of coating the coal particles with binder and agglomerating them in an aqueous pulp, and thereafter briquetting the agglomerated material, as described in that specification, is completely effective. We have, however, encountered several samples of coal which appear to resist coating and agglomeration. For example, with samples of the coals in question, when a suitable binder, such a mixture of pitch and tar, has been added to the powdered coal mixed with water, agitation does not cause the binder to coat and agglomerate the coal particles. The pitch and tar persistently come to the top of the agitation vessel, and the characteristic and necessary agglomeration does not take place. This result has been obtained on a coal slack from Ashington in Northumberland, again on a coal slack obtained from a Midland Colliery, and also by coal from Noeux les Mines in France.

We have now discovered that the treatment of the coal with an acid, preferably a mineral acid such as sulphuric acid, renders the coal amenable not only to coating with a binding medium, but to such agglomeration as will contribute to effective briquetting even in those cases where it naturally resists such coating and briquetting. For example, when a small proportion of mineral acid, such as sulphuric acid, is added to the mobile aqueous pulp in the cases hereinabove referred to, coating of the coal by the binder and also an effective agglomeration of the coal particles is brought about, briquetting being then possible and yielding excellent briquettes.

According to the present invention therefore, a process for the treatment of finely divided coal (such as coal concentrates) for coating such coal with a "binding medium" is characterized by the fact that the coal is treated with or in the presence of an acid to facilitate the adherence of the binding medium and the agglomeration of the coated particles.

Preferably where the coal is suspended in an aqueous pulp for agitation with the binding medium, the pulp is acidified to effect the treatment with acid.

The acid employed is preferably sulphuric acid, and it may be employed in a dilute state.

According to a further feature of this invention, a step in the process of producing briquettes from finely divided coal, such as coal concentrates, is characterized by the fact that the finely divided coal is suspended in water containing acid, preferably mineral acid, and subjected to agitation with liquefied binding medium, whereby the coal particles are coated with the binding medium and are agglomerated so as to be readily separable from water.

In those cases where the powdered coal is made into a mobile pulp with water, the agitation is preferably carried out with aeration to ensure effective coating and agglomeration of the coal particles, such aeration being effected either by an agent which introduces air into the pulp, or by the introduction of air which agitates the pulp.

It is also found that coals of the type to which the present invention relates frequently do not yield good metallurgical coke, or even do not yield homogenous coke at all, but we have discovered that after coating with a binding medium and manufacturing into briquettes in accordance with the present invention, such coal is capable of being coked, in fact the briquettes make excellent coke of great strength, suitable for metallurgical use.

The following is a description, by way of example, of the application of this invention

to the briquetting of coal slack from Ashington Colliery in Northumberland, England. This slack could not be successfully briquetted by any heretofore known means.

1200 grammes of slack (containing 20.7% of ash) obtained from the Ashington Colliery were crushed to pass a screen of 5 meshes I. M. M. This material was subjected to froth-flotation concentration, the reagents added being cresol, in an amount equivalent to 1 lb. per ton of slack, and kerosene, in an amount equivalent to 5/6th lb. per ton of slack. The resulting concentrates comprised 802 grammes of coal containing 7.5% of ash.

In the first part of the test an attempt was made to coat and agglomerate the concentrate with pitch and tar. The concentrate, in the form of a pulp containing about 1.4 parts of water to 1 part of solid, was mixed with 2% of tar (on the weight without the water of the coal in the concentrate) and 5% of pitch ground to pass 100 mesh. The pitch and tar used were obtained from the Bargoed Coke Ovens, Wales. The mixing was done at room temperature. The mixture was then agitated in an agitation vessel of the type used in the froth-flotation process, i. e. one which affords vigorous aeration, such for example as is illustrated in United States Patent No. 1,084,210, steam being admitted until the temperature rose to 100° C. The pitch and tar floated as a scum on the surface and did not coat the coal particles. It was noticeable that the water layer was not clear, the coal was not agglomerated by the binding medium, and that the remaining gangue was deflocculated.

To this mixture was now added sulphuric acid amounting to 2.4 lbs. per ton of concentrate. The tar and the pitch then coated the coal particles, and an intense flocculation and agglomeration of the particles at once took place. The gangue was also flocculated, as was apparent from the fact that on stopping agitation the water layer was perfectly clear. The agglomerated material when subjected to a pressure of 2 tons per square inch made excellent briquettes with a crushing strength of 1 ton per square inch. The water pressed out of the mould was quite clear and no coal was lost.

In another test the coal employed was derived from the Saar Valley in France and consisted of a mixture of bright and dull coal together with carbonaceous shale. The ash content was 24.97%, but after flotation the ash content was reduced to 9.12%.

This concentrate was screened to separate fines of a size such as to pass an aperture of 0.008 of an inch in linear dimensions and the finer portion was treated in an acid circuit containing 1 lb. per ton of sulphuric acid. The treatment was carried out in a cell provided with an agitator as before described and a binding medium was added containing three parts of pitch to two parts of tar in the proportion of 5% of binding medium on the total weight of the coal (fine and coarse). Steam was then admitted and the temperature of the pulp was raised to 90° C. After the agglomeration of the finer portion of the coal in this way, the coarse particles were added during agitation, and the whole material was thus agglomerated. Thereafter it was drained and briquetted under a pressure of two tons per square inch.

Coking was carried out by packing the briquettes in a silica pot and heating them in an electric furnace for two hours at a temperature rising gradually to 1040° C. The coke produced had a crushing strength of 2430 lbs. per square inch. These results were subsequently confirmed on a large scale in a coke oven.

As compared with this result the same concentrate agglomerated in the same way but filtered and not briquetted yielded a coke having a crushing strength of 1038 lbs. per square inch. When neither agglomeration nor briquetting was effected the coke produced was not uniform, nor sufficiently homogeneous to make any tests as to strength.

The following further test on coal slack from the Ashington Colliery is an example of the use of pitch and naphthalene as binder to form hard durable briquettes in the cold from pulverized coal suspended in water to which acid was added:—

1200 grammes of slack, containing 20% ash, from the Ashington Colliery, Northumberland, were crushed to pass a screen of 5 mesh I. M. M. This material was purified by froth-flotation, using cresol at the rate of 1 lb. per ton of slack, and kerosene oil at the rate of 5/6th lb. per ton of slack. The resulting concentrates, when dried, were found to contain 7% of ash. The concentrates, with their associated water, formed a pulp comprising 1.5 parts of water to 1 part of coal. Sulphuric acid (H_2SO_4) was added to the pulp at the rate of 2.5 lbs. of acid per ton of dried coal, and the pulp was agitated while the molten mixture of hard pitch and naphthalene, comprising 2 parts by weight of naphthalene to 5 parts by weight of pitch, was poured into it; the quantity of the mixture added amounted to 6% of the weight of dry coal. An intense flocculation and agglomeration of the coal particles was effected and on subjecting the agglomerated mass to a pressure of 2 tons per square inch, a hard, durable briquette, substantially free from moisture, was produced, that broke under a pressure greater than 1 ton per

square inch. The pitch used was obtained from the Bargoed Coke Ovens, Wales.

The experiments just described disclose a peculiar and specific phenomenon, viz, that with certain types of coal that resist coating and agglomeration with binding agents, it is possible, by the use of acid, to ensure effective coating and agglomeration.

The invention has been described in its application to the treatment of a coal concentrate mixed into a mobile pulp with water, but it will be understood that this invention is also applicable in cases where the proportion of water admixed with the coal is quite small, or in cases in which the proportion of binding agent is different from that mentioned above.

It will be understood that the expression "pitch" is intended to include such substances as the pitch obtained from petroleum distillation. The expression "finely divided coal" is intended to include all coal of the sizes dealt with in briquetting processes or in the flotation concentration of coal or mixtures of various grades suitable for such treatments.

What we claim as our invention and desire to secure by Letters Patent is:—

1. A process for the production of agglomerates of coal particles which consists in agitating coal of suitable fineness in an acidified pulp with a substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated, and separating the resulting agglomerates from pulp liquid.

2. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in an acidified pulp with a substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated and then pressing the agglomerates to form briquettes.

3. A process for the production of agglomerates of coal particles which consists in agitating coal of suitable fineness in a pulp to which sulphuric acid has been added with a substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated, and separating the resulting agglomerates from pulp liquid.

4. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in a pulp to which sulphuric acid has been added with a substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated and then pressing the agglomerates to form briquettes.

5. A process for the production of agglomerates of coal particles which consists in agitating coal of suitable fineness in an acidified pulp with a disintegrated normally solid substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated, and separating the resulting agglomerates from pulp liquid.

6. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in an acidified pulp with a disintegrated normally solid substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium whereby the coal particles are agglomerated, and then pressing the agglomerates to form briquettes.

7. A process for the production of agglomerates of coal particles which consists in agitating coal of suitable fineness in an acidified pulp with a pitch having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated, and separating the resulting agglomerates from pulp liquid.

8. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in an acidified pulp with a pitch having normally no preferential affinity for the coal particles and adapted to serve as a binding medium whereby the coal particles are agglomerated, and then pressing the agglomerates to form briquettes.

9. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in an acidified pulp with a substance having normally no preferential affinity for the coal particles and adapted to serve as a binding medium, whereby the coal particles are agglomerated, then pressing the coated coal to form briquettes, and forming coke from the briquettes.

10. A process for the production of briquettes from coal which consists in agitating coal of suitable fineness in an acidified pulp with a pitch having normally no preferential affinity for the coal particles and adapted to serve as a binding medium and with a frothing agent, whereby the coal particles are agglomerated, then pressing the coated coal to form briquettes, and forming coke from the briquettes.

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

EDWIN EDSER.
WALTER HENRY BEASLEY.