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PROCESS OF BRIQUETTING FINELY DIVIDED COAL, FUEL, OR OTHER PULVERULENT MATERIALS

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When finely divided coal or other fuel is briquetted with coal tar pitch or petroleum asphalt in the manufacture of briquettes, sufficient binding material has to be used to cover all the particles of the material to be briquetted with a film of molten binding agent.

It is a matter of experience that from 7½ to 10 per cent of bituminous binding material has to be utilized to obtain satisfactory results, whereas it is a matter of calculation that less than 5 per cent is theoretically necessary to cover the entire surface of the fragmentary fuel with the molten binder, taking into consideration the average size of the fuel particles and the viscosity of the molten agglomerant under normal working condition. The excess of binder required is due to the inadequate "wetting" of fuel by molten binder in ordinary practice, and results in a briquetted product which softens unduly and gives rise to unnecessary smoke when it is eventually consumed in a furnace.

The object of the present invention is to provide means for improving the quality of the finished product and reducing the quantity of bituminous binder employed to the amount which is theoretically necessary and is carried out as follows:—

The fuel is intimately mixed with from 3 to 6 per cent only of its weight of bituminous binder and before being introduced into the heated incorporating vessel, commonly known as the "pugmill", there is added to it an aqueous emulsion which comprises:—

1. An oil which has a natural affinity for the bituminous binding agent employed; and

2. An emulsifying agent which is capable of forming reasonably stable emulsions with the aforesaid oil, and which is itself preferably—though not necessarily—a substance possessing adhesive properties.

The emulsions which are suitable for the invention are of the "water-in-oil" type. The object and effect of adding such emulsions to a mixture of fuel and bituminous binding material is twofold. First, the oil ingredient of the emulsion fluxes the bituminous base to form a product of lower melting point and viscosity so that a harder pitch or asphalt than could be used alone becomes available for briquetting, with consequent increased ease of grinding and incorporating with the pulverized fuel. Secondly, the emulsifying agent, which will generally be an aqueous solution, but which may also be a pseudo-solution or a suspension in water, induces the dispersion of water in the asphalt or pitch, which is fluxed by the oil, when the emulsifying agent comes into contact with bitumen at a temperature of 80° to 100° C., which is the normal range of temperatures to which the fuel and binder are heated in the final mixing process. This dispersion of water in bitumen is an essential feature of the present invention and results in increasing the volume and covering action of the agglomerant, which is thus compounded in situ during the final incorporation.

It has previously been proposed by various means, (*a*) to disperse water in a bituminous base, or (*b*) to emulsify bitumen in water, and to use these compounded products as binding agents for finely divided fuels, but the present invention differs materially from these known processes. As regards (*a*), not only is special plant required to prepare such dispersions of water in bitumen, but the resulting products are semi-solids which are "tacky" and difficult to grind; moreover, they lose much of their essential dispersed water in the course of grinding.

Further disadvantages attending the use of such compounded binders, are the very considerable costs in power, labour, and plant upkeep which they entail, and the long period which must elapse between the time when the hot, plastic mass is first manufactured and the time when it is sufficiently cool and consolidated to go through a disintegrating appliance without choking it.

As regards (*b*), the products which are known as "bitumen emulsions" are emulsions of bitumen in water in which the water represents the "continuous phase" of the emulsion. Such emulsions cannot be produced by the methods of the present invention, which cause the dispersion of water in bitumen with the bitumen representing the "continu-

ous phase", of the emulsion, which is momentarily produced when the various ingredients are brought together and heated in the final mixer. Furthermore an essential condition of emulsifying bitumen in water is the use of bitumen which melts at about or below the boiling point of water, whereas an important feature of the present invention is the use of bitumens which melt at and above 120° C. and which are quite incapable of yielding emulsions in water by any known process.

It is therefore clear that the present invention does not refer to the use either of a previously manufactured dispersion of water in bitumen or of a previously manufactured emulsion of bitumen in water, but refers solely to the use of emulsions of oil and water which are added to a mixture of finely divided fuel and a bituminous material.

Mixtures of oils with solidifying or saponifying agents have been added to fuel or road metal and pitch or other bituminous binding materials.

Emulsions suitable for the purpose of the present invention can be made in various ways, but these can be subdivided into two principal classes:

Class 1. Emulsions of water in oil are produced by the gradual addition with thorough agitation in an emulsifying vessel, of any one or more of the following substances, previously dissolved in water, to heavy petroleum fuel oil, which may possess either an asphaltic or a paraffin base: the chlorides, sulphates, nitrates, carbonates, or hydroxides of the alkali metals or of ammonia; the chlorides or nitrates of the alkaline-earth metals; the silicates of the alkali metals.

Class 2. Emulsions of water in oil are produced by the same method as in Class 1, but instead of using solutions of mineral or inorganic salts, organic, colloidal solutions or suspensions are employed which possess a high degree of viscosity and which are themselves mostly substances possessing adhesive properties. Typical emulsifying solutions are those of sodium caseate, gelatin or glue, sodium alginate, sodium pectate, sodium tannate or cellulose sulphite waste liquor, either in the acid state or after neutralizing with caustic soda. Typical emulsifying suspensions are the pulps produced by boiling, preferably under pressure, cereals, such as maize, wheat, or barley, or tubers, such as potatoes or beet, or vegetable growths, such as marine or fresh water algae, with sodium carbonate or sodium hydroxide.

The emulsions in question will generally comprise one part of fuel oil to from one to six parts by weight of aqueous solution or suspension, and the manner in which the invention is carried out for the purpose of briquetting finely divided fuel, is as follows:—

The fuel is intimately mixed with from 3 to 6 per cent of its weight of native asphalt, "petroleum asphalt", or other pitch resulting from the distillation of tars or mineral oils. This intimate mixture may take place either by previously grinding the said asphalt or pitch or by adding the latter in a molten condition. After this intimate mixture has taken place a quantity of emulsion, representing from one to four per cent of the weight of the fuel is added to the mixture. Both the mixture of fuel with binder and the added emulsion may at this stage be cold. The addition of the liquid or pasty emulsion is made in such a manner that the emulsion is distributed throughout the mass of fuel as uniformly as possible in the first instance and the three constituents, fuel, bitumen and emulsion, may then be subjected to a further cold mixing process in an appliance such as a squirrel cage or other form of mechanical mixer or homogenizer, before passing into the final mixer in which heating takes place prior to briquetting.

Example 1

Anthracite was briquetted with 6% B1 petroleum asphalt, melting point 120° C., 1.2% of emulsion comprising equal parts by weight of Mexican fuel oil and a 20% soda ash solution.

Example 2

Anthracite was briquetted with 6% B1 petroleum asphalt, melting point 120° C., 1.8% of emulsion comprising one part of Mexican fuel oil to two parts of a 5% solution of sodium caseate.

Example 3

Welsh steam coal was briquetted with 5% of petroleum asphalt, melting point 140° C., 2% of emulsion comprising equal parts of Mexican fuel oil and a 2% sodium alginate solution.

Example 4

Canadian carbonized lignite was briquetted with 6% B1 petroleum asphalt, melting point 120° C., 3.2% of emulsion comprising one part of Mexican fuel oil to four parts of pulp, produced by boiling equal weights of potatoes and water with 1% of sodium silicate under pressure.

Example 5

New Zealand Slack was briquetted with 6% B1 petroleum asphalt, melting point 120° C., 1.8% of emulsion comprising equal parts of Mexican fuel oil, cellulose sulphite waste liquor of 1.3 specific gravity, and water.

All the above examples gave briquettes, pressed at 30 cwt. to the square inch, which posesssed cohesions as determined by the Belgian drum test of from 85 to 90 per cent.

I claim novelty for a process of briquetting in which I bring together, during the stage when the constituents are incorporated and heated, immediately before they are moulded and pressed:—

1. The fuel which is to be briquetted;

2. The bituminous material—which is the binding agent;

3. An emulsion—which serves solely to increase the activity and efficiency of (2).

I do not claim the emulsions (3) as binding agents, which, for the most part, they are not.

I do not claim that all the emulsions which I may use are novel, though most of them are.

What I claim is the method whereby the emulsions (3), applied in the manner I described, cause a dispersion of water in (2) at the moment when the mixture is prepared for briquetting—such dispersion increasing the covering power, and therefore the cementing action, of the binding agent (bitumen) which is employed.

It is an esential feature of my invention that the emulsion should persist unbroken and in its original liquid form until such time as it has been added to the mixture of fuel and binding agent.

I claim:—

1. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material and adding thereto an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

2. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material and adding thereto an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent possessing adhesive properties and capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

3. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material normally melting at and above 120° C. and adding thereto an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

4. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material and adding thereto an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

5. A process of briquetting consisting in mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

6. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material normally melting at and above 120° C. and adding thereto an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent possessing adhesive properties and capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

7. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material normally melting at and above 120° C. and adding thereto an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent possessing adhesive properties and capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

8. A process of briquetting consisting in mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and an emulsifying agent possessing adhesive properties and capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

9. A process of briquetting consisting in mixing a finely divided pulverulent material and a solid bituminous material normally melting at and above 120° C. and adding therto an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

10. A process of briquetting consisting in

mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material normally melting at and above 120° C. and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising an oil having an affinity for the bituminous material and a emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

11. A process of briquetting consisting in mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent capable of forming stable emulsions with the oil, and subsequently heating and pressing the mixture.

12. A process of briquetting consisting in mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material normally melting at and above 120° C. and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent capable of forming stable emulsions with the oil and subsequently heating and pressing the mixture.

13. A process of briquetting consisting in mixing in a cold state a finely divided pulverulent material and from three to six per cent of its weight of a solid bituminous material normally melting at and above 120° C. and adding thereto from one to four per cent of its weight of an emulsion of the water-in-oil type comprising one part of an oil having an affinity for the bituminous material and one to six parts by weight of an emulsifying agent possessing adhesive properties and capable of forming stable emulsions with tne oil and subsequently heating and pressing the mixture.

In testimony whereof I have hereunto set my hand this 5th day of March, 1928.

OTTO REYNARD.