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FUEL BRIQUETTE

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This invention relates to fuel briquettes, binders for fuel briquettes, and an improved method for manufacturing the same, and an object thereof is to provide a binder for use in producing fuel briquettes which may be handled without disintegration and, while burning, will retain their general form.

Among other objects of the invention, I provide an improved binder for effecting under compression strong and positive union between the fuel particles of which the briquette is mainly composed, the said binder being of such a character that but very limited quantities thereof are necessary to maintain the solidity of the briquette and to avoid crumbling, the release of fuel dust or other disintegration thereof under the usual conditions of handling, storage and transportation.

Another object is to provide an improved briquette binder comprising generally a hydraulic cement, which is present in excess of 75% by weight of the total binder, and to this cement there is added a small amount of a heavy petroliferous substance such as asphalts or petroleum residues, a small amount of a metallic salt and other smoke-reducing and combustion aiding material.

Thus in the manufacture of my improved fuel briquette, the latter consists primarily of such solid combustible substances as coal fines, coke breeze, peat, petroleum coke, sawdust, charcoal and the like. To unite these materials in briquette form under compression, my improved binder comprises the following materials which may be grouped in the order indicated:

Group 1.—A finely divided hydraulic cement, to which is added:

Group 2.—A small amount of one or more of the following: pitch, tar, bitumen, bituminous residues, asphalts, petroleum residues, rosin, resins or resinates.

Group 3.—A small amount of one or more of the following metallic salts: ferric chloride, ferric sulfate, magnesium sulfate, sodium sulfate, magnesium sodium chloride, calcium chloride, magnesium chloride, sodium phosphate, barium chloride, calcium oxy-chloride, sodium hypochloride. In this group of materials, I may employ a preparation composed principally of lime and calcium chloride.

Group 4.—A small amount of a mixture made of the following ingredients: sodium or potassium dichromate 0.2 part to 5 parts; sodium or potassium nitrate 0.5 part to 10 parts; sodium or potassium chloride 98.1 to 77 parts; sodium or potassium permanganate 0.1 part to 2 parts; manganese dioxide 0.1 part to 1 part; manganese perchloride 0.1 part to 1 part; carbon 1.0 part to 5 parts.

The above ingredients found in Groups 1 to 4, are mixed and blended in substantially the following proportions, either by parts or by per cent.:

Group 1. 1077.5 parts to 980 parts or 99.65% to 75%.

Group 2. 1.0 part to 50 parts or 0.2% to 10%.

Group 3. 1.0 part to 40 parts or 0.1% to 10%.

Group 4. 0.5 part to 10 parts or 0.05% to 5%.

To produce a successful binder from the materials above specified, it is ordinarily necessary to grind all components of the binder together, so that the resultant powder produced has a fineness of substantially 87% through a 200 mesh per linear inch screen or sieve, but for best results, the ingredients should have a fineness of 93% to 95% capable of passing through a 200 mesh sieve. It is this finely divided or powdered state of the binder which enables it, when mixed with the fuel particles, to readily spread over all surfaces of the fuel particles in a uniform and thinly distributed manner. Preferably, I obtain this powdered form of the binder by passing the same through a rotary grinding mill, containing metallic or other grinding elements, whereby through this process of attrition, the desired fineness of the ingredients of the binder is secured. A tubular grinding mill may be used advantageously in obtaining a continuous grinding operation. The binder may be added to the fuel body in proportions varying from 60 pounds to 75 pounds to one ton (2000 pounds) of coal fines. Moisture is then added to the extent of from 5% to 6% by weight of the whole mass, including coal and binder. The amount of moisture so added will, of course, vary with the normal moisture content of the fuel. The entire mass is then placed under compression of not less than substantially 700 pounds per square inch and the briquette is then in such form that it may be handled in an ordinary manner without any appreciable disintegration.

The briquette may be either cubical or of other desired shape, and its particles will be found to be so bonded that in the actual burning thereof, the briquette does not melt or completely disintegrate, as heretofore, but rather retains its approximate shape until the briquette or cube is substantially completely consumed. This characteristic is due largely to the improved binder and the pressure under which it is made. Due to the density of the briquette, aided by the bonding agent, the fuel

burns more slowly than the coal or other fuel from which it is made, at the same time, due to the chemicals contained in the binder, it burns with a very high heat. This characteristic is apparently attributable to the complete and rapid combustion of the slowly released particles of coal with the supporting combustible in the binder. The binder imparts high early strength to a briquette and is both fast setting and quick hardening. Also, the binder serves as an immediate bonding agent on the fuel particles while the cement is developing its quick hardening and high early strength properties. The use of the binder results in the production of a fuel briquette having improved combustion qualities in that it is substantially smokeless and burns with a non-clinkering ash.

The addition of one or more of the constituents of the compounds specified in Group 2, above, imparts to the binder the following properties: First, it produces a tacky condition in the resultant cement binder which, when mixed with the fuel particles, causes them to adhere together when pressed. Also, these materials induce bulking of the cement binder in processing, causing it to flow almost like water. This property causes the binder when mixed dry with the fuel to cover, diffuse, and penetrate into and over all the fuel particles, so that these particles are in a condition to be quickly and firmly bonded together when subjected to compression. Also, the compounds in Group 2 tend to waterproof the cement binder so that when added to the fuel particles in the desired proportions and mixed with added moisture, the binder will quickly diffuse itself throughout the entire mortar mass and cover all the particles with the bonding agent. Again, these compounds are readily combustible of themselves and, therefore, promote combustion of the fuel particles, and produce practically no ash. They also increase the B. t. u. content of the resultant fuel briquette and when mixed with the fuel produce an immediately effective bonding action.

The addition of one or more of the metallic salts, found in Group 3, above, to the binder, accelerates its setting time and increases its strength. In other words, the addition of these salts provide a fast setting cement binder, one having the ability to harden quickly and of high early strength. The fast setting and high early strength properties of the binder are best obtained by incorporating the salts in the cement during grinding thereof. Thus to produce what I consider to be the best results, it is necessary to grind all components of the binder together so that the resultant powder produced has at least a fineness of 87% through a 200 mesh screen and preferably a fineness of from 93% to 95% through such a screen.

The mixture of ingredients found in Group 4 may be added, as indicated, to the binder in small amounts. This mixture, if used, also accelerates the setting time and increases the strength of the binder. It acts as an aid to the combustion of the briquette by preventing smoking and the formation of soot. The mixture set forth in Group 4, contains oxygen carriers which, under the influence of heat, give off small amounts of oxygen and other combustible materials which aid and support combustion.

In the process of manufacturing this hydraulic cement binder, the various ingredients are all added to and thoroughly incorporated with the hydraulic cement, preferably Portland cement, or clinker by grinding together. This produces both a physical and a chemical combination of the materials which imparts to the binder the special characteristics hereinbefore mentioned.

In my invention, the cement is used as the primary material in the binder, but the added ingredients act as immediate bonding agents. In addition, they also accelerate the hydration of the cement, thereby permitting the use of a minimum amount of the cement binder. For example:

75 pounds of the binder will briquette one ton (2000 pounds) of coal fines, so that such briquettes can be shipped in open cars and dumped from elevated trestles without appreciable damage.

60 pounds of binder can be used to a ton of coal with available improved cements or with ordinary cement binder if the briquettes are put in packages or cartons.

It will be observed that 75 pounds of binder to a ton of coal is a ratio of 1:27 by weight and 60 pounds to a ton of coal is a ratio of 1:33 by weight. The binder in approximately 4% by weight of fuel can be used. This unusually low proportion of binder to the coal is mainly attributable to the fineness or powdered state of the binder, as above specified, and also to the use of the ingredients found in Groups 1 to 4.

My improved composite fuel is new in its burning characteristics in that it contains ingredients that assist in burning the briquette and which are combustible in themselves. Certain of these ingredients, notably those contained in Group 4, liberate a small amount of oxygen when burning. The body of the improved fuel while dense, yet has sufficient voids and pores to permit the escape of gases generated by heat, thus admitting of access on the part of oxygen to these fuel gases so that the latter burn at the surface of the briquette, releasing an intense heat. During the burning of the briquette, the cement disintegrates under the action of heat and permits of the gradual release of the small particles of coal or other fuel. The finished briquette, made in accordance with the present invention, is so bonded and bound that in its actual burning it does not melt or completely disintegrate, but rather retains it approximate shape until substantially consumed. This characteristic is due primarily to the binder and the pressure under which it is made. As stated, in the formation of the briquette, the machine used in applying pressure to the mass of coal and binder should impart pressures of the order of not less than 700 pounds per square inch and preferably not more than 1500 pounds per square inch. With these pressures, I have obtained the results and burning characteristics above mentioned. Due to the density of the briquette, aided by the bonding agent and the pressures above specified, the fuel burns appreciably more slowly than the coal or other fuel from which it is made. At the same time, due to the chemicals contained in the binder, it burns with a very high heat, which is attributable to the complete and rapid combustion of the slowly released particles of coal with the supporting combustibles in the binder.

It is of course possible to vary within certain limits the proportions and ingredients entering into the composition of my improved binder as above specifically set forth without departing from the underlying spirit and scope of the invention, as the latter has been defined in the following claims.

What is claimed is:

1. A new article of manufacture, a solid fuel briquet formed under pressures between 700 pounds per square inch and 1500 pounds per square inch and consisting of a solid combustible fuel and a binder in proportions of the order of 60 to 75 pounds of binder to a ton of fuel, said binder comprising a mixture of hydraulic cement from 75% to 99.65%, hydrocarbon from .2% to 10%, metallic salt .1% to 10% for quick setting of the cement, oxygen-liberating material .05% to 5%; said mixture being ground to a fineness such that at least 87% passes through a 200 mesh screen.

2. A new article of manufacture, a solid fuel briquette comprising a binder and a solid combustible fuel in the ratio of approximately 4% by weight of binder, said binder comprising a mixture of hydraulic cement from 75% to 99.65%, hydrocarbon from .2% to 10%, metallic salt .1% to 10% for quick setting of the cement, oxygen-liberating material .05% to 5%; said mixture being ground to a fineness such that at least 87% passes through a 200 mesh screen.

3. A solid fuel briquette having high early strength formed under pressures between 700 pounds per square inch and 1500 pounds per square inch and comprising coal and a binder in approximate proportions of 60 to 75 pounds of binder per ton of coal, said binder containing at least 75% of Portland cement ground to a fineness such that at least 87% passes through a 200 mesh screen.

4. A fuel briquette including a binder capable of imparting high early strength, fast setting and quick hardening to a solid fuel briquette, said binder being in the proportions of from 60 to 75 pounds per ton of coal, said binder comprising a mixture of hydraulic cement from 75% to 99.65%, hydrocarbon petroliferous material, metallic salt for quick setting of the cement, and said binder ground to a fineness such that at least 87% passes through a 200 mesh screen.

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