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BRIQUETTING OF SOLID COMBUSTIBLES

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The present invention relates to the briquetting of solid combustibles and more particularly to the briquetting of solid combustibles by means of a process which does not require the use of dry combustibles as the basic material of the briquette and which process results in the formation of weather-resistant briquettes which have a high heating value.

Until the present time the briquetting of combustibles, particularly when using damp combustibles as the basic material, resulted in frequent failures of the briquetting process and the production of products which were unusable in industry. As a practical matter it was therefore possible only to utilize a very limited number of binding agents for the briquetting of damp combustibles. However, even these limited number of binding agents did not form briquettes after the compressing operation which complied with industrial requirements. It was therefore necessary until the present time in order to produce briquettes substantially free of faults to first dry the solid combustible, often by the application of heat.

It is therefore an object of the present invention to provide a process of forming briquettes of solid combustibles which process avoids all of the above enumerated difficulties of the prior art.

It is a further object of the present invention to provide a process of forming briquettes of solid combustibles without the necessity of starting with a previously dried solid combustible as the basic material.

It is still a further object of the present invention to provide a process of producing solid combustibles utilizing a cheap and easily obtainable binding agent.

Other objects and advantages of the present invention will be apparent from a further reading of the specification and of the appended claims.

With the above objects in view, the present invention mainly comprises the steps of intimately mixing at least one finely divided solid combustible with an aqueous dispersion of at least one bitumen, a water-dispersible clay and at least 0.5% by weight of the dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of the combustible and the dispersion, and drying the thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of the solid combustible.

The amount of polycyclic aromatic hydrocarbon in the aqueous dispersion of the bitumen, water-dispersible clay and polycyclic hydrocarbon is preferably, according to the present invention, between 1-4% by weight of the dispersion.

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The polycyclic hydrocarbons which are preferred for use with the present invention are those obtained from the high boiling point distillation of mineral coals and the like, such as raw naphthalene, naphthalene, raw anthracene, anthracene, raw phenanthrene, phenanthrene, raw carbazole, carbazole, and the like. It should be noted that raw naphthalene and raw anthracene may contain phenanthrene and carbazole in amounts of up to about 30%. It should also be noted that single polycyclic hydrocarbons of the type mentioned may be used, or any combination of polycyclic hydrocarbons.

According to the present invention it is unnecessary to utilize a dry solid combustible as starting material, thereby eliminating the costly step of drying the solid combustible by heat and the like. In fact, according to a preferred embodiment of the present invention it is desirable to utilize a wet or wetted finely divided solid combustible and it is further preferred in this respect that the solid combustible be wetted with an amount of water equal to about 15-25% of the solid combustible. The wetting of the solid combustible may be carried out in any convenient manner, it only being desirable to make certain that the material is thoroughly and homogeneously wetted throughout.

According to a further preferred embodiment of the present invention the wetting of the solid combustible is carried out using gas condensate obtained from a coking purification process and consisting mainly of water, instead of pure water. This gas condensate in addition to water will contain small amounts of polycyclic aromatic hydrocarbons; i. e. about 0.20% naphthalene, and traces of light oil. The presence in the gas condensate of the polycyclic hydrocarbons is advantageous, for the further briquetting operation according to the present invention.

The gas condensate which is used for this purpose and which may also be used for another purpose which will be more fully described, is obtained in coking in the production of valuable coke products, the condensate being obtained by cooling off the gas after removal of the ammonia and in which process the desulfurized gas is freed under pressure from benzol. By escape of the gases from the desulfurizing there is obtained a water-saturated gas at a temperature of about 30-35° C. which is then compressed at a pressure of about 7-9 atmospheres. The compression of the gas increases the temperature thereof to about 75-85° C. The gas is then fed at this pressure to a pressure cooler in which the gas by indirect cooling is cooled to a temperature of about 20° C. and a gas condensate is obtained. The gas loses the water and naphthalene contained therein until only traces remain, leaving the gas condensate. From there the gas is conducted to the consumer under pressure. The remaining gas condensate contains up to about 0.20% naphthalene, traces of light oil, is milky and has a temperature of about 20-23° C. The gas condensate consists mainly of condensed water.

This gas condensate may also be used instead of plain water in forming the aqueous bitumen dispersion. The advantage in the use of a gas condensate instead of plain water for this purpose is that the gas condensate contains a small amount of polycyclic hydrocarbons and it is therefore possible to use less polycyclic hydrocarbons in the bitumen itself.

In forming the aqueous bitumen dispersion the amount

of polycyclic hydrocarbon necessary to have at least 0.5% by weight of the aqueous dispersion, and preferably between 1-4% by weight, may be added to the bitumen itself or to the water in which the bitumen is dispersed. In the event that gas condensate is used instead of water, the amount of the additional polycyclic hydrocarbon to be added is thus lowered.

The bitumen utilized in the dispersion according to the present invention is preferably derived from coal and most preferably is a substance such as mineral coal tar pitch. However, other bitumens may be utilized with good results. As tar- or pitch-like starting materials for the dispersions it is suitable to utilize mineral coal pitch or mineral coal tar pitch which may be obtained for example from any of the following substances: high temperature coke oven tar, low temperature tar, generator tar, horizontal retort tar, vertical retort tar, oil gas tar, water gas tar, etc. These tars can either be worked up alone or together to tar pitch.

The pitch utilized should preferably have a softening point which is no higher than 60° C. according to Kraemer-Sarnow, or if it has a higher softening point it should preferably be refluxed until the Kraemer-Sarnow softening point is no higher than 60° C. By softening point according to Kraemer-Sarnow is meant the temperature at which a mercury column in a little tube having an inner diameter of 6 mm. and weighing 5 kg. passes through a tar pitch or bitumen layer of 5 mm. height which is contained in a little tube having the same inner diameter.

The water-dispersible clay contained in the aqueous bitumen dispersion is not limited to any particular clay, any clay having the property of being water-dispersible or being made water-dispersible by the action of a wetting agent being suitable. Aluminum silicates, particularly of the kaolin type, are most suitable.

The aqueous dispersion may be simply formed by mixing the bitumen, water-dispersible clay and a sufficient amount of the polycyclic hydrocarbon or hydrocarbons with water or gas condensate. The polycyclic hydrocarbon may either be first mixed with the water, the water-dispersible clay, the bitumen, or the mixture of all three. The mixing is most preferably carried out using heated bitumen, at a temperature of 60-80° C.

The amount of aqueous bitumen dispersion utilized with the finely divided solid combustible to form briquettes according to the present invention may vary within rather wide limits. The best results have been obtained, however, utilizing the aqueous bitumen dispersion in an amount of 1-30% of the amount of solid combustible, depending on the type of combustible utilized. The preferred amount of dispersion as binding agent is generally between 5-10%.

The wetness of the solid combustible utilized as basic material does not affect the briquetting process according to the present invention. It is therefore possible to utilize dry as well as naturally wet starting material. Because of the excellent dispersing power of the aqueous bitumen dispersion which is preferably applied in a thin stream onto the combustible, the distribution of the binding agent into the individual portions of the combustible is highly intensive, so that it is possible to utilize less binding agent than was hitherto possible. This therefore, results in reduced cost of manufacture of briquettes.

The exact amount of dispersion to be utilized can be easily determined by simple pretesting. It is therefore unnecessary to give specific limits.

A further saving of binding agent can be obtained particularly when using a dry combustible as starting material, by first wetting the combustible with water and/or gas condensate before mixing the same with the dispersion.

After shaping, the briquettes may be subjected to some pressure during drying. However, according to the present invention it is possible to utilize much less pressure, due to the use of the aqueous bitumen dispersion as bind-

ing agent, than was previously possible. The drying of the shaped mass may be carried out either by storing in air, in a drying chamber, in an oven or in an oven having air blown through the same.

One of the great advantages of the present invention is the surprisingly short time required for drying of the shaped mass. For example, briquettes of coal sediment lose about 30% by weight water in 24 hours of air drying.

The mixing of the starting combustible and the aqueous dispersion may take place at room temperature and it is not necessary according to the present invention to heat the same while mixing. It is also unnecessary, according to the present invention to utilize a uniform solid combustible as the basic substance, and an advantage therefore is the possibility of utilizing various starting materials, which differ as to shape, size, and origin, while still obtaining briquettes having excellent properties. For example, coal sediment and small coke may be mixed to form briquettes having properties which were unobtainable prior to the present invention.

The application of the binding agents of the present invention increases the porosity and the heat value of the dried briquettes. Another advantage of the present invention is the fact that the briquettes burn practically completely upon use, because the binding agents of the present invention are themselves combustible.

The solid combustibles which may be used in finely divided state according to the present invention and which may be either wet or dry, are not limited to any specific combustibles or mixtures thereof. It is possible to utilize, either dry or wet ores such as flue dust, ore dust, roasted pyrites, flue dust sediment, ore flotation slime and the like, either alone or in combination with ordinary combustibles, such as small coke sediment, small coke, coal sediment, coal dust, finely divided anthracite, and the like.

According to a preferred embodiment of the present invention dry or slightly wet combustible may be first wetted with water and/or gas condensate in an amount of about 15-25% water before mixing with the dispersion. It should be noted, however, that overwetting of the combustible is not harmful and for example, flue dust sediment may be wet with as much as 50% water.

The shaped and pressed articles obtained according to the present invention after drying of the mass are weather-resistant and are not adversely affected even upon exposure to rain and frost. It is desirable, however, to protect the shaped mass until solidification of the same by the sweating-out of water therefrom. The sweating-out of the water results in a larger pore size so that the shaped and pressed articles have particularly good reaction properties in the blast furnace or foundry shaft furnace.

It is further possible according to the present invention to sinter the shaped and pressed articles at temperatures of about 600-700° C., thereby slowly removing the binding agent by degassing, this procedure not causing any falling apart or cracking of the article, because of the large pores and the high solidity thereof.

The sintered or non-sintered shaped and pressed articles retain their shape and form during the smelting or foundry process until the melting point is reached, and do not fall part by action of choke damp or steam of the charged gas, and, in fact, are even further solidified until the melting temperature is reached. The briquettes are only degassed and sintered upon reaching the melting temperature.

The following examples are given as illustrative of preferred procedures according to the present invention, the scope of said invention not, however, being limited to these specific examples.

Example I

1.0 kg. of the gas condensate to which is added an

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amount of naphthalene or anthracene corresponding to 2% by weight of the weight of the final dispersion is mixed in a heated mixture with 1.3 kg. of washed kaolin to which is further added 2.5 kg. of molten mineral coal tar pitch (Kraemer-Sarnow softening point 35–40° C.). The temperature of the mixture is maintained at 60–80° C. An additional 2.0 kg. of gas condensate is added to the mixture.

The formed aqueous dispersion is added to a mixture of 26 kg. flue dust and 42 kg. coke dust which has been previously wetted with 8 kg. gas condensate in the form of a thin stream while thoroughly agitating. The formed mass is shaped as desired and allowed to dry at room temperature in open air for about 1–1½ days. The resulting briquettes are highly porous and stable.

Example II

4.2 kg. of gas condensate to which 0.2 kg. of finely divided raw naphthalene has been added, is thoroughly mixed at 60–80° C. with 2.0 kg. of washed kaolin containing 10% quartz. 3.7 kg. of mineral coal tar pitch (Kraemer-Sarnow softening point 40–45° C.) is then added while hot (120° C.) and is thoroughly mixed.

The resulting dispersion is slowly added in a thin stream to 200 kg. coke dust sediment contained 20% water while thoroughly agitating. After thoroughly mixing the resulting mass is dried in a heated chamber at a temperature of about 60° C. for about 12 hours. The resulting briquettes do not crumble at temperatures up to the melting point thereof and are also weather-resistant.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A process of briquetting solid combustibles, comprising the steps of intimately mixing a preponderant amount of at least one finely divided solid combustible having a water content of 15–25% with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a Kraemer-Sarnow softening point no higher than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 0.5–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

2. A process of briquetting solid combustibles, comprising the steps of intimately mixing a preponderant amount of at least one finely divided solid combustible having a water content of 15–25% with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a Kraemer-Sarnow softening point no higher than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 0.5–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings and being selected from the group consisting of naphthalene, anthracene, phenanthrene and carbazole so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

3. A process of briquetting solid combustibles, com-

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prising the steps of wetting at least one finely divided solid combustible with gas condensate obtained from a coking purification process and consisting mainly of water in an amount such that the water content of said combustible is 15–25%; mixing a preponderant amount of said wetted, finely divided solid combustible with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a Kraemer-Sarnow softening point no higher than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 0.5–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

4. A process of briquetting solid combustibles, comprising the steps of wetting at least one finely divided solid combustible with water in an amount such that the water content of said combustible is about 15–25%; mixing a preponderant amount of said wetted, finely divided solid combustible with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a Kraemer-Sarnow softening point no higher than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 0.5–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

5. A process of briquetting solid combustibles, comprising the steps of wetting at least one finely divided solid combustible with water in an amount such that the water content of said combustible is about 15–25% water; mixing a preponderant amount of said wetted, finely divided solid combustible with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a Kraemer-Sarnow softening point no higher than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 1–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings and being selected from the group consisting of naphthalene, anthracene, phenanthrene and carbazole so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

6. A process of briquetting solid combustibles, comprising the steps of intimately mixing a preponderant amount of at least one finely divided solid combustible having a water content between 15–50% with about 1–30% by weight of an aqueous dispersion of at least one bitumen having a maximum Kraemer-Sarnow softening point of 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said bitumen in said aqueous dispersion and 0.5–4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass at substantially room temperature so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

7. A process of briquetting solid combustibles, comprising the steps of intimately mixing a preponderant amount of at least one finely divided solid combustible having a water content of 15–25% with about 1–30% by weight of an aqueous dispersion of mineral coal tar pitch having a Kraemer-Sarnow softening point no higher

than 60° C., a water-dispersible clay in a minor proportion sufficient to disperse said mineral coal tar pitch in said aqueous dispersion and 0.5-4% by weight of said dispersion of at least one polycyclic hydrocarbon having a maximum of three rings so as to form a homogeneous mass of said combustible and said dispersion; and drying said thus formed homogeneous mass so as to cause the components thereof to adhere to each other, thereby forming a coherent briquette of said solid combustible.

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