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UNITED STATES PATENT OFFICE.

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BRIQUETTING.

No Drawing. Application filed February 25, 1922. Serial No. 539,304.

To all whom it may concern:

Be it known that I, GEORGE B. DAMON, a citizen of the United States of America, residing at Belvidere, in the county of Warren and State of New Jersey, have invented certain new and useful Improvements in Briquetting, of which the following is a specification.

My invention relates to improvements in briquetting, and the object of my invention is to provide an improved process which can be economically carried out, and by which a briquette having certain improved characteristics is produced.

Briefly the process consists in preparing a vegetable binder, mixing therewith the coal fines, and forming briquettes from the mixture. In its broad aspects I am aware that briquettes have heretofore been formed in this manner, and my invention resides in certain novel features which, so far as I have been able to ascertain, have not hitherto been employed in the manufacture of briquettes.

The binder which I employ may consist of any suitable vegetable matter—preferably such as contain resin, gum, or other suitable colloidal carbohydrates or matter of sticky, adhesive character. My experiments have shown corn cobs, stalks, husks, and even corn itself, alone and in combination, to form an extremely efficient binder material, which is particularly desirable in the carrying out of the process by reason of the by-product furfural which may be obtained as an incident to the commercial practice of my invention. Such material is subjected to a suitable digesting operation to reduce it to a sticky mass. When corn cobs, husks and stalks (and the grain as well, if market conditions permit) are used, it is reduced by suitable machinery, to a convenient size for digestion—say to bran or sawdust size. The extent of reduction has a bearing on the characteristics of the finished briquettes; if the material is reduced to coarse size, a fast burning briquette results; whereas, if the material is reduced to fine size, a slow burning briquette results.

The material so reduced is then soaked in hot water and digested—preferably in a closed digester under steam pressure. The digestion of this material, in a closed digester, using steam up to 60 lbs. gauge pressure (308° F.) is completed in about one and one-half hours, sufficient water having been used to produce a sticky, soggy pulp, which contains in solution the soluble gums and other carbohydrates. In any event, the digestion is carried on under such temperature and other conditions that the by-product values of the material are retained therein. The digestion can be carried on with or without the help of mineral acids—governed largely by the nature and extent of the by-product or by-products to be recovered.

This binder pulp while hot, is mixed with coal fines, preferably pre-heated, or warmed, to prevent the "setting" of the binder. The coal fines need not be dry—a feature of the present process which is of considerable practical importance. The agglomerate is thoroughly mixed or pugged in a steam fluxer or malaxeur and is then passed at proper temperatures (preferably through a conditioning trough of the type shown in my copending application Ser. No. 505,436, filed October 4, 1921) to a briquetting press.

In the press the agglomerate is formed into briquettes which are simultaneously subjected to heavy pressure—say about 3000 lbs. per square inch. This heavy pressure has the double function of compacting the mass of the briquette, and also of squeezing out the gummy or sticky substance which is still contained in the digested vegetable matter. This latter function of the pressure is important, since the portion of the gummy substance of the vegetable matter expressed therefrom in the briquetting machine, is the densest and most efficient adhesive. The heavy pressure on the briquettes, not only presses this binder out of the vegetable fiber, but drives it into the interstitial spaces between the coal fines. Inasmuch as the agglomerate is in moist and warm condition, and the particles of coal are covered with films of water, the colloidal binder, which is soluble in water, envelopes the fine coal particles as well as permeating the interstitial spaces. The briquettes are thus formed, and upon the setting of the binder, which occurs when cool, they are in condition for use.

The commercial objection to the briquettes in this condition, is that they are not waterproof. To render the briquettes waterproof or stable under moisture conditions, they are passed from the press to a coking furnace, in which they are subjected to a temperature sufficient to at least partially carbonize the

binder. For briquettes of the size of an egg, it suffices to subject them to a heat of 550° to 625° F. for twenty or thirty minutes. The carbonization of the binder renders it insoluble—and the briquettes may now be subjected to moisture without danger of disintegration.

While any suitable coking furnace may be employed, I prefer to carry out this step of the process continuously by passing the briquettes, as discharged from the press, through a retort counter to a current of hot gas. This may be conveniently accomplished by discharging the press to an inclined chute suitably inclosed, and through which the hot gases pass upward while the briquettes descend by gravity.

The binder material in many instances contains valuable by-product constituents. Thus, a binder made from corn material contains furfural. The boiling point of furfural is 162° C.—(about 325° F.). The digestion of the vegetable matter and the steam pugging of the agglomerate, are carried out therefore at a temperature below that at which the contained furfural is driven off to any appreciable extent. Consequently when the briquettes are discharged from the press they still contain this substance.

I propose to recover it as an incident to the step of coking the binder. The temperature at which the coking operation is performed, being above the boiling point of furfural, the latter is driven off with the contained moisture of the briquette, and is taken up by the hot gases passing through the retort. The discharged gases and vapors containing the furfural, are led from the retort to condensing and evaporating apparatus of suitable type. Appropriate modification of the treatment of the gases to recover other by-product values, when present, will readily occur to those dealing with the invention.

The briquette produced by my process, employing anthracite coal fines or coke, in the mixture, is (1) smokeless, (2) odorless, (3) waterproof, (4) holds its shape and does not split under heat or soften at any temperature, and (5) is hard and smooth and shows hardly any abrasion and dust in handling. It produces a more intense heat owing to the fact that the carbonized vegetable content of the briquette is evenly distributed throughout the mass, and burning more rapidly than the denser coal fines, admits oxygen to the latter more freely than briquettes employing pitch, asphaltum, petroleum residue or sulphite liquor as the binder. Its speed of combustion is controllable to a certain degree by varying the reduction of the vegetable binder material—which if coarse-ground produces a rapid burning briquette, and if fine-ground, a slow burning briquette. In each case the desirable characteristics above mentioned are retained.

Variations in the details of the method will occur to those practicing the invention without departing from certain fundamental ideas which I claim as original with me.

I claim—

1. In a briquetting process, the step of mixing coal fines and a vegetable binder containing digested vegetable matter of approximately sawdust size, shaping said agglomerate into briquettes while moist, and simultaneously subjecting the same to heavy pressure to express from the vegetable matter the colloidal adhesive material contained therein and force it into the interstitial spaces between the coal fines.

2. In a briquetting process, the step of subjecting formed briquettes comprising coal fines and a vegetable binder containing a volatile by-product, to a heat sufficient to at least partially coke the vegetable mass and to drive off the volatile by-product, and recovering the latter.

3. In a briquetting process, the steps which comprise mixing a hot binder mass of digested fibrous vegetable pulp and heated coal fines and subjecting detached quantities of the mixed agglomerate while hot to heavy pressure to simultaneously form the same into briquettes and express from the fibrous vegetable pulp contained colloidal adhesive substance, and force the same into the interstitial spaces between the coal fines.

4. In a briquetting process, the steps of mixing a digested vegetable mass containing a volatile by-product, with coal fines in the presence of heat, but at a temperature lower than the boiling point of said by-product, shaping said mass into briquettes, subjecting the formed briquettes to a heat sufficient to vaporize said by-product, and condensing and recovering the latter.

5. In a briquetting process, the steps of mixing a digested mass of corn growth reduced to bran or sawdust size, with coal fines, in the presence of heat and moisture, but under conditions such that the furfural contained in the corn growth is substantially retained in the mixture, shaping the mixture into briquettes, subjecting the formed briquettes to a heat sufficient to vaporize the furfural and at least partially coke the vegetable matter, and recovering the furfural.

6. A briquette comprising coal fines. and a binder mass of vegetable matter reduced to approximately sawdust size and digested, and having its colloidal adhesive material expressed upon the coal fines and permeating the interstitial spaces therebetween.

7. A briquette comprising coal fines, and a binder mass of vegetable matter reduced

to approximately sawdust size and digested, and having its colloidal adhesive material expressed upon the coal fines and permeating the interstitial spaces therebetween, said vegetable binder mass being at least partially coked.

8. A briquette comprising a mixture of coal fines and a binder of digested vegetable fiber reduced to approximately sawdust size, said binder mass being at least partially coked and forming a relatively rapid burning constituent of the briquette, which on combustion, renders porous the mass of coal fines, thus admitting more freely to the latter the air necessary to support combustion thereof.

In testimony whereof I have signed my name to this specification.

GEORGE B. DAMON.