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BINDING-FUEL MATERIAL FOR BRIQUETTING FINELY-DIVIDED MATERIALS AND PROCESS OF PRODUCING THE SAME.

No Drawing. Application filed April 21, 1923. Serial No. 633,808.

To all whom it may concern:

Be it known that I, THEODORE NAGEL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Binding-Fuel Materials for Briquetting Finely-Divided Materials and Processes of Producing the Same; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to binding fuel materials for briquetting finely divided materials in general, and to the process of producing the same, and has for its object to provide a binder fuel, as well as a procedure which will be comparatively inexpensive in practice and more efficient in use than those heretofore proposed.

With these and other objects in view, the invention consists in the novel composition of matter constituting the binder and in the novel steps and combinations of steps constituting the process, all as will be more fully hereinafter disclosed, and particularly pointed out in the claims.

This application constitutes a continuation in part of my copending application, Serial No. 610,369, filed January 2, 1923, and entitled Artificial fuel and method of making the same.

In order that the invention may be the more clearly understood, it is said: It is well known that a large number of different substances have been heretofore brought to a finely divided condition, mixed with a binding material, and then subjected to pressure and heat in order to agglomerate the particles or to form briquettes therefrom. But it is also well known that the binding materials with which the finely divided particles are bound together are far from satisfactory. Among the recognized disadvantages that pertain to these said binding materials may be mentioned the fact that many of them will soften under a temperature sufficient to burn briquetted coal, for example, and thus permit the briquettes to flow or soften and choke off the draft passing through the burning mass. In other cases, the binding material will soften under ordinary weather conditions, such as soaking rains, and permit the agglomerates to disintegrate into the original finely divided particles. Still other objections pertaining to the prior binding materials are found in the fact that some of these binding materials give off unpleasont odors and smoke, some of them are too expensive to manufacture, or the materials from which the binder is made are too scarce on the market to render them commercially feasible, and some of the prior binders burn out from the briquettes before the coal particles are consumed, and thus permit said unburned particles to fall through the grates with the ashes. There are other objections to the prior binders which are well recognized by those skilled in the art, but it is not deemed necessary to detail them here.

It is the object of this invention when more specifically stated, to avoid all the foregoing objections and to produce a binding fuel material which is free from them, as will now be disclosed.

The carrying out of this invention may be best illustrated by describing the manufacture of an anthracite coal briquette employing this said binder. In making such a briquette one may proceed as follows: The anthracite coal may be used in any suitable finely divided condition. One may take, say, 100 parts by weight of this finely divided coal and thoroughly mix therewith in any suitable manner, say, about 7½ parts of what is known in the wood pulp industry as "sulphite pitch," the well known by-product from pulp mills, which is produced by boiling down or otherwise concentrating waste sulphite liquor to a viscous consistency. To this sulphite pitch is added preferably before being applied to the coal, about 1½ parts of phosphoric acid, H_3PO_4, calculated on the weight of the coal. It is best to mix the sulphite pitch and phosphoric acid together to form the binder before applying to the coal. The mass thus produced consisting of the finely divided coal and mixture of sulphite pitch and combined phosphorus constituting the binder made the subject of this application, is or may be next subjected to the pressure usually employed in the making of briquettes, and thereafter heated to a temperature which may not in some cases exceed, say, 400° F. and should not ordinarily exceed, say, about 800° F., and then cooled. The

resulting briquettes are found to possess a water insoluble, dense, hard, strong structure, that burns without emitting smoke or odors; nor do said briquettes disintegrate, soften or flow while burning as do many of the prior briquettes heretofore proposed.

That is, the mixture of sulphite pitch and phosphoric acid constituting the binder under the influence of heat will be found to have been converted into a hard, strong, tenacious, and water insoluble material that does not run or fuse at the temperature of burning, and therefore it serves to hold the coal particles firmly fixed during storage, shipment and use. The fact that this binding material at the temperature of the burning anthracite does not burn out before the coal is consumed does not permit the individual unburned particles of coal to fall through the grates with the ashes as is the case in some prior binders. This same binder, of course, may be used on other carbonaceous fuels, or in fact, on finely divided materials in general, as above intimated.

I am unable to give a satisfactory scientific explanation of the exact chemical changes that take place in the binder under the influence of heat, but it is possible, and in my opinion plausible, that since the orthophosphoric acid H_3PO_4 is first converted to the pyro form, $H_4P_2O_7$ and finally to the meta form HPO_3, under the influence of heat in accordance with the well known behavior of these compounds when heated, one or more of these acids probably react with the constituents of the sulphite pitch, or with the constituents of the coal, or with both, to form hard, tenacious, water insoluble compounds therewith. It is more probable, however, that the constituents of the sulphite pitch play the more important part in connection with the acids, because when metallic particles are agglomerated the hard, binding action takes place apparently about as well as it does with the coal. Whatever may be the true explanation, actual tests have abundantly shown that the finished product of agglomerated material possesses the surprising and valuable properties above mentioned, due entirely to the peculiar nature of this novel binding material which also has the property of sticking tenaciously to and binding together any finely divided material with which I am acquainted. Further, this said mixture of sulphite pitch and phosphoric acid being water soluble, and therefore capable of being easily applied in the form of a temporary binder for masses of finely divided materials in general, it is exceedingly useful in the art, because its temporary binding qualities impart sufficient toughness to the green briquettes for handling them through the subsequent steps of processing the same. On the other hand, as soon as the temperature of from say 400° F. to 800° F. or higher, is imparted to this said binding material, the cooled product is found to be unusually dense, hard, and strong, so that this said binder seems to constitute an ideal product for this purpose. The binder, however, need not be made with the proportion above given, nor subject to the temperatures stated. In fact, I have found that instead of using by weight 7½% of sulphite pitch as in the example for anthracite coal, I may use quantities varying between, say, 3% and 15% on various coals; and instead of using 1½% of H_3PO_4, I may use quantities varying between say ½ of 1% and 5%. When briquetting other materials such as fine flue dust, finely divided ores in general, I use varying quantities of the binding material according to the nature of the material being briquetted. Further, the temperatures employed will likewise vary according to the use to which the briquetted material is to be subjected. In the case of carbonaceous materials in general, it is not necessary to exceed say 1000° F. and often not necessary to exceed say 400° F. The main constituents of this sulphite pitch are formed from the resinous and tarry compounds present in the wood from which the pulp is made. Accordingly, I have found that tars and pitch like substances in general may be substituted with more or less success for the above mentioned sulphite pitch. That is, said pitch apparently acts as a source of organic carbon in a state of combination which facilitates the reaction of nascent phosphorus therewith, and other pitches of organic origin seem to constitute a similar source.

It will now be clear from the foregoing that I have disclosed a process and a product which provides a binding fuel material for agglomerating finely divided substances in general, but possesses the following qualities all of which qualities no single binder prior to my invention possesses, to the best of my knowledge. That is, the binder formed is hard, tough, and sufficiently water insoluble to resist softening due to all influences of weather conditions, it does not soften at the temperature of burning of anthracite coal, it emits no smoke or odor, and it does not materially add to the ash content of the fuel. By water insoluble I mean such an insolubility of the binder as will prevent it from softening to an undesirable degree, when subjected to rain storms or other atmospheric conditions. The raw material used in making a binder can be produced in unlimited quantities so that the supply and the cost of the binder will not be materially disturbed by this new industrial application. Further, it is not necessary to use commercially pure phosphoric acid for I have found that a very

crude and comparatively inexpensive phosphoric acid which is produced by merely treating phosphate rock with sulphuric acid can be employed in the production of this binder.

It will likewise be observed that the proportions of combined phosphorus to organic carbonizable material in the pitch will vary with different substances to be briquetted and the use to which they are to be put, but in general such proportions will always include sufficient combined phosphorus to cause the mixture containing said organic material to develop under the influence of heat the said hard and water-insoluble qualities above mentioned.

This invention differs from my copending application of even date herewith, Serial No. 633,807 and entitled Binders for agglomerating finely divided materials and process of producing the same, in that it is limited to the binder involving the use of sulphite pitch, and similar substances, as is indicated by the claims.

It is obvious that those skilled in the art may vary the details of the procedure as well as of the product without departing from the spirit of the invention, and therefore I do not wish to be limited to the above disclosure except as may be required by the claims.

What is claimed is:

1. The process of making a binding fuel material for agglomerating finely divided substances which is capable of hardening and becoming water-insoluble when heated which consists in mixing an organic compound containing sulphite pitch with combined phosphorus in such proportions that upon heating said mixture it will form a hard water-insoluble binder.

2. The process of making a binding fuel material for agglomerating finely divided substances which is capable of hardening when heated which consists in mixing a sulphite pitch material with phosphoric acid in such proportions that a hard water-insoluble material will be formed upon heating said mixture to a temperature above 400° F.

3. The process of making a binding fuel material for agglomerating finely divided substances which is capable of hardening and becoming water-insoluble when heated which consists in mixing a sulphite pitch material with combined phosphorus in such proportions that when applied to finely divided substances and the latter are compressed and heated above 400° F. the agglomerate is rendered hard and water-insoluble.

4. The process of making a binding fuel material for agglomerating finely divided substances which is capable of hardening and becoming water-insoluble when heated which consists in mixing a pitch with phosphoric acid in such proportions that upon heating said mixture above 400° F. it will form a hard water-insoluble binder.

5. The process of making a binding fuel material for agglomerating finely divided substances which is capable of hardening and becoming water-insoluble when heated, which consists in mixing a pitch with phosphoric acid in the proportions of from 3 to 15 parts by weight of the pitch and from ½ to 5 parts by weight of phosphoric acid, whereby upon heating said mixture above 400° F. it will form a hard water-insoluble binder.

6. The herein described new binding fuel material consisting of a mixture of a pitch compound and combined phosphorus in such proportions that when said mixture is heated it will be converted into a hard water-insoluble material.

In testimony whereof I affix my signature.

THEODORE NAGEL.