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COAL ACTIVATOR

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The present invention relates to coal activators and the method of producing such coal activators, particularly to be used for activating low grade coal fuel and to transform coal fines into a free burning high grade fuel.

It is well known to men skilled in the art that the combustion of solid fuel is a self-propagating chain reaction. The lighting of a fire releases heat which ignites the neighboring fuel. This in turn releases more heat to ignite more fuel, and the process continues as long as fresh fuel is added, and until all the fuel is consumed. This process can be accelerated if the fuel is of a high order and receives a proper supply of oxygen; it is, however, retarded if the fuel is of lower value and oxygen is improperly supplied. Other retarding causes are poor construction of the fuel bed and, particularly, inherent unfavorable coking and burning characteristics.

The main object of the present invention is, therefore, to provide means the use of which in connection with medium and lower grade solid fuels brings about a greatly accelerated chain reaction which may approach or even exceed that of standard or premium grades.

It is another object of the present invention to provide coal activator means which are economic in their use and comparatively very low in cost.

It is still another object of the present invention to provide coal activator means which are applicable in a thoroughly practicable manner.

It is still a further object of the present invention to make anthracite fines, barley and buckwheat of small size useful and valuable fuels for handfired boilers or furnaces, by admixing with them an activator, that places their burning qualities on the level of larger sized standard coal.

It is furthermore an object of the present invention to make bituminous oxidized strip coal marketable by means of an admixed activating agent.

It is a further object of the present invention to control and to check the coking tendencies of bituminous coal, especially when applied to underfeed stokers, by means of an admixed activating agent, which at the same time obviates a separate dust treatment of the bituminous coal by the dust-binding capacity of the activating agent.

It is yet another object of the present invention to provide coal activator means which do not burn away before the coal particle itself is fully oxidized.

It is an additional object of the present invention to provide coal activator means which, as

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a primary effect, increase the speed of ignition of the solid fuel to be activated and, as a secondary effect, permit more effective distribution of the air through the fuel bed by increasing porosity through an expanding action and in consequence more thorough combustion of the fuel and increased heat release.

It is another additional object of the present invention to provide coal activator means which, when added to a solid fuel of considerable clinkering proclivity, almost completely eliminate the clinkering in the fire.

It is yet an additional object of the present invention to provide coal activator means which remain in intimate combination with the coal particles throughout the entire burning process.

It is a further additional object of the present invention to provide coal activator means which increase the heat content of the solid fuel to be activated.

It is yet another additional object of the present invention to provide coal activator means which increase the speed of ignition and the burning rate of the solid fuel to be activated.

It is still a further object of the present invention to provide coal activator means for controlling the coking tendencies of bituminous coals, particularly when prepared for underfeed stokers.

It is yet a further object of the present invention to provide coal activator means for controlling the clinkering of a solid fuel by either minimizing or eliminating clinkering or creating a desired degree of clinkering.

It is also an object of the present invention to provide coal activator means which reduce ashpit losses of the solid fuel.

It is also still another object of the present invention to provide coal activator means for abating the generation of smoke of high volatile bituminous coal.

It is yet still another object of the present invention to provide a method for forming a coal activator to be added to solid fuel to be activated.

With these and other objects in view which will appear in the following specification, the present invention will become apparent and clearly understood.

The coal activator in accordance with the present invention is based on the perception that in order to improve and to activate a solid fuel, it is not only necessary to increase the heat (B. t. u.) content, but quite more its rate of ignition and combustion throughout the entire burning process and also to assure more complete com-

bustion of the coal, thereby releasing additional heat (B. t. u.'s) from the fuel. In order to achieve, therefore, the main object of the present invention, it is necessary to add hydrocarbons to a fuel base in such a way that they become an integral part of the fuel base and the nature of the hydrocarbons had to be devised in such manner that the latter will ignite somewhat more readily than the coal to be activated, yet will not burn away before the coal itself is oxidized. This can be achieved by processing bituminous coal dust or slack, or anthracite culm, or both combined, with hydrocarbons of an extremely high ignition point by a method which will be described later. Such preferable hydrocarbons are heavy oils having a very high specific gravity and require an ignition temperature of about 350° F. to about 650° F., which oils are used, e. g., in heavy oil motors, or as lubricating oils, or it may also be any heavy organic, vegetable or animal oil of highest viscosity, or any heavy tar oil, both oils of the above stated ignition temperature range.

In order to facilitate and to speed up the ignition and combustion of the activator and thereby also of the coal fuel to be activated, it is preferred to add a comparatively small percentage of either crude oil or of a fuel oil of a high viscosity, or paraffin or other waxes, or stearin to the aforementioned heavy oil, as mineral oil or tar oil, forming thereby an igniting bridge to the less readily inflammable hydrocarbons.

In order to make the mentioned oils an integral part of the culm, coal dust, or coal slack, which substances are only of a very limited absorbent capacity, a binder has to be provided which is not only capable of solidifying the oils and binding them to the coal particles integrally, but which will also burn long enough to ensure a coherence of all constituents until the coal base of the activator is burnt out to ash. Thus it is ensured that the activator will burn just as long as the coal fuel itself, with which it is admixed and which is to be activated.

In order to improve the effectiveness of the activator to its fullest possible capacity, it is preferred to apply a very high percentage of the aforementioned oils in its composition, without jeopardizing the solid structure of the activator. It is for this purpose that it is also preferred to admix with the oils dehydrated fibrous material, like saw dust, peat moss, or the like, of a percentage sufficient to absorb the oils, before admixing these oil soaked fibres with the coal base, and adding this oil soaked substance to the coal base before the binder is added.

As a binder, preferably pitch, which can be coal tar or wood tar pitch or its equivalent, resins, or any suitable binder preferably of a high melting point of 185° F. to 200° F. is used. However, in order to ensure the highest possible binding capacity of the pitch, which will be sufficient to solidify the oil soaked fibrous substances and to integrate them with the coal substances, it is preferred to use a specially prepared and processed pitch-starch binder. This processed pitch-starch binder has not only the advantage of allowing the addition of a very high percentage of oils to the composition, but also, at the same time, of increasing the B. t. u.'s of the composition and of rendering the activator long burning and practically smokeless through a coking effect of the binder in the burning process.

If the heavy mineral oil, as only oil, is applied, a certain retarding effect in the ignition of the activator can be observed, which is desirable when a longer burning period is to be achieved. However, if the crude or fuel oil, without the heavy mineral oil, is applied in the composition, it is preferred to use a somewhat higher percentage of the pitch-starch binder, in order to retard the high rate of combustion of this type of oil.

As a further development of the present invention it is possible to compose the activator without any coal base, but entirely with the hydrocarbonaceous, absorbing fibrous and binding materials. However, when this is done a larger percentage of each of the constituents has to be provided, preferably about the double amount compared with the compound having a coal base, and preferably the binder in even more than the double amount, because the compound would burn out much faster than the coal fuel with which it is to be admixed. Furthermore, it has been found in this case, that a higher percentage of the activating agent having no coal base, must be admixed to the coal fuel to be activated, in order to be effective, than is required with the coal base activator.

As stated above, the activator contains preferably the following elements: heavy oil as mineral oil of an ignition point of 350° F. to 650° F., crude or fuel oil of an ignition point of 150° F. to 300° F., saw dust and a binder material. The binder may comprise pitch and cornstarch or pitch alone, or resins.

The following ranges in percents of weight are to be considered as preferable for the constituents of the activator having a coal base:

Coal base	20 to 75	
Heavy mineral oil	0 to 25	At least a total of 10% of oil.
Crude or fuel oil	0 to 25	
Saw dust	0 to 25	
Pitch	10 to 45	
Starch	0 to 10	
Sulphur and iron powder	5 to 15	

If the activator has not a coal base the following ranges in percents of weight are preferable:

Heavy mineral oil	0 to 50	At least a total of 20% oil.
Crude or fuel oil	0 to 50	
Saw dust	10 to 40	
Pitch	10 to 60	
Starch	0 to 20	
Sulphur of iron powder	5 to 15	

The activator can be accommodated to the different kinds of coal to be activated by changing the percentage of its constituents and also by varying the percentage of the activator to be admixed to the coal fuel to be activated, which latter percentage ranges preferably between 5 and 15%.

These are the means for controlling the effects upon different kinds of coal and achieving all objects pointed out above.

Several examples will be given now disclosing different activator compositions adapted for achievement of particular objects the percentages given by weight:

Example 1

Adapted for a coal base of bituminous coal dust or slack:

	Per cent
Bituminous coal dust or slack	52
Heavy mineral oil of 350° F. to 650° F. ignition point	15
Heavy fuel oil, preferably known as No. 5 or 6	3½
Saw dust	8
Pitch	19
Starch or flour	2½

An activator which is particularly adapted to offset coking tendencies of bituminous coal and for smoke abatement of high volatile bituminous coal, is given in

Example 2

	Per cent
Anthracite culm	52
Heavy mineral oil of 350° F. to 650° F. ignition point	16
Heavy crude oil, preferably Mid-Continental crude oil	3
Saw dust	8
Pitch	18½
Starch or flour	2½

An activator which is particularly adapted for anthracite coal briquets or bituminous coal used in small stokers, where it is desirable to obtain a porous ashbed by small clinker formation and to permit greater ease of ash removal, is given in

Example 3

	Per cent
Bituminous coal dust or slack	45
Heavy mineral oil of 350° F.–650° F. ignition point	9
Heavy crude or fuel oil of 150° F.–300° F. ignition point	3
Saw dust	6
Powdered sulphur	10
Powdered iron	10
Pitch	15
Starch or flour	2

An activator adapted to general use for anthracite or bituminous steam coal is given in

Example 4

	Per cent
Bituminous coal dust or slack	27½
Anthracite culm	27½
Heavy mineral oil of 350° F.–650° F. ignition point	16
Heavy crude oil of 150° F.–300° F. ignition point	2½
Saw dust	5
Pitch	19
Starch or flour	2½

As stated above, preferably 5 to 15% of the activator is admixed to the coal fuel. The percentage is determined by the quality of the coal to be activated. A small sized anthracite steam coal of poor quality requires an admixture of about 10–15% activator in order to render a good standard fuel. If only 5% of the activator is added to a standard fuel, the latter is transformed to a superior fuel. The admixture of the activator to coal fuel is a very simple and inexpensive process. It can be done by the consumer immediately before using the coal or by the coal producer or distributor by means of any conventional mixer. Thus the application of the activator is surprisingly economical in its use with different kinds of coal.

Several tests performed with the activator brought about the above stated results which were surprising and unexpected to men skilled in the art. This is evidently due to the fact that the activator in accordance with the present invention is not only adding B. t. u.'s to the coal fuel, thereby "enriching" the coal, but it increases at the same time the speed of ignition of the coal fuel, and accelerates the self-propagating chain reaction in the combustion process in the coal fuel bed. The activator increases also the rate

of combustion of coal by its own high rate of combustion and by its catalytic effect on the coal fuel, with which it is admixed in concentrated form, namely in solid lumps or granules. The activator further increases the porosity of the coal fuel bed by its expanding action during the burning process, and thereby permits easy access of oxygen to the coal, which in turn causes a much higher liberation of B. t. u.'s from the coal and thereby a more complete combustion of the latter. The activator also greatly and noticeably minimizes clinkering tendencies and clinkering effects. It further reduces the ash pit loss through more complete combustion in the fuel bed and at the same time increases the heat content in the coal.

When the activator is used as activating agent for briquets or packaged fuel, the activator has to be added during the manufacture of the fuel by introducing from 5 to 10% by weight of the activator, which percentage will vary in proportion to the calorific value of the coal bases employed, into the coal base before the briquet binder is applied.

A further development of the present invention is the method of preparing the coal activator in order to produce a solid material in either granulated or briquetted form. The method comprises the steps of, first, heating coal fines, as coal dust, culm or coal slack or all combined, up to about 350° F. for dehydration in a coal dryer or tank, second, by heating the liquid hydrocarbons, as oils, to about 250° F., adding the absorbing fibrous material as saw dust under constant agitation, and further heating up to about 250° F., to drive the moisture content out of the saw dust, whereupon the latter will form an oil soaked mass. The dehydration of the absorbing fibrous material is completed after about 10 minutes and the oil soaked mass is then added to the dehydrated coal under agitation, whereby the temperature of the coal will go down from about 350° F. to 300° F. It is preferred to use a binder which is disclosed in applicant's copending patent application Ser. No. 632,600, which comprises pitch and starch or flour. If this preferred binder is used a third tank is provided which is either steam jacketed or provided with other heating means, in which tank pitch is heated to about 300° F., thereby melted and then starch or flour added under agitation, which will bring about a bubbling-up of the pitch to about twice of its original volume or even more, until the water of constitution of the amonaceous material is vaporized, which status is reached in about 5 to 10 minutes. Then the pitch binder, thus stiffened, is poured into the oil-soaked fibrous material mixed with the coal base under constant agitation for about 4 minutes. Finally the thus bonded, still hot material is led into a tempering mixer or into a briquetting press, depending upon whether a granulated or briquetted material is to be produced. In the first instance, when granulated material is to be obtained, the material taken from the tempering mixer is poured out onto concrete or metal sheets, cooling tables or other cooling means or into a gradually declining chute. During the cooling-off period the material will crystallize into granules of odd shapes and sizes, which will be completely solid after cooling to room temperature.

While I have disclosed the principles of my invention in connection with several different embodiments, it will be understood that these embodiments are given by way of example only

and not as limiting the scope of the invention as set forth in the objects and the appended claims.

What I claim is:

1. In an activator for a coal fuel, about 52% bituminous coal dust, about 15% mineral oil of an ignition point of 350° F. to 650° F., about 3½% fuel oil of an ignition point of 150° F. to 300° F., about 8% saw dust, about 19% pitch, and 2½% starch.

2. In an activator for a coal fuel, about 52% anthracite culm, about 16% mineral oil of an ignition point of about 350 F. to 650° F., about 3% crude oil of an ignition point of 150° F. to 300° F., about 8% saw dust, about 18½% pitch and about 2½% starch, said activator being adapted to offset coking tendencies of bituminous coal and for smoke abatement of high volatile bituminous coal.

3. In an activator for a coal fuel, about 27½% bituminous coal dust, about 27½% anthracite culm, about 16% mineral oil of an ignition point of 350° F. to 650° F., about 2½% crude oil of an ignition point of 150° F. to 300° F., about 5% saw dust, about 19% pitch, and about 2½% starch, said activator being adapted for anthracite or bituminous steam coals.

4. The method, as set forth in claim 12, including the step of mixing said final hot material and pouring said material onto cooling means in order to crystallize the said material into solid granules of odd shape and size.

5. The method, as set forth in claim 12, including the steps of introducing said final hot material into a briquetting press and of forming to solid briquets of predetermined shape.

6. In an activator for a coal fuel, a minor amount to 50% hydrocarbon oils of an ignition point of 350° F. to 650° F., a minor amount to 50% of hydrocarbon oils of an ignition point of 150° F. to 300° F., but at least 20% of said hydrocarbon oils, 10% to 40% of a dehydrated absorbent fibrous material, and at least 10% of a binder material.

7. In an activator for a coal fuel, 20% to 75% of a carbonaceous base, a minor amount to 25% hydrocarbon oils of an ignition point of 350° F. to 650° F., a minor amount to 25% of hydrocarbon oils of an ignition point of 150° F. to 300° F., but at least 10% of said hydrocarbon oils, a minor amount to 25% of a dehydrated, absorbent fibrous material, and at least 10% of a binder material.

8. An activator for a coal fuel consisting substantially of a minor amount to 50% of hydrocarbon oils of an ignition point of 350° F. to 650° F., a minor amount to 50% of hydrocarbon oils of an ignition point of 150° F. to 300° F., but at least 20% of said hydrocarbon oils, 10% to 40% of a dehydrated, absorbent fibrous material, and 10% to 45% pitch and a minor amount to 15% starch.

9. In an activator for a coal fuel, 20% to 75% of a carbonaceous base, a minor amount to 25% of hydrocarbon oils of an ignition point of 350° F. to 650° F., a minor amount to 25% of hydrocarbon oils of an ignition point of 150° F. to 300° F., but at least 10% of said hydrocarbon oils, a minor amount of a dehydrated, absorbent fibrous material, and 10% to 45% pitch and a minor amount to 10% starch.

10. In an activator for a coal fuel, a minor amount to 50% mineral oil of an ignition point of 350° F. to 650° F., a minor amount to 50% crude oil of an ignition point of 150° F. to 300° F., but at least 20% of said oils, 10% to 40% of a dehydrated, absorbent fibrous material and at least 10% of a binder material.

11. In an activator for a coal fuel, 20% to 75% of a coal material, a minor amount to 25% mineral oil of an ignition point of 350° F. to 650° F., a minor amount to 25% crude oil of an ignition point of 150° F. to 300° F., but at least 10% of said hydrocarbons, a minor amount to 25% of a dehydrated, absorbent fibrous material, and at least 10% of a binder material.

12. The method of preparing an activator for a coal fuel, comprising the steps of heating 20% to 75% of coal fines to a temperature up to about 350° F., heating separately a minor amount to 25% hydrocarbon oils of an ignition point of 350° F. to 650° F. and a minor amount to 25% hydrocarbon oils of an ignition point of 150° F. to 300° F. to a temperature of about 250° F., but at least 10% of the said hydrocarbon oils, and adding a minor amount to 25% of an absorbent fibrous materal under constant agitation, heating further said hydrocarbon oils with said absorbent fibrous material to a temperature up to about 250° in order to drive out of the latter the moisture content and to form an oil soaked mass, adding said oil soaked mass to said heated coal fines under agitation, heating separately at least 10% of a binder and finally pouring the latter into the intermixed oil soaked dehydrated absorbent fibrous material and coal fines under constant agitation.

13. The method of preparing an activator for a coal fuel, comprising the steps of heating 20% to 75% of coal fines to a temperature up to about 350° F., heating separately a minor amount to 25% of hydrocarbon oils of an ignition point of 350° F. to 650° F. and a minor amount to 25% of hydrocarbon oils of an ignition point of 150° F. to 300° F. to a temperature of about 250° F., but at least 10% of the said hydrocarbon oils, and adding a minor amount to 25% of an absorbent fibrous material under constant agitation, heating further said hydrocarbon oils with said absorbent fibrous material to a temperature up to about 250° F. in order to drive out of the latter the moisture content and to form an oil soaked mass, adding said oil soaked mass to said heated coal fines under agitation, heating still separately 10% to 45% pitch to about 300° F. and adding a minor amount to 10% starch to the latter under agitation in order to produce a bubbling-up of the pitch until the water of constitution of the said starch is vaporized, finally pouring the said heated stiffened pitch binder into the intermixed oil soaked absorbent fibrous material and coal fines under constant agitation.

14. The method of preparing an activator for a coal fuel comprising the steps of heating 20% to 75% of coal fines to a temperature up to about 350° F., heating separately a minor amount to 25% of hydrocarbon oils of an ignition point of 350° F. to 650° F. and a minor amount to 25% of hydrocarbon oils of an ignition point of 150° F. to 300° F. to a temperature of about 250° F., but at least 10% of the said hydrocarbon oils, and adding a minor amount to 25% of an absorbent, dehydrated fibrous material under constant agitation, thereby forming an oil soaked mass, adding said oil soaked mass to said heated coal fines under agitation, heating still separately at least 10% of a binder to about 300° F. and finally pouring the latter into the inter-

mixed oil soaked absorbent fibrous material and coal fines under constant agitation.

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