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SOLID FUEL COMPOSITIONS

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4 Claims. (Cl. 44—17)

This invention, which is a continuation of my application Ser. No. 526,077, filed Feb. 9, 1966, relates to fuel compositions, and more particularly, to artificial carbonaceous fuel compositions having improved burning properties and to the method for their preparation. Still more particularly, the invention relates to artificial carbonaceous fuel compositions, in the form of briquettes having improved burning properties, the method for their preparation, and having particular utility when employed for purposes of orchard heating.

Heretofore, a serious problem has been encountered in combating low-temperature and frost conditions seasonally encountered in orchards and other outdoor vegetation and in crop areas, which cause destruction or heavy damage to fruit, branches, limbs and, in many instances, to vines and trees themselves. To offset these injurious effects of periodic low-temperature climatic conditions, it is essential that there be provided a source of heat and means for carrying such heat to the vines, trees and other vegetation. For this purpose, heat has heretofore been supplied by various means, ranging from conventional gas and fuel-oil burning frost-pot and return-stack heaters to smudging and the burning of scrap rubber, and in which heat is carried to the vegetation by convection currents, or, in more sophisticated installations, by wind-machines designed to induce such currents. In this respect, however, the use of such devices has resulted in the accompanying dissipation of large quantities of smoke, causing the deposition of soot or smudge upon the fruit or vegetation. Furthermore, the presence of an open flame in close proximity to the fruit, vines, trees or other vegetation may also result in their damage or even in their destruction. Also, prior to the present invention, the burning of artificial solid carbonaceous fuels in the form of small lumps or briquettes in specially designed heaters, has been resorted to; however, in these instances, a smokeless type of fuel briquette is not available. Furthermore, apart from the undesirable deposition of soot resulting from the burning of the briquette, the presence of an open flame is still another factor which heretofore has rendered the use of carbonaceous briquettes, as a source of heat, unattractive for the aforementioned intended purpose.

The ability to employ a substantially smokeless fuel composition, for example, in the form of a briquette, which is capable of burning without the presence of any substantial flame, would, therefore, be highly desirable. The use of equipment such as the aforementioned frost-pots, return-stack heaters, wind-machines, etc. would be completely eliminated, with its attendant saving in cost. In addition, the ability of the fuel composition to burn without the presence of a substantial flame would permit placing it in close proximity to the trees, vines or other forms of vegetation, and would thus avoid expensive waste of heat values, which is presently encountered when the heat source must be placed at a considerable distance from the desired point of application.

Prior to the present invention, charcoal briquettes or lumps for heating purposes, have generally been fabricated from mixtures containing major amounts of charcoal and minor amounts of filler materials such as sawdust, wood shavings, or excelsior, and various forms of binding agents. Such mixtures are usually compressed

under relatively high pressure into the briquette or lump form, and are subsequently coated by immersion or spraying with a waterproofing agent, such as varnish, paraffin, or a resinous or plastic material. Various forrmulary modifications have also been suggested, including improvements relating to the filler, binder and water-proofing components. In all such formulations, it is found, however, that certain highly undesirable disadvantages are inevitably present. Of particular significance is the fact that the conventional briquette or lump-form composition cannot be burned without the release of smoke or the presence of an open flame, as hereinbefore described. Apart from these disadvantages, the ability of the briquette to release its heat at a controlled rate, is highly desirable from both a practical and economic standpoint. In this respect, the conventional form of briquette is also deficient.

In application Ser. No. 401,665, filed Oct. 5, 1964 and now abandoned, there were disclosed new and improved solid fuel compositions, preferably in the form of briquettes, which are manufactured, in general, by first forming a mixture comprising petroleum coke, wood-sawdust and charcoal components; forming another mixture comprising an aqueous solution of an oxidizing agent and a binder; combining these mixtures to form a slurry; and then subjecting this slurry to an extrusion operation to obtain a briquette of the desired configuration. Subsequently, the briquette thus produced is then passed into a heater or other device, in which water is removed at elevated temperatures.

In carrying out the above-described extrusion operation, it has been found, however, that it is difficult to obtain a dimensionally stable column without encountering excessive plugging at the extruder die face. More specifically, when the feed mix contains too much moisture, the column either tends to collapse, or the cut briquettes are not produced in uniform size. On the other hand, when the feed mix is too dry, plugging at the extruder die face results. While increasing the particle size of the wet mix results in a column that can be extruded more easily, such procedure, however, produces a briquette of increased density, which burns at too low a rate to be effective for the above-described purpose for heating orchards or other forms of vegetation. Thus, the ability to carry out the extrusion operation of the above-described briquettes, without encountering die plugging and without altering the density characteristics and the burning rate thereof, could result in an obvious ease of manufacturing procedure and attendant economic advantages.

It is, therefore, an object of the present invention to provide an improved substantially smokeless and flameless solid fuel composition which can be easily extruded or molded into the desired shape.

Another object of the invention is to provide an improved substantially smokeless and flameless solid fuel composition which can be easily extruded or molded into the desired shape, without causing plugging at the extruder die face.

Still another object of the invention is to provide a new and improved method for obtaining solid fuel compositions, particularly in the form of briquettes, having the aforementioned characteristics.

Other objects and advantages inherent in the invention will become apparent to those skilled in the art from the following detailed description.

In accordance with the present invention, and as more fully hereinafter described, there is provided an improved substantially smokeless and flameless solid fuel composition, preferably in the form of an easily extrudable briquette, comprising a major proportion of petroleum coke and minor proportions of wood-sawdust, charcoal,

an oxidizing agent capable of supporting combustion, a binder and a non-hydratable clay. As more fully hereinafter described, the presence of the nonhydratable clay component, makes possible performing an extrustion operation in which the above-described briquette composition is easily passed through the extrusion chamber without encountering any problem of plugging at the die face, thereby facilitating production and also providing economies not heretofore realized in the manufacture of solid fuel compositions of the type described.

Of particular importance in the fuel compositions of the present invention is the petroleum coke component. Petroleum coke, being a refractory carbonaceous residue material, has not heretofore been considered as having any significant fuel value, from a practical commercial standpoint, because of its characteristic lack of being easily ignitable and its inability to readily support combustion. Thus, petroleum coke, which is generally commercially obtained in the form of either a delayed coke or fluid coke, possesses a low volatility content and is ignitable only at temperatures as high as from about 2500° F. to about 2700° F. Delayed coke, varying in physical properties from finely divided particles to relatively coarser and larger particles, is more volatile and less carbonaceous than fluid coke, and is ignitable at a somewhat lower temperature within the aforementioned range, than fluid coke. In this respect, it is found that if petroleum coke can be successfully ignited to a temperature where it can support combustion, it can burn, in a state of glow, without the emission of smoke or the presence of an open flame, and at a controlled rate, making possible the realization of the previously discussed advantages.

In order to attain the aforementioned relatively high temperatures required for initially igniting the petroleum coke and for subsequent self-burning sustained combustion thereof, the solid fuel compositions of the present invention are also comprised of minor proportions of charcoal and wood-sawdust, in combination, as a filler material. In this respect, ignition of the charcoal component results in the combustion thereof at a sufficiently high temperature which is effective for the subsequent ignition and support of combustion of the petroleum coke. The presence of the wood-sawdust component in the filler material makes possible a combustion mechanism in which the sawdust, being the most easily combustible component present, is most readily ignitable, gives off sufficient heat upon being combusted to ignite the charcoal component, and the latter, upon being ignited and combusted, in turn gives off heat at a relatively increased temperature, which is sufficient for the purpose of igniting and initiating sustained combustion of the petroleum coke.

In order to initiate the combustion of the wood-sawdust component in the above-described aforementioned filler material, the aforementioned oxidizing agent, capable of supporting combustion, is incorporated as a component of the solid fuel composition. The concentration of this oxidizing agent in the solid fuel composition above the minimum level required to support combustion of the petroleum coke, can be varied to any desired burning rate. Various types of oxidizing agents may be employed for this purpose, and particularly preferred are the nitrates, perchlorates, peroxides and permanganates, although any type of oxidizing agent which is capable of supporting combustion can be successfully employed for this purpose. It will be apparent, of course, that in a given instance each oxidizing agent would be employed in different amounts in order to obtain a desired burning rate for the fuel composition. In essence, therefore, this ability of being able to effect ultimate combustion of the petroleum coke in a sustained manner and at a controllable burning rate, makes possible the production of a solid fuel composition which can burn without the presence of smoke or an open flame, and with all the obvious attendant advantages, described above.

For purposes of consolidating and obtaining a shaped solid fuel, for example in the form of a briquette or other configuration, a minor proportion of a binder is included in the improved fuel compositions of the present invention. For this purpose, any compatible combustible binder, either natural or synthetic, can be employed. These may include resinous materials, plastics, paraffins, shellac and combustion-supporting adhesives. Particularly preferred are binders comprising a soluble starch. From a practical standpoint, in instances where the fuel composition is to be employed for outdoor heating purposes, the presence of a minor proportion of a water-proofing agent is highly desirable. For this purpose, any compatible combustible water-proofing agent may be incorporated in the fuel composition. These may include water insoluble but dispersible resins and polymers such as polyethylene, and relatively not volatile, viscous, combustible natural or synthetic oils. Particularly preferred are waterproofing agents comprising wax emulsions.

As previously indicated, the presence of the non-hydratable clay component makes possible the carrying out of an extrusion operation, in which the briquette composition, or solid compositions of other configurations, can be easily passed through an extrusion chamber without encountering die plugging. For this purpose, any non-hydratable clay may be employed in combination with the aforementioned petroleum coke, wood-sawdust, charcoal, oxidizing agent, and also water-proofing components. Specific examples, illustrative of this non-hydratable clay comprise: the so-called "fire clays" such as a silica-alumina clay, non-hydratable bentonic clays, kaolin-type clays, commercially available fuller's earth, and other well-known non-hydratable clays.

With respect to the above-described clay component of the novel fuel compositions of the present invention, it should be noted that the term "non-hydratable clay" is intended to denote only those clays which do not absorb water. If a hydratable clay is employed, e.g. bentonite, or English ball clay, it is found, that unless the aforementioned formed wet-mix is not subjected to an immediate extrusion operation, the material comprising the mix, tends to swell upon standing, becomes spongy, and cannot be successfully extruded, inasmuch as plugging at the die-face is encountered.

As previously indicated, the fuel compositions of the present invention comprise a major proportion of petroleum coke and minor proportions of wood-sawdust, charcoal, oxidizing agent, binder and non-hydratable clay. From a practical standpoint, these fuel compositions comprise, by weight, from about 50 to about 90 percent, and, preferably, from about 60 to about 80 percent petroleum coke; from about 3 to about 20 percent, and, preferably, from about 5 to about 15 percent wood-sawdust; from about 4 to about 40 percent, and preferably, from about 7 to about 20 percent charcoal; from about 2 to about 15 percent, and, preferably, from about 5 to about 10 percent oxidizing agent; from about 1 to about 10 percent, and, preferably, from about 3 to about 5 percent binder; and from about 1 to about 15 percent and, preferably, from about 3 to about 6 percent of the non-hydratable clay. In instances where a water-proofing agent is to be employed, the latter is present in an amount from about 0.5 to about 8 percent, and, preferably, from about 1 to about 2 percent, by weight.

In one of its preferred embodiments, in order to facilitate the ignition of the above-described novel fuel compositions of the present invention, an igniting composition may be applied to at least a portion of the fuel composition. This igniting composition is comprised of the same components as are now present in the fuel composition itself, except for the absence of the petroleum coke and non-hydratable clay components. Ignition of this layer causes a relatively high degree of heat to be transmitted to the basic fuel composition itself, for more rapid and complete ignition of the latter. In its preferred form, this

ignition composition comprises, by weight, from about 41.5 to about 47 percent wood-sawdust; from about 41.5 to about 47 percent charcoal; from about 4 to about 10 percent oxidizing agent, and from about 2 to about 5 percent binder. In instances where a water-proofing agent is to be employed, the latter is present in an amount from about 0.4 to about 2 percent, by weight.

The preparation of the novel solid fuel compositions of the present invention is, in general, carried out by forming a mixture comprising the petroleum coke, wood-sawdust, and clay components; forming another mixture comprising an aqueous solution of the oxidizing agent and binder (the water-proofing agent may also be included in this mixture, if its presence is desired); combining these mixtures; and forming from these combined mixtures, the fuel composition of the desired shape.

In its preferred form, in which the solid fuel composition is to be employed in the form of a briquette, the dry and wet mixes are combined in the form of a slurry, and this slurry is then subjected to an extrusion operation. In this modification, the slurry is preferably fed into a pug mill and forced through a die of such contour as to obtain a briquette having the desired dimensions. The briquette thus produced is then passed into a heater or other device, in which water is removed at temperatures from about 160° F. to about 250° F. In another form, the slurry may be pressed in a mold to the desired shape or form and then dried. Also, if so desired, the solid fuel composition may be immersed in, or sprayed with, a water-proofing agent, if such agent was not originally present as a component of the aforementioned wet mix.

If the presence of the aforementioned igniting composition is desired, a thin layer of this composition is added to at least a portion of the surface of the formed solid fuel briquette composition. This layer is preferably applied by spraying a separate mixture of charcoal, oxidizing agent and binder components (and also the water-proofing agent, if so desired), and, simultaneously, spraying the sawdust component through a separate nozzle (to avoid nozzle plugging) over the surface of the solid fuel, or briquette composition, to form the igniting composition layer, in situ. In this instance, also, the water-proofing agent may be applied over the entire surface of the igniting layer and the basic fuel composition itself, if so desired, and if not previously incorporated either in the igniting layer or the basic fuel composition, or both. Also, the entire mixture of charcoal, wood-sawdust, oxidizer, binder and water-proofing agent can be extruded directly onto the surface of the briquette.

The outstanding feature of the novel solid smokeless and flameless fuel compositions of the present invention resides in the phenomenon that, unlike the combustion of conventional charcoal briquettes or pellets, the heat realized is in the form of radiant, infra-red, heat emanations. This form of heat is transmitted by radiation directly to the fruit, limbs, trunks or other forms of vegetation, with minimum loss to the atmosphere. In contrast, it will be noted that conventional grove-heating systems, employing other types of fuel, operate, principally, by heating the air and carrying air, so heated, by convection currents to the desired point of application. In the latter instance, much of the gaseous heat tends to escape without being carried to the vegetation. In actual practice, when employed for outdoor heating, the solid fuel composition, preferably in the form of a briquette, being resistant to weather, can be stored on the ground, or, for example, in the crotch of a tree, for use when frost appears to be imminent. When temperature conditions are such as to indicate the use of these compositions, the briquette may be placed on the ground in the vicinity of the vegetation, or hung from tree limbs, in any convenient manner, and easily ignited by the flame of a torch or other kindling means. In essence, therefore, the present invention provides a method for protecting vegetation against frost damage by combusting a smokeless and flameless solid carbonaceous material, in open atmosphere, which is positioned substantially below the top of the vegetation to be protected and within the area bounded by terminal points of the vegetation, in which radiant heat emitted at the surface of the solid material is absorbed by elements of the vegetation to provide a degree of protection to all elements thereof, and efficiency of fuel utilization both in excess of that obtainable by convection heating, characteristic of flame combustion, and of combustion occurring within a confined area such as a metallic stove. In its more specific form of application, this method provides placing the solid carbonaceous material, e.g. in the form of a briquette, at a vertical position substantially below the top of a tree to be protected and at a horizontal position within the area bounded by the ends of limbs, to provide protection to all elements of the tree, as described above. In this respect, it has been found that a briquette comprising approximately, by weight, 65 percent petroleum coke, 9 percent wood-sawdust, 9 percent charcoal, 10 percent sodium nitrate, 4.5 percent starch, 2 percent of a non-hydratable clay comprising, approximately, 75 percent silica and 25 percent alumina, and 0.5 percent wax emulsion, and covered with an igniting composition comprising, approximately, by weight, 44 percent wood-sawdust, 44 percent charcoal, 8.8 percent sodium nitrate, 2.3 percent starch and 0.9 percent wax emulsion, and measuring 6" x 6" x 9", is capable of releasing approximately 10,000 B.t.u. per hour. With a depth of 6", the briquette can burn for a period of 4 hours, i.e. at the rate of 1½" per hour.

The following examples and comparative results, will serve to illustrate the novel fuel compositions of the present invention, their method of manufacture, and the advantages realized with respect to the presence of the aforementioned non-hydratable clay component in carrying out an extrusion molding operation.

Example 1

This example illustrates the manufacture of a briquette comprising approximately, by weight, 67 percent petroleum coke, 9 percent wood-sawdust, 9 percent charcoal, 10 percent sodium nitrate, 4.5 percent starch and 0.5 percent of an emulsified paraffin wax:

A dry mixture was formed containing approximately, by weight, 79.0 percent petroleum coke. 10.5 percent wood-sawdust and 10.5 percent charcoal. Another mixture was formed comprising an aqueous solution of approximately, by weight, 22.2 percent sodium nitrate, 10.0 percent starch, 1.2 percent of the emulsified paraffin wax and 66.6 percent water. The above-described dry and wet mixes were combined in the form of a slurry. The slurry thus obtained was then subjected to an extrusion operation, by being fed into a pug mill and forced through a die of such contour as to obtain a shaped briquette of desired dimensions. It was found, however, that it was not possible to obtain a dimensionally stable column without encountering excessive plugging at the extruder die-face, thus impairing efficiency and ease of operation, with its economic disadvantages in obtaining the desired shaped briquette.

Example 2

On a comparative basis, this example illustrates the manufacture of a briquette comprising approximately, by weight, 65 percent petroleum coke, 9 percent wood-sawdust, 9 percent charcoal, 10 percent sodium nitrate, 4.5 percent starch, 0.5 percent of an emulsified paraffin wax and 2 percent of a non-hydratable clay comprising, approximately, 75 percent silica and 25 percent alumina:

A dry mixture was formed containing approximately, by weight, 76.5 percent petroleum coke, 10.5 percent wood-sawdust, 10.5 percent charcoal and 2.5 percent of the aforementioned clay. Another mixture was formed comprising an aqueous solution of approximately, by weight, 22.2 percent sodium nitrate, 10.0 percent starch,

1.2 percent of the emulsified paraffin wax and 66.6 percent water. The above-described dry and wet mixes were combined in the form of a slurry. The slurry thus obtained was then subjected to an extrusion operation by being fed into a pug mill and forced through a die of such contour as to obtain a shaped briquette of desired dimensions. On a comparative basis, it was now found that the slurry was easily passed through the chamber of the die, and that a dimensionally stable column was obtained without encountering plugging at the extruder die-face. In an attempt to substitute a hydratable clay, viz., bentonite, it was found that die plugging was nevertheless encountered, thus illustrating the necessity for employing only a non-hydratable clay for the aforementioned intended purpose.

While preferred embodiments of the novel substantially smokeless and flameless fuel compositions of the present invention and the method for their preparation have been described for purposes of illustration, it will be understood that various modifications and adaptations thereof, which will be obvious to those skilled in the art, may be made without departing from the spirit of the invention.

I claim:

1. In a method for preparing a fuel composition comprising a major proportion of petroleum coke; from about 3 to about 20 percent, by weight, wood-sawdust; from about 4 to about 40 percent, by weight, charcoal; from about 2 to about 15 percent, by weight, of an oxidizing agent capable of supporting combustion; and from about 1 to about 10 percent, by weight, of a binder; and wherein said composition is subjected to an extrusion operation, the improvement which comprises incorporating in said composition, prior to extrusion, from about 1 to about 15 percent, by weight, of a non-hydratable clay to prevent plugging of the die face during extrusion of said fuel composition.

2. The method of claim 1 wherein said non-hydratable clay is present in said composition in an amount, by weight, from about 3 to about 6 percent.

3. In a method for preparing a fuel composition comprising a major proportion of petroleum coke and minor proportions of wood-sawdust, charcoal, an oxidizing agent capable of supporting combustion and a binder; and wherein said composition is subjected to an extrusion operation, the improvement which comprises incorporating in said composition, prior to extrusion, a non-hydratable clay in an amount sufficient to prevent plugging of the die face during extrusion of said fuel composition.

4. The method of claim 3 wherein said non-hydratable clay is present in said composition in an amount, by weight, from about 1 to about 15 percent.

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