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CARBONACEOUS FUEL AND METHOD OF PREPARING THE SAME

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This invention relates to carbonaceous fuel and to the process of treating the fuel to benefit the combustion characteristics of the fuel.

It is the principal object of the invention to provide a method of improving the combustion characteristics of carbonaceous fuel by producing a material reduction in the tendency of the ash of the fuel to clinker.

It is a further object to provide a method of treating carbonaceous fuel, such for instance as coal or other solid fuel, with a small quantity of a highly effective and inexpensive mineral material to effect a reduction in the tendency of the ash of the fuel to form clinker.

It is a further object to provide a carbonaceous fuel having a relatively low ash content and an altered and raised softening temperature and a reduced tendency to clinker.

Other objects and advantages will be apparent from the description and the appended claims.

It is well known that in the combustion of carbonaceous fuel, such for example as coal or other solid fuel, the production of high temperatures during the combustion process is often accompanied by an objectionable clinkering of the ash constituents of the fuel. The ashes of some fuels exhibit a greater tendency toward clinkering than others, but in most cases the tendency to clinker is a serious obstacle to obtaining proper and efficient combustion, and the clinkering problem becomes more important with the higher furnace temperatures.

The exact phenomenon of clinkering is not entirely understood but it is believed to be in some manner dependent upon the temperature at which the ash of the fuel softens. The softening temperature of the ash as measured in the standard test of the American Society for Testing Materials is defined as that temperature at which the standard test cone of the ash has fused down to a half-spherical or dome-shaped lump. As the temperature is increased beyond this softening temperature, the spherical shape of the test cone gradually disappears and the ash becomes more fluid and falls to a formless mass. The fluid temperature is defined as that temperature at which the cone has spread out over the base in a flat layer. This latter temperature is also probably related to the clinkering tendency of the fuel.

We have found that when certain several mineral materials are admixed with the fuel in controlled proportions in advance of combustion, there results an extraordinary inhibiting effect upon, and resultant extraordinary decrease in, the clinkering tendency of the ash of the fuel. This seems to be due to some unusual, and not now understood, reactions which cause a marked raising of the softening temperature. These unusual and unexpected results are attained in practice through the admixture of bauxite and a refractory clay of unusual and characteristic effectiveness in proportions and quantities suitable for the particular fuel, its ash content, etc. And by properly proportioning the quantities of bauxite and such clay, and the proportioning of the resulting admixture of clay-bauxite and fuel, a result of maximum effectiveness may be secured which is much greater and more pronounced than other proportions in admixture, also much greater and more pronounced than will be the case if either of the additive materials is used alone. The range of proportions producing superior effects upon the clinkering tendency may, in many cases, be quite broad; and, of course, commercial considerations—such as price, may suggest departing from the most effective proportionings of the fuel and additive material. Also these desirable results are attributable to the use of clay having the characteristics in effectiveness when so admixed with bauxite to produce extraordinary and unexpected effects upon the clinkering tendency. It has been found that this superior effectiveness is obtained over a wide range of proportions of the two materials. For example, starting with clay, and adding small but effective amounts of bauxite, a marked improvement in effectiveness of the mixture, is obtained. As the proportion of bauxite to clay is increased, continued increase in effectiveness of the mixture results until a range of maximum effectiveness is reached. The effectiveness of this range of proportions is considerably in excess of the effectiveness of like amounts of either clay or bauxite alone, and similarly is considerably in excess of the cumulative results that would be expected from the amount of each material present. As the proportion of bauxite to clay is further increased up to the point of pure bauxite, decreased effectiveness results.

The range of proportions of the constituents which gives maximum effectiveness has been found to vary materially with the particular fuel treated, and with the characteristics of the added materials. Bauxite is ordinarily more expensive than clay and it is sometimes desirable to use a mixture containing a lesser proportion of bauxite to clay than that proportion which would give the maximum effectiveness, all mixtures of clay

with effective amounts of bauxite up through the maximum range however producing the desired and unexpected results of this invention.

The quantity of the additive materials may vary with the effect desired in the resultant fuel, the proportion of the additive materials increasing to produce a fuel having higher softening and fluid temperatures and consequently less tendency toward clinkering. In the case of solid fuel, the quantity of additive materials will generally be not materially greater than the quantity of natural ash that is originally present in the fuel itself. It is usually desirable to keep the quantity of additive material as small as required to produce the desired effect in order to reduce the quantity of ash to be handled. This is particularly true in the case of certain low ash coals which command a premium on the market by reason of their low ash content and in order to maintain this desired freedom from excessive ash, it is of course desirable to use small amounts of additive materials having high effectiveness with respect to the clinkering tendency of the ash of the fuel.

The additive materials may be applied in any desired manner which will properly distribute them and maintain them in the desired distributed relation throughout the fuel. In the case for instance of a solid fuel such as coal, the additive materials may be mixed with and applied to the surface of the coal by any suitable adhesive means such for instance as a suspension of the additive materials in an oil water emulsion, which is applied to the surface of the coal and dried thereon to maintain the additive material in proper functioning position. In the case of fuel which is introduced in streams such as powdered fuel, the material may be admixed in the desired proportion with the fuel at any convenient point.

As a specific example of a manner in which the invention has been successfully carried out, a bituminous coal from the Taggart seam, Virginia, was used, the coal having a natural ash content of approximately 2.7% and the untreated ash having a softening temperature of approximately 2200° F. A mixture of bauxite from Alabama and a refractory clay known as sagger clay and obtained in Western Tennessee was added to the coal in the proportion of 2.37 lbs. of the mixture of additive material to 100 lbs. of coal, giving a total ash content of the coal and additive material of 4.6%. The softening temperature of the fuel ash using a mixture of 80% clay and 20% bauxite was improved to 2645° F, and this was increased to a maximum of 2845° F. at approximately 40% clay and 60% bauxite. When a comparable amount of clay alone was added to produce with the coal the same total ash content, viz. 4.6%, the softening temperature of the fuel ash was 2555° F.; when a comparable amount of bauxite alone was added, to give the same total ash content, the softening temperature of the fuel ash was 2710° F.

As another example using the same coal and bauxite, but using a refractory clay known as Old mine hickory sagger clay from Graves county, Kentucky, mixed clay and bauxite was added in controlled proportions to produce the same total ash content of 4.6%. With a mixture of 75% clay and 25% bauxite the softening temperature of the fuel ash was 2715° F. This temperature was increased to a maximum of 2805° F. with a mixture containing approximately 50% clay and 50% bauxite. A comparable amount of clay alone when added to the fuel produced a softening temperature of the fuel ash of 2585° F.

As another example using still a different clay, a comparable quantity of this different clay and bauxite was added to the same coal, to produce the same total ash content of 4.6%. The clay was a refractory clay from Buena Vista, Rock Bridge county, Virginia. With a mixture comprising 75% clay and 25% bauxite, the softening temperature of the fuel ash was 2555° F., and a maximum softening temperature of 2860° F. was obtained with a mixture comprising approximately 40% clay and 60% bauxite. A comparable amount of this clay alone produced a softening temperature of 2390° F.

As an example using a different type of coal, coal from #3 Pocahontas seam, McDowell county, West Virginia, was used, this coal having a natural ash content of 5.7%, and the untreated ash having a softening temperature of 2390° F. For comparative purposes the quantity of additive materials of this invention was made such as to increase the ash content of the fuel in the same proportion as in the examples given above, the amount of the additive material in each of the following cases being such as to produce a total ash content of 9.7%. With a mixture comprising 75% of the refractory sagger clay from Western Tennessee and 25% bauxite, the softening temperature of the fuel ash was 2670° F., and a maximum softening temperature of 3000° F. was obtained with a mixture comprising approximately 20% clay and 80% bauxite. A comparable amount of the clay alone produced a softening temperature of 2520° F.; and a comparable amount of bauxite alone produced a softening temperature of 2755° F.

While the process and product herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise process and product, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. An improved carbonaceous fuel of the character described having a reduced clinkering tendency comprising a fuel having added thereto a small quantity of a mixture of refractory clay and bauxite in predetermined controlled proportions such that the combined effect of said mixed materials with respect to raised softening temperature of the fuel ash is in excess of the effect produced by comparable amounts of either constituent if used alone.

2. The method of reducing the clinkering tendency of solid carbonaceous fuel which comprises admixing with the fuel a small quantity of bauxite and clay in predetermined controlled proportions effective to raise the softening temperature of the fuel ash an amount in excess of the results produced by either the bauxite or clay if used alone.

3. The method of improving the clinkering tendency of carbonaceous fuel which comprises distributing throughout the fuel a small quantity of an added mixture of refractory clay and bauxite in predetermined controlled proportions, said mixture of clay and bauxite being effective to raise the softening temperature of the fuel ash by an amount in excess of the individual effects of said clay and said bauxite.

4. An improved carbonaceous fuel of the character described having a reduced clinkering tendency comprising a fuel having distributed throughout an added mixture of bauxite and clay in predetermined controlled proportions such

that the combined effect of said mixed materials with respect to raised softening temperature of the fuel ash is in excess of the individual effectiveness of said clay and said bauxite.

5. An improved carbonaceous fuel of the character described having reduced clinkering tendency comprising a solid fuel having added thereto a mixture of clay and bauxite in predetermined controlled proportions such that the combined effect of said mixed materials with respect to raised softening temperature of the fuel ash is in excess of the individual effectiveness of said clay and said bauxite, said materials being used in the proportion of 20% to 80% bauxite and the remainder clay.

6. The method of providing an improved solid carbonaceous fuel having the reduced clinkering tendency of the character described, which comprises treating a fuel of such composition that its ash has an undesirable low softening temperature to add to such fuel and to admix therewith and with each other a small quantity of a mixture of refractory clay and bauxite in predetermined controlled proportions relative to each other, the combined effect of such materials as thus admixed being to raise the softening temperature of the ash material within the admixture by an amount in excess of the effect produced by such amount of either constituent if used alone.

7. The method of producing an improved solid carbonaceous fuel of the character described having reduced clinkering tendency which comprises adding to a fuel a predetermined small quantity of a mixture of refractory clay and bauxite in predetermined controlled proportions and admixing said bauxite and clay to distribute said constituents throughout the fuel, said mixture of clay and bauxite with the fuel being effective to raise the softening temperature of the fuel ash by an amount in excess of the individual effectiveness of the added clay or bauxite if used alone, said added clay and bauxite being used in the proportion of 30% to 70% bauxite and the remainder clay.

8. An improved carbonaceous fuel of the character described having reduced clinkering tendency comprising a solid fuel having added thereto a mixture of clay and bauxite in predetermined controlled proportions such that the combined effect of said mixed materials with respect to raised softening temperature of the fuel ash is in excess of the individual effectiveness of said clay and said bauxite, said added clay and bauxite being used in the proportion of 30% to 70% bauxite and the remainder clay.

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