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COMPOSITE FUEL AND THE COMBUSTION THEREOF

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This invention relates to an improved composite fuel and the combustion thereof, the invention being particularly concerned with the utilization of what has become known in the trade as anthracite fines or silt, especially grades ordinarily identified as #4 and #5.

Considerable surpluses of these anthracite fines are available and are still being accumulated, and these are available at low cost compared with the B. t. u. content thereof. However, the fines by themselves constitute a material which is very difficult to handle and feed, and which further does not produce a desirable type of fuel bed.

Various attempts have been made to utilize anthracite fines in coal mixtures and in briquettes, but these attempts have either been unsuccessful or economically unjustified under present circumstances, or both, for various reasons discussed herebelow.

In attempting to utilize anthracite fines by mixing them with other fuels, for example with some softer coal, it has been found necessary, for various reasons, to use very large quantities of the softer coal, with the result that the economic gain due to use of the fines was so small as not to justify the additional costs incident to preparing the mixture. Thus, while a mixture of anthracite fines with bituminous up to about 20 to 25% of anthracite produced a fuel which handled and burned satisfactorily, attempts to increase the amount of anthracite fines gave rise to several serious difficulties, as follows:

In the first place, the bituminous and anthracite tend to segregate in handling and feeding. This is due to the difference in specific gravities of the two fuels (1.3 for anthracite and 1 for bituminous) and also the physical nature of the particles of the two coals. The anthracite particles, on the one hand, present a smooth, hard surface, while the particles of bituminous coal are softer, and readily slip on the surfaces of the anthracite. Bearing in mind that for many purposes, such as burning on an underfeed stoker, it is necessary to subject the fuel to considerable handling, by the time the fuel actually reached the fuel bed the segregation had proceeded to such an extent that the fire was spotty, being pitted with blow holes. This resulted in an excess of oxygen and lowered the CO₂, lowering the efficiency of combustion. Other losses occurred as a result of the carrying of anthracite fines up the stack and also into the ash.

Another difficulty encountered in previous attempts to exceed about 20 to 25% of anthracite

fines in a mixture, was that in the fire bed the bituminous did not uniformly coke, in consequence of which the fire bed was of an unsatisfactory nature.

Attempts to utilize anthracite fines by briquetting have also proven unsatisfactory or economically unjustified, or both, as will appear from the following consideration of that practice.

In making briquettes the anthracite fines were frequently mixed with a binder and also with some softer coal, the mixture being heated to a fairly high temperature sufficient to coke the softer coal, the coke thus produced actually serving as the binding agent in the briquettes. This is uneconomical since it uses up some of the heat value of the ingredients.

The briquetting practice is also disadvantageous since it requires a considerable number of operations in actually forming the briquettes.

Over and above the foregoing, for briquetting purposes a relatively heavy and, therefore, expensive oil is ordinarily required in order to obtain briquettes which will withstand considerable handling. In attempts to use a lighter oil it is found that the amount thereof must be increased to an uneconomically high figure.

Briquettes also are of limited usefulness since they may only be satisfactorily burned in certain specific types of installations.

With the foregoing in mind, the present invention provides for effective utilization of large quantities of anthracite fines in a manner which completely overcomes the difficulties hereinbefore mentioned. Briefly, the invention contemplates employing anthracite fines in a composite fuel, in which the fines constitute substantially more than half of the fuel by weight. The remainder of the composite fuel is made up of comminuted bituminous coal and an oil binder. Preferably the oil binder constitutes from about 3 to 5% of the total by weight, the bituminous from about 15 to 20% by weight, and the balance anthracite fines.

I have found that the binder performs two very important functions. First, the oil prevents segregation of the bituminous and anthracite particles, even in situations where very substantial handling is involved in transporting and feeding the fuel. Second, the oil promotes coking of the bituminous, with the result that the fuel bed resists substantial churning and shaking (as in an underfeed stoker). Apparently the oil binder acts as an accelerator of combustion of the soft coal in the mixture, quickly enclosing

the particles of anthracite in a bituminous coke matrix. In connection with the second point, comparative experiments which I have made show that a mixture of anthracite and bituminous in a 7 to 3 ratio (without the presence of an oil binder) does not form a solid coke-like fire bed in less than thirty minutes in a gas-fired furnace at 1800° F. In contrast, the addition of an oil binder to a mixture of essentially the same proportions can be burned within a furnace into an "anthracite coke" within fifteen minutes.

My improved fuel may be burned on a variety of types of stationary grates without encountering any special problems.

My improved fuel may further be burned on various automatic stoker-fired grates such, for instance, as an underfeed stoker.

On an underfeed stoker, the mixture of anthracite, bituminous and binder may show some tendency to form balls or lumps, which, in the fire bed, would result in thin spots and an excess of unconsumed coal in the refuse. According to my invention, however, this problem is solved by loading the stoker hoppers alternately with one part of bituminous coal and two parts of my improved fuel mixture. By this method, a solid, even fuel bed is secured which, in full-scale operation, I have found burns with an efficiency as high as 93.2%, which is comparable to the efficiency of burning the same amount of bituminous coal. By following this method of feed in an underfeed stoker, the anthracite fines constitute about 50% of the total fuel bed.

In connection with the several ingredients of my composite fuel, I desire to point out the following:

First with regard to the anthracite, use of the term "anthracite fines" refers especially to Nos. 4 or 5 fines or slit, and also to any essentially similar hard coal slit.

In using the term "bituminous coal" I have reference to any of the well known coking or soft grade coals. I have satisfactorily employed 20% of gas coal, containing 30% of volatile hydrocarbons, and also the same amount of semi-bituminous coal, containing 17.7% hydrocarbons. Thus it will be seen that considerable variation in the quality of the coal is permissible, my experiments indicating that the important qualification of the "bituminous coal" ingredient is its "coking" characteristic. As hereinbefore indicated, this coal is preferably comminuted, i. e., is broken up into quite fine particles, although it need not be pulverized. For example, it is sufficient to grind the bituminous coal to a de-

gree of fineness such that 85% thereof will pass through a $\frac{3}{32}$ " screen. This relatively coarse grinding which is permissible in accordance with my invention is, of course, a distinct advantage from the economical standpoint.

As binder for the mixture of anthracite and bituminous, I employ a mineral oil, preferably what is known in the art as Bunker Fuel C. This oil, while too light to serve as a binder for briquetting, is highly effective to prevent segregation of the constituents of the loose granular mass constituting my improved composite fuel, even in the relatively small amounts above mentioned. While some other binders may also be employed, such as other mineral oils or vegetable binders, I prefer Bunker Fuel C as indicated, especially because of its relatively high fuel value.

Concentrate sulphite liquor (for example of 30° B.) may also be employed as a binder.

In accordance with the foregoing, I provide for the economical utilization of large quantities of anthracite fines, without the difficulties heretofore encountered as a result of segregation, and further without the disadvantages of briquetting, including the multiplicity of operations commonly employed in effecting the briquetting and also the fact that substantially more binder is necessitated in briquetting processes.

I claim:

1. A composite physically intermixed loose granular fuel mass of anthracite fines of comminuted bituminous coal and of an oil binder, the oil binder constituting from 3% to 5% of the total weight, the bituminous coal from 15% to 20% of the total weight, and the balance anthracite fines; the oil binder preventing segregation of the bituminous and anthracite particles and acting as a combustible constituent of the mixture for permitting coking of the bituminous coal.

2. A composite physically intermixed loose granular fuel mass of anthracite fines of the grade identified as #4 and #5 and of comminuted bituminous coal having a fineness such that about 85% thereof will pass through a $\frac{3}{32}$ inch screen, said composite also including a mineral oil binder, the oil binder constituting from about 3% to 5% of the total weight, and the anthracite fines constituting substantially more than half of the fuel by weight; the oil binder preventing segregation of the bituminous and anthracite particles and acting as a combustible constituent of the mixture for permitting coking of the bituminous coal.

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