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(54) **Fuel composition.**

(57) A fuel composition is prepared from a friable solid fuel, e.g. coal, and a lower alcohol, e.g. methanol. The solid fuel is ground in the alcohol until the mean particle size of the solid fuel particles is reduced to a value in the range 1 to 10 micron and the composition contains 15 to 65% by weight of the solid fuel. Air is excluded during the grinding operation. The composition is suitable for use as a liquid fuel for industrial burners.

FUEL COMPOSITION

This invention relates to fuel compositions which are dispersions of solid fuel in an alcohol and to a method for their preparation.

Coal oil-slurries have previously been disclosed, see for example, British Patent Specification No. 975687. Whilst these have
5 behaved as near-Newtonian non-settling fluids in pipelines, they separate on standing. Thus such slurries are suitable for use immediately after preparation or pipelining but are not suitable for transportation by tanker nor for storage.

Our British Patent Specification No. 1523193 describes and claims
10 a method for the preparation of a uniform coal oil dispersion which method comprises grinding coal in a medium consisting essentially of gas oil and/or a heavier petroleum fraction until the particle size is reduced to a value below 10 micron and the dispersion contains 15 to 55% by weight coal, expressed as a percentage by weight of the total
15 dispersion, and until a stable dispersion results on ceasing grinding.

GB 1514888 - Keller Corporation discloses a fuel composition comprising a combustible, pseudo-thixotropic liquid-solid suspensoid including a critical proportion of coal particles having a critical settling velocity uniformly dispersed in a solution of methyl fuel
20 including methanol, water and other alcohol soluble constituents of the coal. The coal particles have a relatively wide range of particle sizes and a majority are less than 150 micron in lateral dimensions. Because of surface area considerations, 1514888 warns that not more than 1% of the coal should have a particle size below 10 micron. In
25 the preparation of such suspensoids it is necessary to store a slurry

of coal and methanol. The storage period may vary from one to many days or weeks. The particles in the final suspensoids remain in suspension with low intensity stirring on storage and in motion through a pipe line. They do, however, settle out on standing but can be redispersed by stirring.

We have now surprisingly discovered that, contrary to the teachings of 1514888, dispersions of improved stability can be prepared by reducing the mean particle size to below 10 micron and furthermore, that if this is done, the lengthy storage step is not
10 necessary.

Thus according to the present invention there is provided a fuel composition containing 15 to 65% by weight of a friable solid fuel., preferably 25 to 40%, uniformly dispersed in a lower alcohol, the mean particle size of the solid fuel being in the range 1 to 10 micron,
15 preferably 2 to 5 micron, the percentage being expressed as a percentage by weight of the dispersion.

By lower alcohol we mean an alcohol containing from 1 to 6 carbon atoms per molecule. The preferred lower alcohol is methanol.

Suitable friable solid fuels include coals of various ranks,
20 solvent refined coal, coal coke and petroleum coke. A very suitable coal is bituminous coal.

The compositions are prepared by grinding solid friable fuel in the alcohol in the absence of air.

Thus according to another aspect of this invention there is
25 provided a method for the preparation of a uniform dispersion of a friable solid fuel in a lower alcohol, which method comprises grinding the solid fuel in the alcohol until the mean particle size of the solid fuel particles is reduced to a value in the range 1 to 10 micron, preferably 2 to 5 micron, and the dispersion contains 15 to
30 65% solid fuel, preferably 25 to 40%, the percentage being expressed as a percentage by weight of the total dispersion, air being excluded during the grinding operation.

Preferably the solid fuel supplied to the grinding process is pre-ground to a particle size not greater than 250 micron.

35 Grinding can be carried out in vibratory, agitatory or tumbling ball mills.

When using an agitatory or vibratory ball mill, the pre-ground solid fuel is preferably pre-mixed with the alcohol before grinding, e.g. in a high speed vortex mixer.

The grinding time will depend on the nature of the mill.

5 It is necessary to exclude air during the grinding operation. This can be easily achieved in the case of an agitatory ball mill by filling the mill completely. In the case of vibratory and tumbling ball mills, it is not practical to fill the mill completely and the milling should be carried out under an inert gaseous atmosphere, e.g. a blanket of nitrogen.

When using a ball mill it is, of course, desirable to use balls made of a material which does not react with the solid and which does not wear unduly either itself or the interior surface of the mill during the grinding. Ball mills usually contain steel or glass balls
15 and these are suitable for the present purpose.

The stability of the solid fuel dispersion is a function of three variables - the method of grinding, the final particle size and the final concentration of solid in alcohol. If all three are chosen correctly, then the resulting dispersion at ambient temperature is in
20 the form of a gel in which a physical network is formed by solid particles in alcohol. It is a uniform structure from which the solid particles cannot settle out because they form part of it.

If the solid is not ground in the alcohol in the absence of air, the gel will not form. If the solid particle size is too great, then
25 the gel will not form. The concentration of the solid particles is also critical. If it is too low, the gel will not form. If it is too high, the gel will be too solid-like for pumping.

Such solid fuel alcohol dispersions are suitable for use in blast furnaces, cement kilns, industrial boilers, marine boilers and utility
30 boilers.

Example 1

The coal was a bituminous coal ex Durham coal field of Rank 501 and with the following ultimate and initial analyses:

		<u>% wt</u>
	Carbon content	79.9
	Hydrogen content	4.94
	Nitrogen content	1.6
5	Total sulphur content	1.9
	Chlorine content	0.23
	Water content	2.4
	Ash content at 815°C	4.3
10	+ 500 μm	Trace
	+ 212 - 500 μm	1.9
	+ 75 - 212 μm	27.5
	+ 53 - 75 μm	15.8
	- 53 μm	54.8
15	The coal (1050 g) was mixed with methanol (1950 g) with continuous stirring using a high-speed vortex mixer. The resulting slurry, which was extremely unstable (i.e. the coal settled rapidly out of suspension), was pumped at a rate of 300 ml/m giving a nominal residence time of one minute to a stirred ball mill sold under the	
20	name Dyno Mill Type KDL by Willy Bachofen Maschinenfabrik, Basle, Switzerland. The mill grinding chamber, a horizontally mounted cylinder of capacity 600 ml contained 1 mm steel balls (nominally 500 ml). After allowing for the void volume between the balls the volume of the grinding chamber actually available to the feed was	
25	300 ml. The balls were stirred by agitator discs mounted on a horizontal shaft running parallel to the axis of the cylinder. The shaft speed was set at 4500 rpm giving a disc peripheral speed of 15 mm^{-1} . The product was collected as it emerged from the mill and was passed through the mill for a second time, at the same flow rate.	
30	The double-pass product emerged from the mill as a mobile liquid which showed no increase in coal content at the base of a test sample after storage at ambient temperatures for seven days.	
	The mean particle size of the coal particles in the dispersion was 3.7 micron as determined by an optical microscope technique.	

Claims:

1. A fuel composition containing 15 to 65% by weight of a friable solid fuel uniformly dispersed in a lower alcohol, the mean particle size of the solid fuel being in the range 1 to 10 micron, the percentage being expressed as a percentage by weight of the total weight of the dispersion.
2. A fuel composition according to claim 1 wherein the lower alcohol is methanol.
3. A fuel composition according to either of the preceding claims wherein the composition contains 25 to 40% by weight of the solid fuel.
4. A fuel composition according to any of the preceding claims wherein the mean particle size of the solid fuel is in the range 2 to 5 micron.
5. A fuel composition according to any of the preceding claims wherein the friable solid fuel is a bituminous coal.
6. A method for the preparation of a uniform dispersion of a friable solid fuel in a lower alcohol which method comprises grinding the solid fuel in the alcohol until the mean particle size of the solid fuel particles is reduced to a value in the range 1 to 10 micron and the dispersion contains 15 to 65% by weight of solid fuel, the percentage being expressed as a percentage by weight of the total dispersion, air being excluded during the grinding operation.
7. A method according to claim 6 wherein the solid fuel is pre-ground to a mean particle size not greater than 250 micron before being ground in the presence of the alcohol.
8. A method according to either of claims 6 or 7 wherein grinding is carried out in an agitatory or vibratory ball mill.
9. A method according to claim 8 wherein the solid fuel is dispersed in the alcohol prior to grinding.

10. A method according to either of claims 6 or 7 wherein grinding is carried out in a tumbling ball mill.