

1

3,210,168

STABILIZED OILED COAL SLURRY IN WATER

Arnold J. Morway, Clark, N.J., assignor to Esso Research and Engineering Company, a corporation of Delaware

No Drawing. Filed May 22, 1962, Ser. No. 196,611

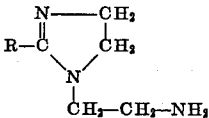
2 Claims. (Cl. 44—51)

This invention relates to a stabilized slurry of pulverized coal coated with a liquid hydrocarbon fuel in water to make the slurry suitable for pumping through a pipeline. In particular, this invention is concerned with stabilizing the pulverized coal coated with hydrocarbon oil using an imidazoline surfactant which stabilizes the dispersion of the oil-coated pulverized coal in a relatively small amount of water.

Tests have been carried out to demonstrate that an aqueous coal slurry containing at least 30 to 40 wt. percent water can be pumped through pipelines for transportation to where the coal is to be burned. However, there are disadvantages in using only water as the liquid medium in that the water of such proportions, above 20%, makes combustion of the slurry in the furnace less efficient. Difficulties also arise in the transporting of an aqueous slurry or oil slurry of coal in the tendency of the powdered coal to settle out.

The present invention has been found to provide a more suitably powdered coal slurry in a composition with petroleum oil and a more limited amount of water, particularly when the mixture is stabilized by the use of a relatively small amount of imidazoline which serves to stabilize the slurry.

The imidazoline agent has the general formula:



wherein R is an aliphatic hydrocarbon chain radical containing 10 to 23 carbon atoms. The aliphatic radical may be an alkyl group such as present in high molecular weight fatty acids, e.g., lauric, myristic, palmitic, stearic, archidic and carnaubic. The aliphatic radical may be alkenyl radical or an alkadienyl radical, or in other words, an unsaturated aliphatic radical such as present in the following unsaturated acids, e.g., oleic, linoleic, linolinic and eurcic.

These imidazolines and methods for their preparation are described in U.S. Patent 2,361,488 of Louis A. Mikeska.

The stable coal slurry compositions made in accordance with the present invention using pulverized coal coated with hydrocarbon oil dispersed in water should contain about 15 to 20 wt. percent of water. Larger amounts than this proportion give unsatisfactory combustion and difficulties in maintaining a stable slurry. The proportion of hydrocarbon oil, e.g., crude petroleum oil or a petroleum fuel oil, used in coating the coal particles is in the range of about 25 to 35 wt. percent. The amount of pulverized coal used in the slurry is in the range of 45 to 55 wt. percent. The amount of the surfactant agent in the slurry formulation is about 0.3 to 2 wt. percent. The pulverized coal is preferably of a particle size to make substantially all the pulverized coal pass through an 8 mesh sieve, and with about 90% which would be retained on a 200 mesh sieve. In these slurries, the hydrocarbon oil, with the aid of the imidazoline surfactant in small amount, coats the coal particles and replaces the amount of water that cannot be tolerated for stable suspension and satisfactory combustion.

In preparing a composition containing the maximum amount of water, 20 wt. percent water, the pulverized

2

coal was first mixed with the water in a proportion of 5 parts by weight of coal with 2 parts by weight of water to obtain a pasty or mud-like consistency. The imidazoline stabilizing agent used was of the kind in which the aliphatic hydrocarbon radicals attached to the carbon atom having a double bond to N in the heterocyclic ring were obtained from tall oil which made these radicals mainly heptadecenyl and heptadecadienyl. This oil solution of the imidazoline was mixed with the aqueous powdered coal suspension to obtain the following slurry formulation:

	Percent
Pulverized coal	50.0
Water	20.0
Fuel oil	28.0
Imidazoline surfactant	2.0

Petroleum fuel oils found suitable for use in the formulations are residual oils of the following types:

Inspection of heavy fuel oils from various crudes

	Venezuelan		U.S.A.		Middle East
	1	2	East Coast	West Coast	
Specific Gravity @ 60° F.	0.962	0.980	1.008	0.971	0.983
Closed Flash Point, ° F.	192	162	210	180	200
Viscosity Redwood, Sec. @ 100° F.	3,570	3,745	4,050	1,850	3,347
Sulfur Content, percent	2.17	2.65	1.7	1.24	4.5
Gross Calorific Value, B.t.u./lb.	18,540	18,440	18,200	18,490	18,290

In general, the more suitable residual fuel oils for use in the slurries have specific gravities of about 0.9 to 1 (at 60° F.) and viscosities about 40 to 300 Saybolt furo seconds at 122° F.

The pulverized coal may be of various types of coal, e.g. bituminous, anthracite, or semi-bituminous. Other finely-divided solid carbonaceous materials may be used, e.g. coke either from coal or petroleum.

The following example describes a slurry formulation which was considered closer to the optimum in stability.

Slurry formulation

	Percent
Pulverized coal	50.0
Fuel oil <sup>1</sup>	30.0
Water	19.0
Imidazoline	1.0

Residual fuel oils

Grade No.	Flash, ° F.	Viscosity		Specific gravity @ 60° F.
		Saybolt, 100° F.	Furo, 122° F.	
5	130	150	40	0.95
6	150		300	0.99

<sup>1</sup> Residual type oils for burner installation equipped with preheating facilities.

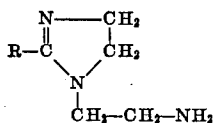
This slurry formulation showed no appreciable tendency to settle out after standing for over 24 hours. It has suitable fluidity under pressure for pumping through a pipeline, being equivalent in this respect to a slurry of 60 wt. percent pulverized coal in 40 wt. percent water.

The invention described is claimed as follows:

1. A stabilized aqueous slurry of powdered coal and residual petroleum fuel oil which comprises 8 to 200 mesh particle coal in a proportion of 45 to 50 wt. percent, 25 to 35 wt. percent of petroleum residual oil having a

3

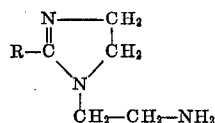
specific gravity of 0.9 to 1 at 60° F. and a Saybolt furol viscosity of 40 to 300 seconds at 122° F., 15 to 20 wt. percent water and about 0.3 to 2.0 wt. percent of an imidazoline surfactant of the formula:



wherein R represents heptadecenyl and heptadecadienyl chains, the powdered coal being coated with the oil containing the surfactant.

2. A stabilized aqueous slurry of powdered coal and oil which comprises about 45 to 50 wt. percent of powdered coal, about 25 to 35 wt. percent of hydrocarbon fuel oil, 15 to 20 wt. percent water, and about 0.3 to 2.0 wt. percent of an imidazoline having the formula:

4



5

wherein R represents a C<sub>10</sub> to C<sub>23</sub> aliphatic hydrocarbon radical, the powdered coal being coated by the hydrocarbon oil containing the imidazoline and the thus-coated powdered coal being suspended in the water.

10

#### References Cited by the Examiner

##### UNITED STATES PATENTS

2,128,913	9/38	Burk	44—1
2,553,183	5/51	Caron et al.	44—63
2,622,018	12/52	White et al.	44—63

##### FOREIGN PATENTS

408,951	4/34	Great Britain.
454,796	10/36	Great Britain.

DANIEL E. WYMAN, *Primary Examiner.*