

[54] **FUEL COMPOSITION**
[75] Inventors: **James T. Clancey; John A. Phinney,**
both of Pittsburgh, Pa.; **Thomas J. Regan,**
Martinsville, W. Va.; **Edward J. Wasp,** San Rafael, Calif.
[73] Assignee: **Consolidation Coal Company,**
Pittsburgh, Pa.
[22] Filed: **Dec. 14, 1970**
[21] Appl. No.: **98,037**

Related U.S. Application Data

[63] Continuation of Ser. No. 518,425, Jan. 3, 1966,
abandoned, which is a continuation-in-part of Ser. No.
229,423, Oct. 9, 1962, abandoned.
[52] **U.S. Cl.** **44/51**
[51] **Int. Cl.** **C10I 1/32**
[58] **Field of Search** **44/51; 252/31;**
100/7, 75

References Cited

UNITED STATES PATENTS

2,648,950	8/1953	Miller	44/51
728,854	5/1903	Browne	44/5
728,855	5/1903	Browne	44/51
3,168,350	2/1965	Phinney et al.	44/51

3,341,256	9/1967	Adams	44/51
3,359,040	12/1967	Every	44/51
3,124,086	3/1964	Sage et al.	44/51

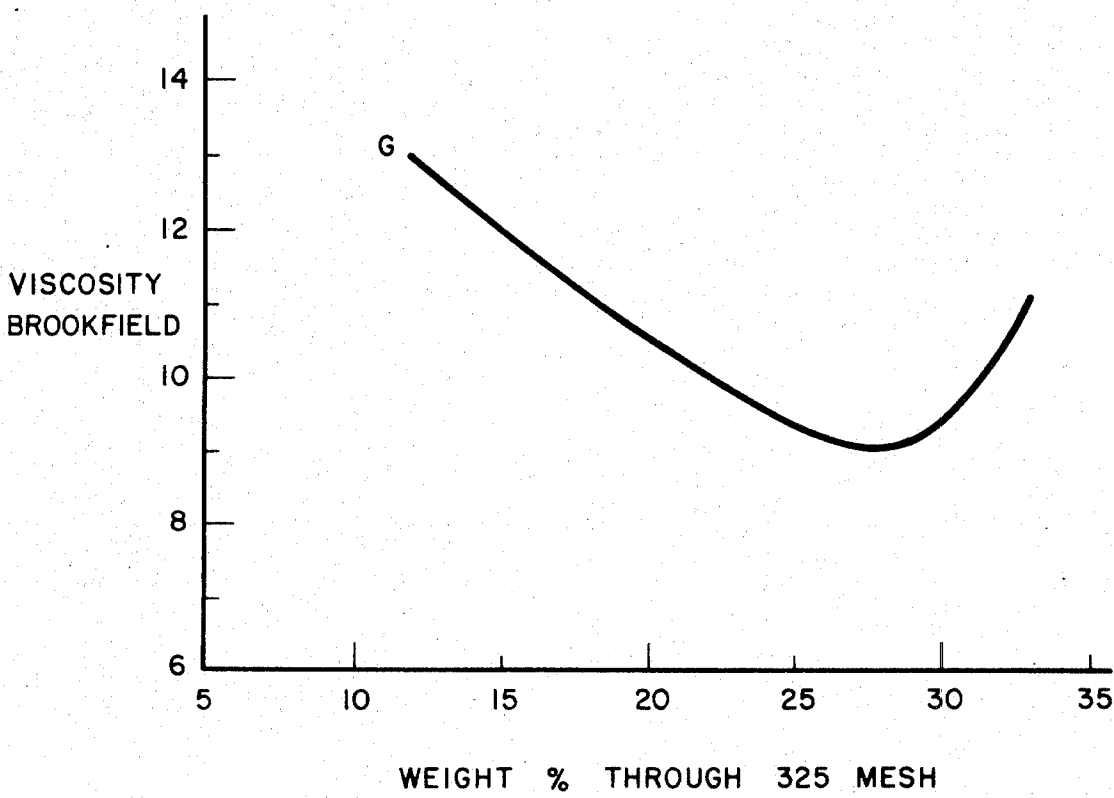
Primary Examiner—Daniel E. Wyman
Assistant Examiner—Mrs. Y. H. Smith
Attorney—D. Leigh Fowler, Jr. and Stanley J. Price, Jr.

[57] **ABSTRACT**

A liquid fuel composition that has as its sole constituents, particulate coal and water. The particulate coal and water are mixed to form a homogeneous slurry that can be handled, stored, pumped and burned in substantially the same manner as conventional liquid fuels. The coal and water in the slurry have the relative proportions of between 54 and 69 per cent by volume coal and 46 to 31 per cent by volume water. The coal particles have a size distribution so that substantially all of the particles pass through a 4 mesh Tyler Standard Screen and between 18 and 33 per cent by weight pass through a 325 mesh Tyler Standard Screen. Less than 60 weight per cent of the coal particles have a size that remains on a 28 mesh Tyler Standard Screen and the remaining coal particles have a size that passes through a 28 mesh Tyler Standard Screen and remains on a 325 mesh Tyler Standard Screen.

4 Claims, 1 Drawing Figure

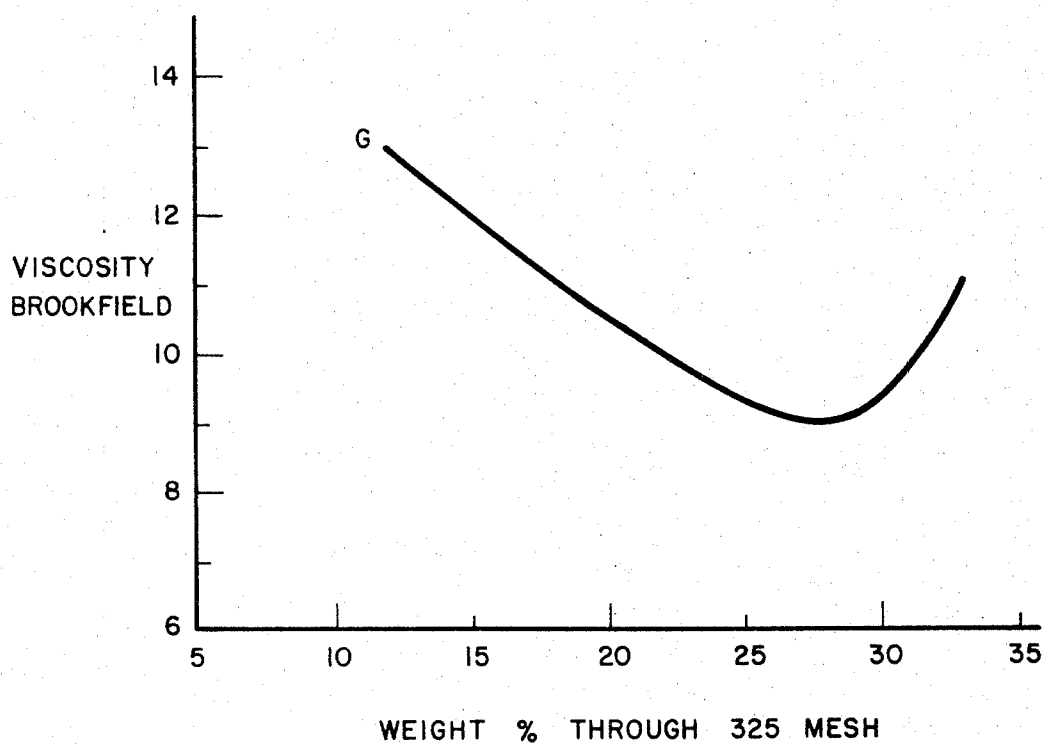
VISCOSITY vs FINES LEVEL



PATENTED OCT 2 1973

3,762,887

VISCOSITY vs FINES LEVEL



INVENTORS

J. A. PHINNEY

E. J. WASP

T. J. REGAN

J. T. CLANCEY

NEW FUEL COMPOSITION

This application is a continuation of our copending application Ser. No. 518,425, filed Jan. 3, 1966, entitled "A New Fuel Composition," now abandoned which in turn is a continuation-in-part of application Ser. No. 229,423, filed Oct. 9, 1962, entitled "A New Fuel Composition," which is now abandoned.

This invention relates to a new composition of matter which is suitable for use as a liquid fuel, and, more particularly, to a coal-water slurry which has the characteristics essential to use as a liquid fuel for cyclone burners, and the like.

The primary object of this invention is to provide a coal-water slurry that can be handled, stored, pumped, and burned as a liquid fuel.

Other objects of this invention will become apparent as the invention is more fully hereinafter described.

In accordance with our invention, we have provided a coal-water slurry, that is, a mixture of water and finely divided coal, which simulates a fuel oil in the following respects:

1. Its composition is homogeneous and remains substantially so after being stored for days and even months. To the extent there is any settling of the coal particles, and it is at most slight, the settled phase is homogeneous; that is, little or no size segregation of the particles occurs during the slight settling.
2. It is readily pumped and fed under control of automatic valves or other liquid control means to a coal conversion unit.
3. It is readily burned without prior removal of the water, for example, in a cyclone burner.

The new liquid fuel of our invention has the following composition. It consists essentially of finely divided coal and water in the relative proportions of 54 to 69

For a better understanding of our invention, reference should be had to the following description and to the accompanying drawing in which is shown a graph of the correlation between viscosity and per cent by weight of the coal particles in the coal having a size less than 325 mesh Tyler Standard screen.

The preferred method of making the new fuel of our invention is described in U.S. Pat. No. 3,168,350 entitled "Transportation of Coal by Pipeline" issued Feb. 2, 1965, and assigned to the assignee of the present invention. Specifically this method comprises blending a finely divided coal having a nominal top size between 4 and 28 mesh Tyler Standard screen, obtained by conventional grinding or crushing means such as rod mills, hammer mills, etc., with a fraction of coal particles passing through a 325 mesh Tyler Standard screen in such relative proportions as to yield a composition having the size specifications set forth above. The mixture is then stirred to effect homogeneity. The requisite water to yield the desired coal concentration is preferably added to the fractions of coal before blending to facilitate such blending. Any additional 4 × 28 mesh particles that may be required to meet the recited specifications are also added. The coal concentrations and the size distributions of the coal of examples of coal-water slurries in accordance with this invention (with the exception of Example R) are given in the following Table I. Example R is the size distribution of a so-called natural grind of coal having a nominal top size within the range of our invention and is included for purposes of comparison only. The coal employed in these examples was a Pittsburgh Seam coal having a specific gravity of 1.35. With such specific gravity, the range of concentrations of the coal expressed as per cent by weight rather than per cent by volume is 62 to 74 (corresponding to 54 to 69 per cent by volume set forth above).

TABLE I

	Percent by weight																		
Example.....	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
Concentration.....	68.4	68	65	72	63	65	62.0	62.8	63.1	66.4	67.2	69.0	69.4	73.1	66.2	67.6	70.3	-----	
On 4 mesh.....	0	0	0	0	0	0	0	Tr.	0	0	0.4	0	0	0	0	Tr.	0	0	
On 8 mesh.....	0.1	0.2	1	0	8.2	0.9	0.9	1.2	1.1	1.0	3.1	3.0	2.3	1.5	0.7	0.8	0.8	1.2	
On 14 mesh.....	4.4	5.0	11	3	22.8	9.9	10.4	13.5	11.3	12.9	10.5	15.4	14.9	15.3	9.2	7.9	11.5	13.7	
On 28 mesh.....	20.7	21.0	27	11.0	20.5	23.0	26.7	25.3	23.3	24.6	25.7	20.2	19.8	20.2	21.4	21.2	24.7	29.1	
On 48 mesh.....	19.9	18.0	20	26.4	12.0	16.2	19.4	18.5	18.6	17.0	12.2	13.3	13.2	12.5	17.6	17.6	18.3	20.7	
On 100 mesh.....	13.4	13.5	10	17.6	6.1	12.0	10.4	9.7	11.6	8.5	10.2	9.2	9.4	8.8	13.3	11.7	8.9	13.9	
On 200 mesh.....	8.3	6.0	6	10.6	2.6	9.0	0	0	0	0	0	7.7	7.8	6.7	8.6	6.6	4.7	6.1	
On 325 mesh.....	5.5	6.2	3	6.6	1.1	6.3	7.8	8.0	10.4	7.4	12.2	5.1	5.1	4.8	4.7	8.6	2.3	3.9	
Through 325 mesh.....	27.7	30.0	22	27.5	26.7	22.7	24.4	23.8	23.7	28.6	25.8	26.1	27.5	30.2	24.5	30.6	28.8	11.4	

per cent by volume of coal and 46 to 31 per cent by volume of water. The size distribution of the finely divided coal is such that all the particles will pass through a 4 mesh Tyler Standard screen. Between 18 and 33 per cent by weight of the particles pass through a 325 mesh Tyler Standard screen. The balance of the coal particles have a range of sizes between 325 mesh and 4 mesh, with less than 60 per cent by weight of the total coal in the range between 28 and 4 mesh.

We prefer, however, that the compositions have a coal concentration in the slurry between 57 and 65 per cent by volume, and that the size distribution of the coal be as follows: between 22 and 28 per cent by weight of the coal through 325 mesh, and between 20 and 30 per cent by weight in the range of 4 to 28 mesh, with the balance between 28 and 325 mesh.

In general the compositions of this invention have the appearance of a black heavy fuel oil such as that commonly referred to as Bunker C fuel oil. Their specific gravity is about 1.19. Their net BTU content (that is, the BTU content of the coal less the BTUs consumed in vaporizing the water present) is about 9,000 BTU/lb. of slurry for a Pittsburgh Seam bituminous coal which has been subjected to conventional cleaning procedures.

One of the most important properties of our new fuel is its stability upon storage for protracted periods of time. Even on extended periods of storage there occurs little or no segregation of sizes, and changes in concentration are slight. The following Table II illustrates the behavior of a typical composition (Example A of Table I) upon standing during three days in a 25-foot high

column. Samples were taken for size analyses and concentration determinations from the top and the bottom of the column at the end of the first and third days.

TABLE II

		Thru			
		Conc. On 8 Mesh	8 x 14 Mesh	325 Mesh	
		% by Wt.	% by Wt.	% by Wt.	% by Wt.
Top	1st Day	67.7	5.7	21.1	25.3
Bottom	1st Day	71.1	5.9	22.7	23.4
Top	3rd Day	70.0	6.6	21.3	25.5
Bottom	3rd Day	71.0	6.1	22.9	24.0

In general the viscosity of our new fuel is in the range of that of hot Bunker C fuel oil. It can be readily pumped in centrifugal or positive displacement pumps. The drawing shows graphically a correlation of viscosity with weight per cent of through 325 mesh particles in the coal. This correlation is typical of the compositions of our invention, although the minimum may shift somewhat depending upon the precise size distribution. The one shown in the drawing was obtained by blending in water a relatively coarse coal fraction A with a relatively fine coal fraction B to yield a final coal concentration of 63 per cent by weight with varying amounts of through 325 mesh coal to provide samples for the viscosity determinations with the exception of the point on the curve designated G. This point represents the viscosity of the mixture obtained by making up a 63 per cent concentration of the coal listed as Example R in Table I, i.e., a natural grind. The viscosities shown in the drawing are those obtained in a Brookfield Synchro-Lectric Viscosimeter (made by the Brookfield Engineering Laboratories, Stoughton, Mass.). Our new fuel is a non-Newtonian pseudoplastic fluid, and as such has no ordinary viscosity. The size distributions of the two fractions A and B are listed in Table III below.

TABLE III

	Fraction A (% by Weight)	Fraction B (% by Weight)
On 8 mesh	1.2	—
On 14 mesh	13.7	—
On 28 mesh	29.1	0.5
On 48 mesh	20.7	0.6
On 100 mesh	13.9	1.0
On 200 mesh	6.1	4.9
On 325 mesh	3.9	9.6
Through 325 mesh	11.4	83.4

We have found the compositions of this invention to be completely satisfactory as a substitute for fuel oil fed to a cyclone type burner. The burner needs no modification to permit the use of our new fuel. As an example, a coal-water slurry having the specifications of Example A in Table I was prepared from a Pittsburgh Seam coal that had a BTU content of 13,500 on a moisture-free basis. The coal had the following proximate analysis (dry basis):

Volatile Matter	38.8%
Fixed Carbon	53.6%
Ash	7.6%

The liquid slurry was kept in a storage tank during the period of the burning test, and was withdrawn continuously under the control of a conventional liquid fuel valve. A small amount of circulation comparable to that used in Bunker C fuel oil tanks was maintained

in the tank. The pump used to withdraw the slurry from the tank was a centrifugal pump normally used in cyclone burner installations. During the period of test, i.e., 23 days, the flow of fuel was trouble-free. The performance of the burner was essentially the same as though fuel oil were being employed, allowing for the difference in BTU contents. There was no visual difference between the slurry flame and a fuel oil flame. The steam formed by the conversion of the slurry water was discharged from the burner in the same manner as the steam formed by combustion.

According to the provisions of the patent statutes, we have explained the principle, preferred construction, and mode of operation of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A homogeneous composition of matter suitable for use as a liquid fuel consisting essentially of particulate coal and water in the relative proportions of 54 to 69 percent by volume of coal and 46 to 31 per cent by volume of water, said particulate coal having a size distribution substantially as follows: 0 per cent by weight on 4 mesh Tyler Standard screen, 18 to 33 per cent by weight less than 325 mesh, less than 60 per cent by weight between 4 and 28 mesh, and the balance in the size range of 28 to 325 mesh.

2. A homogeneous composition of matter suitable for use as a liquid fuel consisting essentially of particulate coal and water in the relative proportions of 57 to 65 per cent by volume of coal and 43 to 35 per cent by volume of water, said particulate coal having a size distribution substantially as follows: 0 per cent by weight on 4 mesh Tyler Standard screen, 22 to 28 per cent by weight less than 325 mesh, 20 to 30 per cent by weight between 4 and 28 mesh, and the balance in the size range of 28 to 325 mesh.

3. A homogeneous composition of matter suitable for use as a liquid fuel consisting essentially of particulate coal having a specific gravity of about 1.35 and water in the relative proportions of about 68 per cent by weight of said coal and about 32 per cent by weight of water, said particulate coal having a size distribution substantially as follows: 0 per cent on a 4 mesh Tyler Standard screen, about 28 per cent by weight less than 325 mesh, about 25 per cent by weight between 4 and 28 mesh, and the balance in the size range of 28 to 325 mesh.

4. A composition of matter suitable for use as a liquid fuel consisting essentially of particulate coal having a specific gravity of about 1.35 and water in the relative proportions of about 68 per cent by weight of said coal and about 32 per cent by weight of water, said particulate coal having a size distribution substantially as follows:

0 percent by weight on 4 mesh Tyler Standard Screen;
0.1 percent by weight on 8 mesh Tyler Standard Screen;
4.4 percent by weight on 14 mesh Tyler Standard Screen;
20.7 percent by weight on 28 mesh Tyler Standard Screen;
19.9 percent by weight on 48 mesh Tyler Standard Screen;
13.4 percent by weight on 100 mesh Tyler Standard Screen;
8.3 percent by weight on 200 mesh Tyler Standard Screen;
5.5 percent by weight on 325 mesh Tyler Standard Screen;
7.7 percent by weight through 325 mesh.

* * * * *