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3,794,472

**METHOD FOR PREVENTING THE FREEZING
TOGETHER OF COAL PARTICLES**

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4 Claims

ABSTRACT OF THE DISCLOSURE

Coal particles are prevented from freezing together and/or to the surfaces of coal storage containers by coating either the coal particles and/or the surfaces of said storage containers with a thin film of a composition comprising a hydrocarbon liquid which has emulsified therewith from 5 to 75% by weight of an aqueous solution of a polyhydric alcohol.

INTRODUCTION

Coal particles, especially fine particles or small lumps, are known to freeze together when the surfaces are wet and are in a water-freezing environment. This freezing is objectionable because it makes difficult the unloading or dumping of railway coal cars. It also makes difficult the movement of coal out of outdoor coal storage piles in a condition for fuel or other use.

The freezing problems of coal particles are not particularly critical in coal with lump sizes wherein the smallest dimension of the particles or lumps is in the order of about 2 inches or more. Even if such particles or lumps freeze together, they can generally be broken apart relatively easily. Coal particles such as a stoker coal and industrial screenings present freezing problems, however. Stoker coal generally has lump sizes of about 1½ to 2 inches while industrial screenings generally embrace particle sizes as low as about 100 mesh and as high as about 1½ inches, and may include coal fines known as coal dust.

In U.S. Pat. 3,298,804 it has been shown that certain fatty substituted imidazolines when combined with certain hydrocarbon oils are effective in preventing coal particles from freezing together. While commercial applications of this type of treatment for coal particles has shown the products to be successful they are, however, subject to several drawbacks. In the first instance the materials are relatively expensive since they are prepared from alkylene polyamines, and secondly when sprayed as a fine mist tend to produce an unpleasant odor to the operators applying these materials.

If it were possible to provide an antifreeze composition for coal particles which was composed of readily available inexpensive chemicals of commerce, which would prevent coal particles from freezing together or to the surfaces of storage containers such as hoppers, coal cars and the like, which were effective at relatively low dosages, did not emit noxious odors and yet were easily applied, a valuable contribution to the art would be afforded.

THE INVENTION

In accordance with the invention it has been found that particles of coal may be prevented from freezing together and to the surfaces of storage containers which comprises coating the coal particles and/or the surfaces of said storage containers with a thin film of an emulsified chemical composition. The chemical composition comprises a hydrocarbon liquid, which has a solidification point not greater than -20° F., and which contains emulsified therewith from 5 to 75% by weight of an aqueous solution of a polyhydric alcohol. The weight ratio of water

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to polyhydric alcohol generally is within the range of 1:10 to 10:1. Preferably the ratio is 1:5 to 5:1 and most preferably 1:2 to 2:1. The composition is capable of modification in that the hydrocarbon liquid may be treated with the aqueous solution of polyhydric alcohol to provide the latter two ingredients in a preferred amount of from 30 to 60% by weight, most preferably the water polyhydric alcohol solution is present in the hydrocarbon liquid as an oil-in-water emulsion which contains from 40 to 55% by weight.

As indicated, the emulsions used in the practice of the invention are oil-in-water emulsions. When the products are prepared in a manufacturing plant and are to be shipped to a different location for use, it is beneficial that an emulsifier be added to the product which produces a stable emulsion of the oil in the water-polyhydric alcohol solution. The amount of emulsifier contained in the finished product may vary in amount ranging from as little as 0.5% up to as much as 5 to 10% by weight depending upon the particular emulsifier used, the quantity of ingredients and the like.

Any conventional oil-in-water emulsifying agent can be used. Emulsifying agents having a high hydrophile-lyophile balance are preferred. Exemplary emulsifiers are taught in the literature, e.g., by the Atlas HLB surfactant selector. A simple test suffices to determine whether a given oil-in-water emulsifying agent is adequate for a given oil-in-water system, and whether one oil-in-water emulsifying agent is preferable to another.

Stable emulsions have been prepared using blends of emulsifiers such as a 50:50 blend of nonylphenol which has been reacted with 9 moles of ethylene oxide and a pentaerythritol ester formed by reacting a pentaerythritol with oleic acid.

THE HYDROCARBON LIQUID

The hydrocarbon liquid may be one of or a composite of a wide variety of liquid aliphatic, aromatic and/or naphthenic hydrocarbons which have a freezing or solidification point at not greater than -20° F. The aliphatic hydrocarbon liquids straight or branched chained and saturated or olefinically-unsaturated, are preferred, especially those with eight or more carbons and the aforesaid freezing or solidification point. Composites of hydrocarbon liquids such as kerosene, diesel fuel oil and like hydrocarbon liquid compositions may be used.

THE POLYHYDRIC ALCOHOLS

The polyhydric alcohols useful in the practice of the invention are by definition water soluble and may be selected from a large number of well known water soluble polyhydroxy compounds. Preferably the polyhydric alcohol is an ethylene glycol or a polyoxyethylene glycol having the structural formula $\text{HO}(\text{CH}_2\text{CH}_2\text{O})_n\text{H}$ where n is an integer of sufficient value to produce a polyoxyethylene glycol of a molecular weight of approximately not greater than 10,000. Examples of other polyhydric alcohols that may be used are glycerine, pentaerythritol, 1,2-propylene glycol, 1,3-propylene glycol and the like.

Of the above compounds ethylene glycol is preferred due to its commercial availability and low cost as well as its ability to depress the freezing point of water.

The compositions in the invention, as indicated, are applied to coal particles in the form of a thin film. Also, they may be used to coat the surfaces of storage containers such as hoppers, coal cars and the like thereby preventing the coal particles from freezing and adhering to such surfaces. For instance, coal particles that freeze together in hopper cars often require unloading times 3 to 4 times longer than when the coal particles are not in a frozen state or have been treated with the compositions of the invention.

The amount of the compositions necessary to coat the coal particles are dependent upon the nature of the coal, the makeup of the composition used in the practice of the invention and several other factors. Tests using the composition of the invention to treat the coal have shown that good results are achieved when the compositions are used at a rate of 1 to 5 gallons and preferably 1 to 3 gallons per ton of coal when applied in the form of a high pressure spray. When it is desired to prevent coal from freezing to the sides of coal cars, dosages ranging between 1 to 5 gallons per car have given good results under actual operating conditions.

SPECIFIC EMBODIMENT OF THE INVENTION

A typical composition that has been tested under field conditions is set forth below:

Ingredient:	Percent by weight
Fuel oil—#2 Diesel -----	50
Ethylene glycol -----	24
Water -----	24
Emulsifier ¹ -----	2

¹ 50:50 weight blend of nonylphenol reacted with 9 moles of ethyleneoxide and pentaerythritol esterified with oleic acid.

The above composition was applied to coal particles of about 2 inch diameter being dropped from a storage hopper into a standard hopper type coal car. The material was applied as a spray from a standard atomizing spray system which delivered the chemical at 100 pounds per square inch pressure. The dosage rate was at 2 gallons per ton of coal. Prior to spraying the coal the inside surfaces of the hopper car had been similarly sprayed with 3 gallons of the above composition. After the coal had been loaded into the hopper car the outside temperature was determined to be 20° F. The coal thus placed in the hopper car was transported to a nearby unloading site, allowed to stand for a day and was then emptied using conventional unloading equipment. The coal was readily emptied from the hopper car without any mechanical or other means being needed to unload the car.

Under similar conditions without the above treatment the same grade and size coal would frequently stick inside of the car and require mechanical force such as banging the sides of the car, the use of pinch bars and the like to empty the car which operation took three times longer

than the unloading of the car which contained treated coal.

The invention is susceptible to many modifications, particularly with respect to the application of the compositions. Where large scale plants are treated with a composition of the invention it is possible to apply a glycol water solution with the fuel oil under conditions of good mixing thereby forming the emulsion in situ which is then coated onto the coal without necessitating the use of an emulsifier.

Having thus described our invention it is claimed as follows:

1. A process for preventing particles of coal from freezing together and to the surfaces of storage containers which comprises coating the coal particles and/or the surfaces of said storage containers with a thin film of a composition comprising a hydrocarbon liquid which has a solidification point not greater than -20° F. which contains therein from 5 to 75% by weight of an aqueous solution of a polyhydric alcohol as an oil-in-water emulsion with the weight ratio of water to polyhydric alcohol being within the range of from 1:10 to 10:1.

2. The process of claim 1 where the emulsion contains from 30 to 60% by weight of an aqueous solution of a polyhydric alcohol, the weight ratio of polyhydric alcohol to water is within the range of 1:5 to 5:1, and the polyhydric alcohol is from the group consisting of ethylene glycol and water soluble polyoxyethylene glycols.

3. The process of claim 1 where the emulsion contains from 40 to 55% by weight of an aqueous solution of ethylene glycol and the ratio of water to ethylene glycol is within the range of 2:1 to 1:2.

4. The process of claim 1 where the composition contains from 1 to 10% by weight of an emulsifier.

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