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METHOD FOR INJECTING DENSE ADDITIVE INTO DRILLING WELLS AND COMPOSITION THEREFORE

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to an improved additive for use in control of lost circulation, fluid loss and/or seepage loss of drilling fluid during drilling operations. In particular, the additive is formed such that the additive can be incorporated into the drilling fluid with much greater speed than powdered or ground additives of similar components.

Description of the Prior Art

Various additives are known in the art that are used to control lost circulation or seepage in a drilling operation. While the types of additives used for this purpose range from organic products to mineral products to plastics, most of these additives are introduced into the drilling fluid as a powder. There are numerous disadvantages to the use of a powder. The primary disadvantage is that the additive is very light causing it to mix slowly with the highly viscous drilling fluid. In drilling operations, speedy incorporation of the additives into the mud and circulation down through the hole is essential and affects the profitability and occasionally the safety of the operation. To overcome this disadvantage of slow incorporation, hoppers have been designed with cyclones, venturis and jets to enhance mixing and to attempt to pull the additives from the hopper into the fluid at a higher rate. In spite of the improvement in technology, mixing is still relatively slow. The flow through the cyclones is slow, clogging occurs, and dust becomes a problem. In certain areas of the world where a zero emission standard is in place, dust is a particular problem. Regardless of the level of emission standards, dust creates a hazard for the workers.

Another problem of traditional powdered additives arises due to the general change in drilling operations. There is a trend toward drilling in deeper water with bigger

rigs thus requiring larger volumes of mud. The muds being used tend to be more expensive muds and synthetic oils emphasizing the need for lost circulation and seepage control additives. These factors also create a need for larger volume of additives. However, storage space, particularly on an offshore rig, is a limiting factor.

In the search for a better additive, huge numbers of organic substances have been tested for their efficiency as lost circulation and seepage control agents. In US 4,217,965 issued to Jim G. Cremeans, it is disclosed that discarded cattle feed can be used as an additive. This organic material is made from cottonseed hulls in combination with cottonseed meal, bentonite, some cottonseed lint and a surface active agent. To make feed for the cattle, these components are heated and then compressed and extruded as pellets. Cremeans discloses that the advantage of using discarded cattle feed is that it avoids the steps of grinding, shredding, and pretreatment processes required when using other organic waste products. The surface active ingredient in the pellet acts as a wetting agent to improve mixing time without further chemical additions. The cattle pellets are relatively dense and thus require less storage space. A shortcoming of the cattle feed is that it does not immediately break down upon contact with the mud but instead maintains its shape and structure as it is added to the mud. They only begin breakdown when they are well down the drilling hole.

There is a need to provide additives in a form that minimizes space required for storage and/or shipping. There is a need to provide additives in a form which mixes with the drilling fluid at substantially faster speeds. There is a need for a low or no-dust alternative for delivery of the additives to the drilling fluid. It is an object and a goal of this invention to meet these and other needs. It is an object and a goal of this invention to provide an additive that is quickly and efficiently distributed throughout the drilling fluid upon introduction. These and other objects of the invention will appear to one skilled in the art as the description thereof proceeds.

BRIEF SUMMARY OF THE INVENTION

The present invention discloses a method for creating a dense additive for use in

drilling fluids as well as the composition. A method of creating a dense additive from lost circulation and seepage control material for use in drilling operations includes grinding of the lost circulation and seepage control material to produce a small particle size, heating the lost circulation and seepage control material, and applying pressure to the lost circulation and seepage control material such that it densifies and is forced through apertures creating a pelletized dense additive. While many lost circulation and seepage control materials are appropriate, a preferred embodiment includes organic material as the lost circulation and seepage control material. This pelletized dense additive for use in drilling operations made from a ground lost circulation and seepage control material that is compressed into a pellet has a density substantially greater than that of the ground lost circulation and seepage control material before being compressed.

Of the organic lost circulation and seepage control materials available to produce the dense additive, a preferred embodiment includes a cellulosic material. In particular, one or more of the following in combination are preferred: ground wood, pine bark, fruit pomace, vegetable pomace, yellow pine, pine bark, corn cobs, peanut hulls, pecan piths, almond shell, corn cob outers, bees wings, cotton burrs, oat hulls, rice hulls, seed shells, sunflower, flax, linseed, cocoa bean, feathers, peat moss, jute, flax, mohair, wool, paper, sugar cane, bagasse, sawdust, bamboo, cork, popcorn, tapioca, and grain sorghum.

The pelletized dense additive, while characterized by increased density, is preferably in the range of 1/8 inch to 3/4 inch for diameter and a range of 1/8 inch to 1 inch for length. The density of the additive ranges widely according to the lost circulation and seepage control material, with the preferred density being the highest ratio of compression achievable based on the characteristics of the material. Many organic materials can be compressed to between two and three times the density of the ground material.

This invention also encompasses a method of performing drilling operations wherein a drilling fluid is circulated in a well being drilled in the ground including grinding a lost circulation and seepage control material to produce granules, heating the granules to liquify naturally occurring binding agents, pressing the heated granules through apertures such that pellets are formed that are of substantially greater density than the lost

circulation and seepage control material, adding the pellets to the drilling fluid for circulation in the well. The heating is typically a result of the friction produced during the pressing process. The grinding process can also produce a small quantity of heat. With certain lost circulation and seepage control materials, additional heat input is desirable. In the situation where naturally occurring binding agents are not present in the lost circulation and seepage control material, the preferred embodiment includes minimizing the amount of heat produced by the process and adding an appropriate binding agent.

Frequently, sources of fiber as a lost circulation and seepage control material are already in a ground form, such as sawdust. The method of creating a dense additive for such a lost circulation and seepage control stock includes obtaining the ground fiber and compressing the ground fiber into a pellet such that the pellet has substantially greater density than the ground fiber before being compressed.

The structure and method of the present invention as well as other features, advantages, benefits and objects thereof over other structures and methods known in the art can be better understood with reference to the detailed description which follows.

DETAILED DESCRIPTION OF THE INVENTION

The present invention includes many advantages over traditional art. Among such advantages are an increased rate at which additives can be added to drilling fluid, reduced area required for storage and shipping, and reduced or eliminated dust emission. A characteristic of the present invention is that the dense additive immediately begins to hydrate on contact with the drilling fluid. With the quick hydration, the dense additive promptly disperses such that the additive is uniformly distributed through the drilling fluid as the drilling fluid is pumped down the hole. A preferred embodiment includes distributing the dense additive through the drilling fluid using a traditional hopper known in the art for mixing non-dense or traditional additives. A typical hopper will have an outlet diameter in the range of 4-6 inches. The pellets are of a size to easily and compactly flow through the outlet. As with the non-dense additives known in the art, the hopper creates a mixing effect to contact the dense additive with the fluid. When

necessary, the pellets can be added to the drilling fluid without the use of a hopper. In this case, the pellets will hydrate as they come into contact with the drilling fluid and will immediately break down into fibers or other lost circulation and seepage control material, but it will take longer for the mixing action of pumping the drilling fluid into the hole to uniformly distribute the fibers throughout the fluid. Although not uniform when added in this manner, the additive is readily available to perform its function after being mixed with the drilling fluid at the surface and the rheological properties of the fluid at the surface are consistent with the properties down hole.

One of the advantages of use of the densified additive is the substantial or complete reduction of dust during addition to the drilling fluid. Traditional powders added through a hopper create volumes of dust which create a hazard to the environment and to the working personnel. Certain areas, such as the North Sea, have stringent regulations on dust. The use of the densified additive results in a virtually dust-free lost circulation and seepage control additive.

Traditional powder or finely-ground additives, particularly cellulosic additives, have a maximum speed at which they can be introduced into the mud or drilling fluid. This rate of addition is related to the additive's angle of repose that impacts the speed at which the additive can be discharged. While previous attempts to increase speed of introduction have focused on the design of the hopper, including varying outlet size, and the addition of cyclones and other physical aids, the current invention is directed toward reducing the angle of repose of the additive to allow the material to flow faster. The angle of repose relates to how a material will stack and thus relates to the speed at which it will flow. By increasing density of the additive, the angle of repose is reduced allowing the same amount of material to be added to drilling fluid in substantially less time.

The pellets can be made in a variety of shapes and sizes. The preferred size of the pellet depends upon the particular application, such as the diameter of the outlet of the hopper, the materials used to create the pellets and stacking behavior of specific shapes and sizes. The pellets can range from very small dense granules and dense flakes up to several inches. A preferred size is a pellet from 1/8 inch up to 3/4 inch in diameter with a length between 1/8 inch and 1 inch. Any apparatus useful for forcing material through

apertures can be employed in this invention. A preferred embodiment includes a belt drive pellet mill, such as the commercially available Ace Pellet Mill from Koppers of Muncy, Pennsylvania. This traditional pellet mill includes a feed screw forcing the material into a conditioner chamber. Steam can be injected when necessary into the feeder section or the conditioning chamber. A roll assembly forces the material through a die at the end of the conditioning chamber. Capacity is based in part on hole size of the pellet die. The force generated by such a pellet mill is generally sufficient to achieve maximum or optimum compressibility of the ground material. Also, the heat generated as a result of the friction is generally sufficient to release oils or binders of those materials containing such components without the addition of heat. Other methods of compressing the ground material can also be used. Likewise, it is encompassed within the invention that the grinding and compressing processes can also be performed in one apparatus.

The lost circulation and seepage control material useful for the present invention includes any untreated material that performs the function of a lost circulation additive and/or a seepage control agent. At least one of the lost circulation and seepage control materials should be somewhat compressible to allow the pellet formed from such material to be denser than the lost circulation and seepage control material prior to compression. Some of the organic materials useful as lost circulation and seepage control material in this invention include cellulosic products such as ground wood, pine bark, pomace or pulp of fruits and/or vegetables, yellow pine, yellow pine bark, corn cobs, peanut hulls, which is also a carrier for insecticide, pecan piths, almond shell, corn cob outers, bees wings, cotton burrs, kenaf, sillage, oat hulls, rice hulls. Other representative organic materials include seed shells, sunflower, flax, linseed, cocoa bean, feathers, peat moss, jute, flax, mohair, wool, sugar cane, bagasse, sawdust, bamboo, cork, popcorn, tapioca, and grain sorghum. Many assorted organic materials useful as lost circulation additives are also appropriate for this invention including carrageenan guam, guar gum, and other soluble gums.

Organic materials frequently contain natural binders, such as lignin sulfonates, wood sugar, oils or other binding agents. As the lost circulation and seepage control materials are untreated, these natural agents act as binders for the additive. With most organic materials useful as additives, to create the dense additive, the material is exposed to friction through a grinding process

to produce a fine material. This ground material is then subjected to pressure that forces the material with its oil through small openings or aperture to create pellets. The process of pressing produces heat that, in turn, releases oils and other readily liquified components of the material. These oils and other materials act to bind the material such that it is maintained as a pellet. When inorganic materials alone are used or when insufficient oil is present for binding of the pellets, oil or other binder can be added to the lost circulation and seepage control materials. Likewise, in cases where the oil contained within the material is of a higher melting point, additional heat can be input.

The pellet can be formed of one or more additives effective as lost circulation additives or seepage control agents. Also, the step of applying friction to produce a fine material can produce material of various sizes such that the pore openings of the permeable formation are effectively plugged without adverse effects. Thus, the particle distribution in the drilling fluid resulting from the pellet of the invention not only ensures an even mix of additive, but an even mix of various sizes of particles of additive should a mix of granule sizes be desirable.

Among the inorganic materials useful in this invention, mineral components are readily available, such as calcium carbonate, mica, diatomaceous earth, Fuller's earth and other silicates, activated charcoal, bauxite, alumina gel, graphite, gilsonite and the like. Such materials are frequently provided in fiber or ground form. Carbonate may be used alone or in combination with other desirable additives. The effect of adding carbonate to organic additives is an improved acid solubility. This also results in a pellet of increased density. Also useful are plastics.

A substantial increase in density is observed between the lost circulation and seepage control materials useful in this invention and the dense additive. A typical example includes a cellulosic additive with a density of 10 lbs/cf. Upon pelletizing this additive with mica, the resulting density is about 17 lbs/cf. Substantial greater density is defined as a non-trivial increase in density as compared to the density of the raw materials used to create the denser additive. Thus, while the addition of a component such as mica would increase the density of the mixture of the raw materials, compression into a pellet substantially increases the density of the mixture. The increase in density is directly

related to the size and shape of the particles being compressed and the nature of the material. Thus, for example, increasing of density from 10 lbs/cf to 11 lbs/cf for a specific material can be a substantial increase in density creating a faster flow of the material out of the hopper with reduction of dust. Preferred materials for use in the invention include those which have low density and are highly compressible. In addition to the advantages listed above relating to speed of incorporation, such low density materials can be highly compressed resulting in a product which requires far less space for storage. For example, corn cobs can be compressed into a pellet approximately double the density of corn cobs in ground form.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus and structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

Because many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense. For example, the dense additive can also include insecticides, biocides or other biological operatives to reduce susceptibility to various types of degradation or to repel pests. While one of the advantages to this invention is to use agricultural byproducts as a lost circulation and seepage control material thus minimizing what would otherwise be a waste product, some agricultural products and other lost circulation and seepage control materials useful to this invention are provided in a ground form. The method of creating a dense additive from such a lost circulation and seepage control stock includes obtaining the ground lost circulation and seepage control material. Obtaining the material in ground form as opposed to grinding the material is also encompassed within this invention.

WHAT IS CLAIMED IS:

22 MAR 2002

1. A method of creating a dense additive from lost circulation and seepage control material for use in drilling operations comprising the steps of:

grinding of lost circulation and seepage control material to a small particle size;

heating the lost circulation and seepage control material;

applying pressure to the lost circulation and seepage control material such that it densifies and is forced through apertures to create pelletized dense additive.

2. The method of claim 1 wherein the lost circulation and seepage control material comprises an organic material.

3. A pelletized dense additive for use in drilling operations comprising a ground lost circulation and seepage control material that is compressed into a pellet, said pellet having a density substantially greater than that of the ground lost circulation and seepage control material.

4. The pelletized dense additive of claim3 wherein the lost circulation and seepage control material is organic matter.

5. The pelletized dense additive of claim 4 wherein the lost circulation and seepage control material is a cellulosic material.

6. The pelletized dense additive of claim 3 wherein the lost circulation and seepage control material is selected from the group substantially consisting of ground wood, pine bark, fruit pomace, vegetable pomace, yellow pine, pine bark, corn cobs, peanut hulls, pecan piths, almond shell, corn cob outers, bees wings, cotton burrs, kenaf, sillage, oat hulls, rice hulls, seed shells, sunflower, flax, linseed, cocoa bean, feathers, peat moss, jute, flax, mohair, wool, paper, sugar cane, bagasse, sawdust, bamboo, cork, popcorn, tapioca, and grain sorghum.

7. The pelletized dense additive of claim 3 wherein the pellets have a diameter substantially in the range of 1/8 inch to 3/4 inch and a length substantially in the range of 1/8 inch to 1 inch.

8. The pelletized dense additive of claim 3 wherein the pellets have a density that is between two and 3 times greater than the density of the ground lost circulation and seepage control material.

9. A method of performing drilling operations wherein a drilling fluid is circulated in a well being drilled in the ground comprising the steps of:

grinding a lost circulation and seepage control material to produce granules,

heating the granules to liquify naturally occurring binding agents; and

pressing the heated granules through apertures such that pellets are formed that are of substantially greater density than the lost circulation and seepage control material.

10. The method of claim 1 wherein the lost circulation and seepage control material comprises an organic material.

11. The method of creating a dense additive for use in drilling operations comprising the steps of:

obtaining a ground fiber;

compressing said ground fiber into a pellet such that the pellet has substantially greater density than the ground fiber; and

adding the pellets to the drilling fluid for circulation in the well.