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PREVENTING LOST CIRCULATION OF MUD IN WELL DRILLING

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The present invention concerns improvements in the technique of drilling wells and more particularly relates to a method and a composition for preventing the lost circulation of drilling fluids during the drilling of bore holes in the earth.

In conventional procedures for drilling oil and gas wells, particularly when the rotary method is employed, it is common practice to circulate around the drill in the bore hole a fluid known as a drilling mud which serves a number of functions, including carrying the bit cuttings out of the bore hole, lubricating the drill pipe and drilling tool, and providing a hydrostatic head in the well to prevent the uncontrolled escape of gases or liquids from various formations encountered during drilling. The drilling mud also serves to form a lining on the wall of the bore hole, thus helping to prevent the walls of the bore hole from caving and to plug up permeable formations and thereby prevent the flow of fluid from the well bore outwardly into the permeable formations. The normal procedure during drilling is to circulate the mud down through the interior of the drill pipe and then back up to the surface through the annulus between the drill pipe and the wall of the bore hole. The most common type of drilling mud is one consisting essentially of a dispersion of a finely divided solid such as clay in water, the mud usually having a density of about 9 to 12 lbs. per gallon.

It frequently happens during drilling that an extremely permeable formation is encountered having large pore openings and/or fractures through which drilling mud may leave the bore hole to produce the phenomenon known as "lost circulation," characterized by a drop in mud pressure and a depletion in the total quantity of mud being circulated. When such lost circulation occurs, it is conventional practice to add to the drilling fluid a very coarse granular or fibrous solid material such as cottonseed hulls, cellophane particles, solid plastic particles, peat moss, beet pulp, scraps of burlap or other fabric, and the like. The use of bulky or fibrous or granular materials of this type to seal off such a permeable zone is not always successful. In view of the fact that the mud must remain pumpable, it is sometimes impossible to add sufficient bulky or fibrous or granular material to get an effective seal without impairing the pumpability of the mud. Furthermore, although various materials that have been proposed heretofore for addition to drilling muds for the purpose of preventing lost circulation have been effective in limited degrees, each of them is unsatisfactory because of one or more disadvantages. For example, many of the materials proposed will not withstand the high temperatures encountered at depth. Other materials are variously affected by chemical additives, especially caustic soda, that are frequently incoporated into drilling muds. Still others, such as cottonseed hulls, tend to ferment and "sour" the mud with adverse effects. Another common fault with the materials presently used to prevent lost circulation is that they prevent lost circulation of drilling mud by forming a mat over the well bore surface of the lost circulation zone,

and this sealing mat of material is many times subsequently destroyed by the rotating of the drill pipe and/or raising and lowering of the drill pipe and bit.

In accordance with the present invention superior results are obtained in preventing lost circulation by adding to the drilling mud a minor proportion of pig hair. Preferably the hair is of relatively short length, no greater than about 1½ inches. If the length of the hair is excessive it may be made shorter by breaking or crushing it in a ball mill or hammer mill. Pig hair has the advantage over other hair that it does not tend to mat but remains dispersed in the mud. When the mud leaves the bore hole through cracks and fissures the pig hair is entrained in these cracks and fissures and forms an effective seal against further loss of mud.

In general, from 1 to about 8 pounds of pig hair per barrel of mud will effectively prevent loss of mud circulation. As a specific example it was found that addition of three pounds of 1 to 3 inch-long natural pig hair to 1 barrel of drilling mud made of natural untreated clay dispersed in water resulted in the successful seal of fractures 2 inches long and 0.124 inch wide against a pressure differential of 1,000 pounds per square inch. Inspection of the seal formed in the test fractures indicate that the accumulation of an undesirable layer of pig hair over the face of the fracture could be prevented by shortening the length of the pig hair. Subsequent tests showed that addition of minor proportions of pig hair cut to not more than about 1 to 1½ inches in length effectively sealed the 0.124 inch wide fracture against a 1,000 pounds per square inch pressure differential without the formation of an undesirable layer of pig hair over the face of the fracture. Other tests have indicated that addition of pig hair to drilling mud does not "sour" or result in any adverse chemical effect on the drilling mud and that pig hair is not adversely affected by chemicals used in treating drilling muds even at temperatures as high as 220° Fahrenheit.

Visual study of the seal formed by the pig hair in the fractures in tests described revealed that the special property of pig hair that caused the superior prevention of lost circulation is the rigidity or stiffness of the long slender pig hair. Because of the rigid or stiff nature of pig hair, the pig hair is oriented lengthwise with the direction of flow of the drilling fluid such that the pig hair is wedged into the fracture or pore lengthwise. This results in actually sealing the fracture or pore rather than building a mat over the face of the fracture or pore. Also because of the rigidity of pig hair, it does not mat when added to drilling mud as do bulky or fibrous materials. This property of pig hair of not matting and/or knotting results in two other distinct advantages for the use of pig hair as an additive to drilling muds for the prevention of lost circulation. First, the addition of pig hair to drilling mud, in proportions several times that proportion necessary to seal fractures in no way impairs the pumpability of the drilling mud. Second, even if a layer of pig hair is formed over the surface of the zone of lost circulation, the seal formed in the large pores and fractures will not be affected by the abrasion of the rotating drill pipe and bit and/or by the raising and lowering of the drill pipe and bit. This is so because removal of the surface layer of pig hair will not affect the seal in the fractures and pores, since the surface layer will not be knotted or matted into the seal.

It is likewise contemplated in the practice of this invention to use other slender fibers having a rigidity of the same order of magnitude as pig hair provided such fibers are able to withstand the conditions of heat, pressure and chemical environment that are encountered in the drilling of wells. Thus it is possible to employ slender plastic or metal fibers of essentially the same physical characteristics as pig hair in place of pig hair and attain essentially the

same result. Such materials will be of essentially oval, circular, square or nearly square cross section and will have a rigidity of the same general magnitude as pig hair, say at least one half as rigid as pig hair.

In selecting fibers suitable as substitutes for pig hair their rigidity can be ascertained by a fairly simple test. A one-inch specimen of the fiber is clamped securely between the horizontal faces of two superimposed blocks, with one quarter inch of the fiber between the blocks and three quarters of an inch extending out in a horizontal position. Measurement is made of the downward force that must be applied vertically to the fiber one eighth of an inch from the free end to deflect the free end of the specimen one quarter of an inch. Compasion of this force with the force necessary to deflect an average pig hair of the same length the same amount will give a measure of the comparative rigidity of the two fibers.

It is to be understood that although it is preferred in most instances when practicing this invention to employ slender fibers having a length of not substantially greater than about 1 to 1½ inches there may be extreme conditions where unusually large fractures and/or pores are encountered which may make it advantageous to use longer fibers, for example pig hair in its natural uncut length. Also, although a concentration of fibers of from 1 to 8 pounds per barrel will normally be effective it may be practical in some instances to obtain many of the advantages of this invention with greater concentrations than these.

As modifications and variations of the invention as herein described are possible without departing from the spirit of the invention it is not intended that its scope be limited to the specific matter described but that only such limitations should be applied as are set forth in the appended claims.

What is claimed is:

1. A composition of matter for use in drilling bore holes in the earth comprising drilling mud to which has been added a minor proportion of slender fibers comprising pig hair, the quantity of fibers being sufficient to retard the loss of drilling mud into crevices and fissures encountered by the bore hole.

2. Composition as defined by claim 1 wherein said fibers are of relatively short length.

3. Composition as defined by claim 1 wherein said fibers have a length of not substantially greater than about 1 to 1½ inches.

4. Composition as defined by claim 1 wherein said fibers are added in the amount of from about 1 to about 8 pounds per barrel of drilling mud.

5. A composition of matter for use in drilling bore holes in the earth comprising drilling mud to which has been added a minor proportion of pig hair of relatively short length, said minor proportion being sufficient to retard the loss of drilling mud into crevices and fissures encountered by the bore hole.

6. In the drilling of a bore hole into the earth wherein drilling mud is circulated through the bore hole to aid in the drilling operation the method of preventing the loss of drilling mud into cracks and fissures encountered by the bore hole which comprises adding pig hair to the drilling mud.

References Cited in the file of this patent

UNITED STATES PATENTS

2,064,936	McQuiston	Dec. 22, 1936
2,119,829	Parsons	June 7, 1938
2,214,366	Freeland et al.	Sept. 10, 1940
2,398,347	Anderson	Apr. 16, 1946
2,599,745	Campbell et al.	June 10, 1952
2,610,149	Van Dyke	Sept. 9, 1952
2,634,236	Simon et al.	Apr. 7, 1953

OTHER REFERENCES

Sawdon: Lost Circulation in Rotary holes; article in the Petroleum Engineer, February 1936, pages 27 to 30.

Rogers: Composition and Properties of Oil Well Drilling Fluids, 1st edition, pages 449 to 451 and 459. Pub. 1948 by Gulf Pub. Co. of Houston, Texas.