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METHOD AND MEANS OF PREVENTING FLUID LOSS THROUGH POROUS WALLS

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This invention relates to a method and product which may be employed in drilling and carrying out other processes in wells for the purpose of preventing or reducing loss of fluid from the well bore into the surrounding formations.

During the drilling of an oil well or the like it is not uncommon to encounter porous gravels, fissured formations, honeycombed and cavernous limestone, or weak formations which are ruptured by the hydrostatic pressure of the drilling fluid, with the result that the drilling fluid circulated down through the drill pipe during drilling enters the porous formation and does not return to the surface. Since drilling fluid performs a number of functions in the course of a drilling operation, one of which is to serve as a vehicle for carrying the cuttings to the surface, and another of which is to exert sufficient hydrostatic pressure against the formations drilled to balance any pressures existing in these formations, it is necessary for all or substantially all of the fluid pumped into the hole to return to the surface and for the hole to remain full of fluid. When porous formations are encountered, which allow the mud to escape from the hole, drilling operations must stop because cuttings cannot then be removed and fluid must be pumped into the bore hole at a rapid rate in order to maintain sufficient hydrostatic head to balance formation pressures, or the hole will collapse and the danger will exist that fluids or gas under pressure will blow out of the hole.

Drilling fluid is usually a water suspension of colloidal clays, weighting materials and formation solids that is stabilized by chemical treatment. Drilling fluids have viscosities that range from approximately 15 centipoises to as much as 80 centipoises. The weight of a drilling fluid varies from 9 pounds per gallon to as heavy as 19 pounds per gallon. During the drilling operation it is usual practice to provide in some fashion for settling or removing of the cuttings from the drilling mud. The mud is then collected in a pit from which it is picked up by pumps and pumped back into the hole. Drilling fluids such as that just described are ordinarily capable of building a relatively impervious filter cake on porous formations made up of materials such as fine sand grains, but such fluids will readily flow through small cracks or other openings in formations. In order to prevent this loss of fluid in the porous formations, it has been the usual practice to add various types of materials such as fibrous materials or flake materials which can be mixed with the mud and which are capable of circulating through the reciprocating pumps ordinarily employed in pumping the mud. Materials which have been used or suggested in the past for this purpose include chopped up corn stalks, sugar cane, beet pulp, cottonseed hulls, sawdust, wood shavings, flake cellophane, chopped up paper and mica flakes.

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It is the object of this invention to provide a material substantially more effective than those previously employed which will build an impervious mat in or over fissures, cracks and porous formations through which mat mud will not pass, and which will be of such a nature that it will not foul the valves and other working parts of the circulating pumps. It is also an object to provide a method preventing fluid loss by employing such a product and a method of making same.

It has been found that exceptionally and unexpectedly good results may be secured through the employment of a product made from whole ripe flax straw. However, the flax straw is not employed in the usual manner of employing straws and the like for this purpose but is specially treated to change it into a fluffy mass of small fibers having particles of the hard woody outside of the flax straw interspersed therein. Such treatment consists of first cutting the straw into lengths of the order of one-inch or less, then shredding it in a hammer mill, then blowing the dust out of the fluffy mass thereby produced. The strong, fine, long fibers which are found in the central portion of the flax straw provide the fluffy mass which is highly desirable for the purpose indicated, and the hard, woody outside portion of the flax straw, commonly known as shives, provide relative stiff members capable of assisting the long, fine fibers in providing a bridge over fissures and the like. This cotton like mass can be easily mixed with mud and when strained out on a porous medium, forms a mat that is impervious to the passage of mud. It appears that the two principal constituents both play an important part in making the shredded and fluffed flax straw a suitable material for plugging porous formations. The rigid woody portion greatly assists in bridging the crevices to be sealed while the fluffy fibrous portion provides a mat that rapidly produces a filter bed on which the solids in the mud will strain out and form an impervious wall. The resulting mat has some structural strength and rigidity, as well as being very impervious as a result of the intermatting of the strong hairlike fibers of the flax.

While it has been noted above that the straw is initially cut into lengths of one-inch and less, it is to be noted that this dimension is not extremely critical and that cutting into longer lengths than one-inch will not greatly impair the result of the use of the product as regards its utility in forming a filter cake. However, the employment of fibers of greater length than one-inch involves a tendency on the part of the fibers to ball up and not to disperse properly in the mud, and also involves the possibility of interfering with the action of the mud pumps. With the practice of cutting the material to a length of one-inch or less, the likelihood of difficulty is greatly reduced. In fact, the length preferred from the stand-point of greatest effectiveness and freedom from difficulty is in the neighborhood of three-quarters of an inch.

As compared with other materials commonly used in the drilling of wells for the purpose above indicated, shredded flax straw prepared in the manner above described, has been found to be greatly and unexpectedly effective.

For example, as regards actual use in a well being drilled, one well in which loss of circulation in the cavernous limestone was being experienced, was treated with numerous materials including flake cellophane, shredded sugar cane fiber, wood fiber, mica flakes, and chopped hemp rope. The use of all these materials was unsuccessful in stopping the loss of fluid. Upon the addition of 1250 pounds of shredded flax straw, the loss of fluid was stopped and returns of the mud were established. This product has been used in several hundred wells in order to combat the loss of mud in the porous formations, and reports on such wells indicate that the shredded flax straw product is in almost every instance more effective than other materials which had been previously used.

In order to more carefully compare the effectiveness and action of this flax straw product with the action of other materials which have been used or suggested for this purpose, a laboratory test method has been employed which is suggested by the American Petroleum Institute as a method of testing materials for the prevention of loss of the drilling fluids to the formation while drilling. This method of testing involves the use of a standard filter press which is modified to accommodate an enlarged pressure filtration cell. The special cell is a cylinder approximately 10-inches in length, and $3\frac{1}{16}$ inches inside diameter, having a capacity of 1000 cc. A one-quarter inch brass plate perforated with thirty ¼-inch holes is brazed into the cylinder three-eighths of an inch from the lower end. The standard filter press cap and bottom plate are used to confine the ends of the cell. The filter bed is made up of a three-fourths inch layer of copperclad steel BB shot which are 0.173 inch in diameter resting on the perforated plate. This bed is formed by rapidly pouring 400 grams of the BB shot into the cell so that the one-quarter inch holes in the perforated plate are bridged. This gives a filter bed having a porosity of approximately thirty-five (35%) per cent and a permeability of approximately 70,000 darcys.

In accordance with this method a suspension of Wyoming bentonite of a strength of five (5%) per cent to eight (8%) per cent of the bentonite is prepared and stirred thirty minutes on a high-speed mixer. It is then aged a minimum of seventy-two (72) hours and stirred ten minutes

after which it is adjusted to have a viscosity of 30 centipoises, plus or minus two centipoises. Weighed portions of the sealing material under test are then added to 800 cc. of the 30-centipoise base mud and stirred ten minutes. The prepared sample is then poured into the filter cell carefully so as not to distrub the filter bed, and the filter cell is closed and air pressure in the amount of 100 pounds per square inch is applied. The object of this test is to determine the volume of mud that passes through the filter bed before the strained out additive seals sufficiently to cause normal filtration. The test is of thirty minutes duration unless no seal-off is accomplished. A record of both the volume of mud that passes through the filter bed before a seal-off is obtained and the volume obtained by dropwise filtration is made. The thickness and character of the sealing material cake built upon the BB shot filter bed is measured and recorded. The concentration of sealing material is expressed as pounds per barrel added. It should be noted in this connection that one gram in 350 cc. of drilling fluid is the equivalent of one pound per barrel.

The data given below shows the results of a series of tests employing the above method in which the materials being tested were various fibrous materials which have been used or suggested for the purpose of preventing fluid loss in drilling wells, as indicated below. The data given shows the results of these tests and indicates the volume of mud which passed through the porous bed in an initial surge prior to the formation of a mat or seal over the surface of the shot bed by the material being tested. The column headed "Mat Thickness" indicates the thickness of the mat which formed over the surface of the shot bed, and the column headed "Dropwise Filtration cc. in 10 Minutes" indicates the amount of fluid filtering through the mat during the first ten minutes following the formation of the mat.

Additive	Concentration	Initial Surge cc.	Mat Thickness	Dropwise Filtration cc. in 10 Mins.
	#/bbl.		*inches*	
Newspaper	10	(1)	No mat	----------
Bagasse	10	(1)	2	----------
Cottonseed hulls	10	(1)	1	----------
Shredded prairie hay	10	600	2	(1)
Shredded wheat straw	10	500	2⅜	(1)
Ground asbestos	10	700	(2)	(1)
Shredded rice straw	10	600	1⅛	(1)
Bagasse and paper pulp	10	230	¼	29.6
Shredded balsa wood	10	530	¾	43.8
90% flax straw 10% asbestos fiber	10	125	¼	9.5
Shredded flax straw	5	350	⅛	11.5
Do	10	105	⅛	8.2

[1] No seal off.
[2] Unconsolidated mass.

In the foregoing it will be seen that by far the best product tested is the shredded flax straw of this invention, and that of all the other products tested, the best results were indicated by the combination of 90% shredded flax straw and 10% asbestos fibers.

In addition to the very considerably greater effectiveness of the product herein set forth, is the fact that it is produced from a substance currently regarded as a waste product and hence is very inexpensive. In this connection it is to be noted that this product is made from ripe flax straw such as is produced when the plants are permitted to mature in the growing of flax seed.

Such straw is considered unfit for use in producing fibers for use in fabrics but is highly suitable for the use in accordance with this invention because the woody portion of the straw will have become dry and brittle, and though still relatively rigid as compared with the fine inner fibers of the straw, will readily break up and become interspersed with the fluffy mass of fine fibers so as to produce the product of this invention.

From the foregoing it will be seen that there has been provided a product for use in a drilling fluid for the purpose of preventing a loss thereof into porous formations, which product is both economical and highly effective, and makes possible a method which is capable of accomplishing the desired results to a degree better than heretofore obtained. Furthermore, there has been produced a new method of making such a product which differs distinctly from methods employed in preparing previously used materials for this purpose and which is highly advantageous in producing a vastly improved material.

All the objects and advantages sought by this invention are thus attained by the method and means set forth, although it is to be understood that the foregoing specific disclosure is by way of illustration and example only and is not to be taken by way of limitation. This invention is to be limited only by the prior art and by the terms of the appended claims.

The invention having been described, what is claimed as:

1. An article of manufacture comprising a dry fluffy mass of fine flax fibers having shives interspersed therethrough and derived from ripened flax straw, the lengths of the fibers and shives being of the order of one-inch and less and at least some of the shives being elongated to provide relatively stiff bridging members to give body to the fibers.

2. The method of preventing drilling fluid loss in earth bore holes which comprises introducing into the bore hole a quantity of shredded ripened flax straw comprising a fluffy mass of fine fibers having shives interspersed therethrough.

3. The method of preventing drilling fluid loss in earth bore holes which comprises introducing into the bore hole a quantity of shredded ripened flax straw comprising a fluffy mass of fine fibers having shives interspersed therethrough, the shives and fibers being of lengths of the order of one-inch and less.

4. The method of preventing drilling fluid loss in earth bore holes which comprises introducing into the bore hole a quantity of whole shredded ripened flax straw comprising a fluffy mass of

fine fibers having shives interspersed therethrough.

5. The method of making an additive for drilling fluid for preventing loss thereof in drilling earth bore holes which comprises chopping whole ripe flax straw into lengths of the order of one-inch and less, shredding and fluffing the cut straw in a dry state, and blowing the dust therefrom.

6. The method of making an additive for drilling fluid for preventing loss thereof in drilling earth bore holes which comprises chopping whole ripe flax straw into short lengths in a dry state, shredding and fluffing the cut straw, and blowing the dust therefrom.

7. A drilling mud which comprises, in combination, sufficient liquid to maintain the mud as a fluid, sufficient clayey material to form a filter cake on the wall of a well and a lost circulation reducing material comprising a quantity of shredded ripe flax straw made up of a mass of fine fibers adapted to mat and form a membrane and relatively stiff shives interspersed therethrough to provide a bridging for support of said membrane, the quantity of said straw being sufficient to reduce mud loss to porous formations contacted by said mud.

8. The drilling mud of claim 7 wherein said fibers and said shives are of lengths of the order of one inch and less.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,168,285	Coyne	Jan. 18, 1916
2,119,829	Parsons	June 7, 1938
2,298,994	Wells	Oct. 13, 1942
2,351,434	Jessen et al.	June 13, 1944
2,477,219	Van Dyke	July 26, 1949

OTHER REFERENCES

Hertel & Edson, "Drilling Mud Practice in the Ventura Avenue," pps. 387–388, Petroleum Development & Technology, 1930.

Wallace A. Sawdon, "Lost Circulation in Rotary Holes . . . A Problem Requiring Specific Treatment," pps. 27–30, The Petroleum Engineer, February 1936.

Rogers, Composition and Properties of Oil Well Drilling Fluids, 1948, pps. 455–461.