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OIL WELL DRILLING MUD

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This invention relates to the production of drilling mud primarily for use in the drilling of oil and gas wells for the purpose of carrying the cuttings out of the hole and of lining the walls of the drill hole to prevent either flow of water or gas from the outside formation into the drill hole and to prevent loss of drilling fluid from the hole into the formation through which the hole is being drilled.

Drilling muds are used in almost all rotary drilling operations for deep wells for oil and gas and serve several functions. They are used primarily to lubricate the drill bit and to carry the cuttings from the hole and for this purpose, in many instances, drilling muds made from native materials in the formation in which the well is drilled are sufficient.

In cases where high gas pressure is encountered, it is often necessary, however, to add a material which will increase the specific gravity of the drilling mud in order to increase its weight and hold down the gas pressures. For this purpose weighting materials, such as iron oxide and barytes, have been commonly used in accordance with the Stroud patents, No. 1,575,944 and No. 1,575,945.

In other cases where porous, sandy or sloughy formations are encountered in the wall of the hole, it is necessary to use a material which will have a high colloidal dispersion so as to produce a viscous mud which, by filtration of the liquid of the mud through the walls of the bore hole, will provide an impervious or substantially impervious lining along the walls of the drill holes which will prevent the loss of drilling mud to the surrounding formations and will prevent seepage of water, gas or slough of the surrounding formations into the hole. For this purpose bentonite has been found to be highly desirable because of the high viscosity which can be secured with a relatively small percentage of bentonite in the drilling mud. The bentonite, furthermore, has the characteristic of forming a relatively thin but substantially impervious coating along the walls of the bore hole which effectively walls off the surrounding formation and prevents loss of drilling mud to the surrounding formation and also prevents seepage or sloughing from the formation into the drill hole.

Bentonite, however, is a colloidal material of relatively low mechanical strength and while it serves admirably the function of controlling the viscosity of the muds and of preventing the settling and segregation of cuttings in the hole, the protective coating on the bore of the hole formed

by bentonite alone is not sufficiently dense in all instances to meet with practical conditions encountered and occasionally leads to difficulties.

In view of the fact that bentonite is a relatively expensive material for this purpose, it is desirable to increase the mechanical strength of the lining of the hole formed by a bentonite mud and to increase the density of the lining to thereby reduce the amount of bentonite necessary to provide an impervious wall, and it is the object of my invention to improve the bentonite wall structure of an oil or gas well by incorporating in the bentonite mud, and therefore in the lining of the wall formed therefrom, a material which will increase the mechanical strength and density of the lining of the bore hole without increasing the cost of the mud so as to thereby reduce the amount of bentonite used to accomplish the desired result.

Another object of the invention is to provide an improvement in drilling muds of the bentonite or high gelatinous type which will facilitate the formation and handling of the drilling muds.

Another object of the invention is to provide an additive material for drilling muds which will have distinct color characteristics to facilitate spotting of the various formations through which the drill is passing and checking the returns of the drilling mud.

Various other objects and advantages will appear as the description of the invention proceeds.

I have discovered that the addition of a relatively small percentage of iron oxide, tripoli, or other material having a rough cellular flake or sponge-like structure to a bentonite drilling mud will produce a material increase in the strength of the mud wall lining the bore of the hole and will provide a denser and more impervious wall than can be provided by the use of bentonite alone.

I have found, for example, that the addition of as little as 2% of iron oxide to a bentonite drilling mud will produce an increase of over 10% in the mechanical strength and density of the mud, which means, in practical operation, that with the addition of 2% of iron oxide to a bentonite drilling mud, 10% less of the bentonite is used up in forming a wall of the same degree of imperviousness than is used in the forming of a wall along the bore of the hole from bentonite alone. This also provides a thinner wall for the same degree of imperviousness and leads to less blocking of the hole by the wall formation and greater facility and less disturbing of the wall formation in the removal of the drill bit or in the applications of casings to the wall, etc., as this

thinner lining is more resistant to mechanical and frictional abrasion.

For example, with a drilling mud containing 5% of bentonite in water and a drilling mud containing 5% of a mixture of 98% of bentonite and 2% of cellular iron oxide and a drilling mud containing 5% of a mixture of 90% of bentonite and 10% of limonite, the relative weight of filter cake along the bore of the hole to hold back the same amount of water or water pressure is as follows:

	Bentonite in water	Bentonite+2% iron oxide	Bentonite+10% limonite
15	1.591.....	1.413	1.239
	2.543.....	2.190	1.984
	2.947.....	2.710	2.630
	3.447.....	3.268	
	3.940.....	3.660	3.540

By simple calculation from the above table, it will be seen that with 2% of iron oxide the average weight of filter cake to hold back the same amount of water pressure is over 10% less than the weight of an all bentonite wall to accomplish the same result, and with 10% of iron oxide added to the bentonite, the weight of the filter cake is an average of about 10% to 20% less than the weight of an all bentonite cake to accomplish the same results.

While the principles of my invention may be applied in various ways, I prefer to mix from 2% to 10% of iron oxide, tripoli or other porous cellular materials with dry bentonite by a suitable grinding operation or otherwise, so as to insure a fairly uniform distribution of the iron oxide or other cellular material through the dry bentonite, so that there will be no chance segregation of the iron oxide or other cellular particles in the mud as might occur if the iron oxide were added to a premixed bentonite mud. This material is then shipped to the oil field where it is mixed with water in sufficient portions to form a drilling mud of the desired viscosity.

In general a 5% suspension of the iron oxide-bentonite mixture in water will form a drilling mud of the desired viscosity and other characteristics suitable for normal oil and gas well drilling operations, although a greater or less amount of the material may be used and instead of mixing the bentonite iron oxide mixture with water, it may be added to the native drilling mud formed in the bore of the hole. The addition and distribution of the iron oxide or tripoli through the dry bentonite facilitates mixing the latter with water because iron oxide, tripoli, etc., are porous cellular materials which have an affinity for and are extremely easy to wet with water, whereas bentonite wets with extreme difficulty, so that an iron oxide-bentonite mixture containing from 2% to 10% of iron oxide is wetted with greater ease than bentonite alone.

By using an iron oxide of distinctive color, such as a yellow oxide, it is possible to impart a distinctive color to the mud, which is very helpful in spotting the particular formation being penetrated by the drill at a given time and in showing the rate of circulation of the mud, etc.

While the increase in mechanical strength and density of the wall formed on the bore of the hole by the addition of a relatively small amount of iron oxide or other porous cellular materials may be explained in various ways, I believe that this unexpected increase in strength is due to the fact that the iron oxide or tripoli particles of the types

used by me have a rough cellular sponge-like or plate-like structure. These particles are very much larger than the ultimate bentonite particle which is of colloidal size and characteristics and have inherently greater mechanical strength than the gel-like particles of the bentonite. The polar characteristics of the bentonite particles enable them to become attached to the larger iron oxide or tripoli particles and build up an aggregate consisting of a layer of bentonite particles around each particle of iron oxide or tripoli. The bentonite particles so interlock with the larger sponge-like particles of iron oxide that a stronger and more compact, uniform wall structure is formed than is possible with bentonite particles alone. When a layer of these reinforced bentonite particles is built up as a protecting wall along the bore of an oil well, the result is a denser coating of materially greater mechanical strength and much more impervious to water than a wall built of bentonite particles alone.

While I do not wish to be bound in any manner by this theory of operation, it appears to be a correct explanation of what happens when a small percentage of iron oxide is mixed with bentonite and at the same time explains why the inclusion of silica, sand and other particles of a rounded granular nature from the native mud or from the drill cutting in a bentonite drilling fluid leads to the formation of a less dense and more porous wall than bentonite alone.

The iron oxide or other cellular or plate-like materials should be in a state of fine sub-division, preferably of the order of iron oxide as used in paint pigments, and should be in a granular or crystalline condition, preferably in the ferric state as distinguished from ferrous oxide which is sometimes found in combination with bentonite and is often of a colloidal nature.

By thoroughly incorporating and distributing the iron oxide through the dry bentonite or other highly colloidal or gelatinous clay a uniform distribution of the reinforcing particles in the wall layer is insured, which will be well bonded together by the surrounding matrix of bentonite particles, whereas coarser particles, such as the cuttings from the drill or coarser sand particles from the native muds, do not act in the same manner.

The term "bentonite" is used herein in a generic sense as including all clays having high gelation characteristics whether they are true bentonites or not and is intended to include such gelatinous natural materials as Mojave mud and other clays having gelling properties similar to bentonite.

While I have attempted to explain the theory on which the addition of a small amount of iron oxide to a bentonite drilling mud results in a substantial increase in density and mechanical strength of the mud lining formed along the wall of the bore hole, it will be understood that I do not wish to be limited to this theory of operation and that the scope of my invention is defined by the claims appended hereto, regardless of the theory on which the results of the invention are accomplished.

I claim:

1. A compound for use in a drilling mud for oil and gas wells consisting of 90% to 98% of bentonite in combination with 2% to 10% of a flaky, cellular material, such as iron oxide.

2. A compound for use in a drilling mud for oil and gas wells containing 90% to 98% of bentonite

in combination with 2% to 10% of iron oxide having a cellular, sponge-like structure.

3. A drilling mud for use in the drilling of oil and gas wells consisting of an approximately 5% suspension of bentonite and iron oxide in water, the portion of iron oxide relative to bentonite being from 2% to 10%.

4. The method of increasing the strength of a bentonite lining along the bore of an oil or gas well which comprises adding to the dry bentonite from 2% to 10% of a cellular, flaky material, such as iron oxide, prior to forming the drilling mud, mixing with a liquid to form the drilling mud and introducing the drilling mud into the well where-

by the cellular, flaky material will become distributed through the bentonite lining along the bore of the well to strengthen the same.

5. In the art of boring or controlling oil or gas wells the process which comprises introducing into the well a wall-building fluid containing bentonite to which has been added from 2% to 10% of iron oxide.

6. In the art of boring or controlling oil or gas wells the process which comprises introducing into the well a wall-building fluid containing a colloidal gelatinous material and a small percentage of a flaky reinforcing material, such as iron oxide.

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