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DRILLING FLUIDS HAVING ENHANCED LUBRICATING PROPERTIES

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18 Claims. (Cl. 252—8.5)

This invention relates to drilling fluids or muds having enhanced lubricating properties. In one aspect this invention relates to drilling fluids containing an added agent which imparts enhanced lubricating properties to said drilling fluid.

In the art of drilling wells to tap subterranean deposits of fluids such as oil and/or gas, especially when drilling by the rotary method employing a rotary bit and drill stem, a drilling fluid, usually a compounded fluid made to predetermined physical and chemical properties, is circulated to the bottom of the bore hole, out through openings in the bit at the bottom of the bore hole, and then back up said bore hole to the surface by passage through the annular space between said drill stem and the wall of said bore hole (or between said drill stem and the wall of the casing where casing has been put in place).

The drilling fluid must act as a liquid medium of controlled viscosity for removing cuttings from the bore hole; it must prevent excessive amounts of fluid from flowing from the bore hole into surrounding formations by depositing on the wall of the hole a thin but substantially impervious filter cake; it must possess a gel structure of sufficient strength to hold in suspension solids, particularly during any time the fluid is not circulating; it must serve as a weighting material exerting sufficient pressure to counterbalance any pressure exerted by water, gas, oil, or other fluid from a penetrated structure and to prevent caving or other intrusion into the drill hole.

Said drilling fluid must also serve as a lubricant for the bearings of the drill bit and the cutting surface of the bit teeth, and to reduce frictional forces on the drill pipe.

These requirements have been met in the past by employing both aqueous or water base and non-aqueous or oil base drilling fluids. The aqueous drilling fluids normally comprise water, finely divided inorganic materials such as various types of clays and clayey materials, and weighting materials suspended in the water. The non-aqueous or oil base drilling fluids normally comprise a non-aqueous liquid such as crude oil or a petroleum distillate, and a weighting material which can be a clay or other suitable material. In addition to aqueous and non-aqueous drilling fluids as defined above, emulsion-type drilling fluids are often used. These emulsion drilling fluids normally comprise a substantially water-insoluble liquid such as oil, a finely divided inorganic material such as clay, and water, together with a suitable dispersing or emulsifying agent. The two types of emulsion drilling fluids are the oil-in-water emulsion type, sometimes referred to as water base emulsion type, and the water-in-oil emulsion type, sometimes referred to as oil base emulsion type. In the latter, oil forms the continuous phase of the emulsion, and in the former, water or brine forms the continuous phase of the emulsion.

An important property which a drilling fluid should possess is that of lubrication. In recent years increased emphasis has been placed upon this property. A large portion of the drilling time consumed during the drilling of a well is taken up in replacing drill bits. The amount of time consumed during drilling operations in replacing drill bits increases roughly in proportion to the depth drilled because, in order to replace a bit the entire drill string must be removed, the bit replaced, and the entire drill string then rerun. Furthermore, each time circulation of the drilling fluid is stopped and the drill string

pulled, the likelihood of a cave-in is increased. Past experience has shown that the most important factor in shortening the life of a drill bit is failure of the bit bearings. Such bearing failures frequently occur long before the cutting teeth are worn to such an extent as to require replacement of the bit. Thus, conventional prior art drilling fluids are obviously lacking in adequate lubrication properties insofar as the bearings of the bit are concerned.

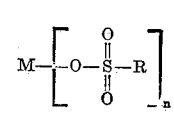
It is also important to reduce the frictional forces on the drill pipe. There exists considerable torque on said drill pipe due to the friction between the outside of the drill pipe and the wall of the well, whether said wall is represented by casing, open hole, cement, or other materials. A drilling fluid possessing enhanced lubrication properties will minimize said frictional forces.

I have now discovered that aqueous drilling fluids, e.g., water base drilling fluids and oil-in-water emulsion drilling fluids, can be made to possess enhanced lubricating properties by incorporating therein a sulfonate of a metal such as iron, lead, tin, arsenic, antimony, bismuth, and germanium. Said drilling fluids can also contain the usual clays or clayey materials, weighting agents, emulsifying agents, etc. which are commonly used in the drilling muds of this type according to the prior art.

Thus, broadly speaking, the present invention resides in a drilling fluid having enhanced lubricating properties and comprising water, finely divided inorganic solids, and a sulfonate of a metal such as lead, tin, antimony, bismuth, and germanium which is present in a small but effective amount sufficient to impart enhanced lubricating properties to said drilling fluid, and methods of using said drilling fluids. If desired, mixtures of said metal sulfonates can be used used in the practice of the invention.

An object of this invention is to provide an improved well drilling fluid. Another object of this invention is to provide an improved drilling fluid having enhanced lubricating properties. Another object of this invention is to provide an additive for use in aqueous drilling fluids, e.g., water base drilling fluids and oil-in-water emulsion drilling fluids, which will impart enhanced lubricating properties to said drilling fluid so that said drilling fluid will more effectively lubricate the bearings of a rotary bit under extreme pressure conditions which are encountered during drilling operations employing said bit. Another object of this invention is to provide an additive for aqueous drilling fluids, e.g., water base drilling fluids and oil-in-water emulsion drilling fluids, which will impart both high torque and high film strength properties or high load carrying capacity to said drilling fluids when tested by extreme pressure testing equipment. Another object of this invention is to provide methods of using said improved drilling fluids in the drilling or workover of wells. Another object of this invention is to provide a method of drilling and/or completing a well in which method a drilling fluid of the invention is circulated in said well. Other aspects, objects, and advantages of the invention will be apparent to those skilled in the art in view of this disclosure.

Thus, according to the invention, there is provided an aqueous well drilling fluid having enhanced lubricating properties comprising water, finely divided inorganic solids, and at least one metal sulfonate characterized by the following formula



wherein: M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium; R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8

carbon atoms; and n is the valence of said metal M and is an integer of from 2 to 3.

Further according to the invention, there are provided methods of using the improved well drilling fluids of the invention, which methods comprise circulating said well drilling fluids into and from the bore hole in contact with the walls of said bore hole.

The metal sulfonates which are utilized in the practice of the invention are preferably those which are soluble in the water phase of the drilling fluid. However, as discussed further hereinafter, the invention is not limited to the water soluble metal sulfonates. It is sufficient if the metal sulfonate can be readily dispersed in the water phase of the drilling fluid in any suitable manner. Examples of metal sulfonates which can be used in the practice of the invention include, among others, the following:

Lead methyl sulfonate
Lead ethyl sulfonate
Tin propyl sulfonate
Antimony n-butyl sulfonate
Germanium ethyl sulfonate
Lead cyclohexyl sulfonate
Bismuth benzene sulfonate
Bismuth methyl sulfonate
Arsenic methyl sulfonate
Arsenic propyl sulfonate
Antimony 1-methyl-4-sulfo-benzene (antimony toluene sulfonate)
Lead 1-phenyl-1-sulfo methane (lead toluene-ω-sulfonate)
Lead 2-sulfo-propane
Antimony 2-sulfo-butane
Tin 1-sulfo-2-methyl butane
Germanium n-octyl 1-sulfonate
Lead hexyl sulfonate
Iron methyl sulfonate

Many of the above-named and other metal sulfonates which can be used in the practice of the invention can exist in forms having water of crystallization associated therewith. For example, lead methyl sulfonate can exist as the dihydrate. Such compounds can be used with or without the associated water of crystallization. Thus, herein and in the claims, unless otherwise specified, it will be understood that the names of the metal sulfonates are employed generically and include both the hydrated and non-hydrated forms of the particular compound being referred to.

The metal sulfonates utilized in the practice of the invention are known compounds and can be prepared by any suitable method known to the art. One presently preferred method for preparing said metal sulfonates comprises the oxidation of a suitable organic disulfide with a suitable peroxide and the neutralization of the sulfonic acids which are produced with a basic salt of the desired metal. When an alkyl group attached to a benzene ring is to be sulfonated, it is preferred to use concentrated sulfuric acid and the corresponding ketone. For example, toluene-ω-sulfonic acid and acetic acid result from heating methyl benzyl ketone in acetic anhydride with sulfuric acid. In another method alkyl mercaptans can be oxidized to the corresponding sulfonic acids by treating same with concentrated nitric acid. The sulfonic acid is then neutralized with a basic salt of the desired metal. Better yields are obtained if the metal salt of the mercaptan is first formed and the salt then oxidized with the nitric acid. Another method reported in the literature, Ephraim, Berichte, 44, 633 (1911), utilizes an excess of a sulfide and 1-chloro-n-alkanes in an autoclave at 200° C. In still another method the higher members of the series can be obtained in good yields by oxidation of the corresponding thiols or disulfides in acetone or acetic acid solution with the desired metal permanganate or dichromate.

The amount of the metal sulfonate used in the drilling fluids in accordance with the invention will vary from well to well depending upon conditions encountered in the drilling of the well, the characteristics of the particular drilling fluid being used, the formation being drilled, etc. For example, as the drilling of the well progresses and the well becomes deeper, or a particularly hard formation is encountered, more metal sulfonate will be required because of the increased pressure on the bit bearings due to the increased weight of the drill stem. While therefore the amount of metal sulfonate used is not of the essence of the invention, it can be stated that the amount of said metal sulfonate used will normally be within the range of about 0.1 to 5, preferably 0.25 to 5 pounds per barrel of drilling fluid. However, it is within the scope of the invention to employ amounts of metal sulfonate which are outside said ranges. As used herein and in the claims, unless otherwise specified, the word "barrel" refers to a barrel of 42 standard U.S. gallons.

The metal sulfonates utilized in the practice of the invention can be used in a wide variety of aqueous drilling fluids, e.g., water base drilling fluids and oil-in-water emulsion drilling fluids. In some wells, particularly where hard limestone formations containing no shale or clay are being drilled, the drilling fluid can be water containing only a very small amount of finely divided inorganic solids such as clay solids. Many times the drilling of a well is started with water as the drilling fluid. As the drilling progresses and shales or clay formations are penetrated, the circulating water will pick up natural clays and become what is commonly referred to as a drilling mud or drilling fluid. In such instances the natural clays can constitute as much as 40 percent by weight of the drilling fluid. More frequently, however, it is desirable to prepare a drilling fluid which is to be used in the drilling by mixing a clayey material such as a natural clay or bentonite with water. If a drilling fluid is thus prepared, the concentration of the clayey material is usually much lower, generally constituting from about 1 to about 8 weight percent of the entire composition. Thus, the drilling fluids of the invention in which the metal sulfonates are utilized can contain only relatively small amounts of said clayey materials or can contain said clayey materials in amounts up to about 40 weight percent of the entire composition.

The finely divided inorganic solids used in the drilling fluids increase the viscosity and afford plastering properties to said fluids by aiding the formation of a filter cake on the wall of the bore hole and thus aid in reducing fluid loss to the formations penetrated by said bore hole. While the presence of said solids is desirable initially, it should be pointed out that the drilling fluids of the invention are operable without the initial addition of said solids because a certain solids content will develop during the drilling. The finely divided inorganic solids used in the practice of the invention should be insoluble in the oil phase as well as insoluble in the water phase so that they will remain undissolved over long periods of time. Examples of finely divided solids suitable for use in the practice of the invention include, among others, the following: bentonite, ground limestone, barites, ground oyster shells, diatomaceous earth, fuller's earth, kaolin, attapulgite, McCracken clay, and other native and/or treated clays. Mixtures of two or more of said finely divided solids can also be used. Some of said materials such as barites and limestone are used primarily as weighting agents. All of said materials are preferably ground until at least about 90 percent will pass through a 325-mesh screen.

A preferred drilling fluid for many drilling operations is an oil-in-water emulsion drilling fluid. These drilling fluids can also contain clay or clayey materials in concentrations ranging from small amounts up to about 40 weight percent. Said oil-in-water emulsion drilling fluids are usually distinguished from water base drilling fluids by their content of from 5 to 40, preferably 5 to 25, weight percent of oil. However, there is really no sharp dividing line between water base drilling fluids and oil-in-water emulsion drilling fluids because water forms the con-

tinuous phase in both. Both are frequently referred to as aqueous drilling fluids. Thus, herein and in the claims, unless otherwise specified, the term "aqueous drilling fluid" is used generically and refers to both water base drilling fluids and oil-in-water emulsion drilling fluids.

In an oil-in-water emulsion drilling fluid, the principal value of the oil is as an aid in controlling the density of the drilling fluid and its fluid loss properties. Oils which can be used in the practice of the invention are usually petroleum oils, although other oleaginous materials such as vegetable and animal oils can be used, though seldom with economic advantage. The oils in any event should contain at least some material boiling above the gasoline boiling range, i.e., above about 400° F. at atmospheric pressure. Oils with too high a content of highly volatile hydrocarbons in the gasoline boiling range are undesirable because of the danger of fire, and because of the low viscosity. It is preferred that the oil have a flash point about 140° F. Examples of suitable oils which can be employed in the practice of the invention include, among others, the following: topped crude oil, gas oils, kerosene, diesel fuels, heavy alkylates, fractions of heavy alkylates, and the like. The more preferred oils are predominantly paraffinic in character since these are less detrimental to rubber components in pumps, lines, etc. It is preferred that the oil have a gravity within the range of 15–40° API.

The aqueous drilling fluids of the invention, both the water base drilling fluids and the oil-in-water emulsion drilling fluids, can contain other additives such as emulsifiers, stabilizers, and thinning agents when required to adjust the properties of the drilling fluids in accordance with conventional practice. Thus, it will be understood that other additives can be added to the drilling fluids of this invention without departing from the scope of the invention. Special materials are oftentimes added to drilling fluids for particular purposes, and such additional materials can be employed in the drilling fluids of this invention, providing a usual and conventional test indicates a lack of obvious adverse reactions, and such additional additives are applicable in the drilling fluids of this invention with few, if any, exceptions.

Examples of stabilizing and/or dispersing agents which can be used in the drilling fluids of the invention include, among others, carboxymethylcellulose, the quaternary ammonium cellulosic derivatives formed by reacting a carboxyalkyl cellulose compound with a quaternary ammonium compound having at least one long chain aliphatic radical containing from 8 to 20 carbon atoms as disclosed and claimed in my U.S. Patent 2,816,073, issued December 10, 1957; alkali metal salts of carboxymethylcellulose, for example, as disclosed and claimed in U.S. Patent 2,578,888, issued December 18, 1951, to H. H. Kaveler; other cellulosic derivatives having carboxyl groups or soluble salts thereof; and others known to the prior art such as starch, natural gums such as gum arabic, karaya, tragacanth and others. Mixtures of one or more stabilizing and/or dispersing agents can be used as desired. Thus, the drilling fluids of the invention are not limited to using a stabilizing and/or dispersing agent or any particular stabilizing and/or dispersing agent. Any suitable stabilizing and/or dispersing agent can be used in the practice of the invention as desired or necessary. The amount of stabilizing and/or dispersing agent to be used will depend upon several factors such as the characteristics of the drilling fluid being used, the particular stabilizing agent being used, and economic considerations. Those skilled in the art will know how much to use upon being acquainted with my invention. Generally, the amount used will be in the range of 0.1 to 10, preferably 0.1 to 5, pounds per barrel of drilling fluid.

An important advantage of the metal sulfonates used in the practice of the invention is the ease with which they can be dispersed in water or in the water phase of the drilling fluid. Said metal sulfonates can be incorporated in the drilling fluids by merely adding same to a stream of the circulating drilling fluid. Many of the metal sulfonates are easily pulverized solids which can be added directly as such to the jet hopper commonly used in formulating drilling fluids. When the metal sulfonate is water soluble it can, if desired, be predissolved in the water and the water solution added to the drilling fluid. The incorporation of the metal sulfonates with the drilling fluid can either be before or during the drilling of the well. Thus, said metal sulfonates can be incorporated in the drilling fluids in any suitable manner.

It is an important advantage of the invention that aqueous drilling fluids having excellent lubricating properties can be prepared. This is an especially important advantage for the widely used water base drilling muds.

It has been found that the Baroid extreme pressure tester provides an excellent indication of the effectiveness of a drilling fluid in reducing wear of the bit bearings. This testing machine is widely used in the drilling industry for this purpose. Tests have shown that there is a good correlation between the results obtained with said tester and actual results obtained in the actual drilling of wells. Thus, the load carrying capacity of a drilling fluid as indicated by said Baroid tester is commonly used in evaluating the lubricating properties of drilling fluids. Other testing machines such as the Timken lubricant testing machine, etc. are also sometimes used for this purpose.

The other properties, and the tests therefor, which are essential to drilling fluids, such as viscosity, surface tension, gel strength, and absence of foaming are not significantly affected by the presence of the metal sulfonates in the drilling fluids.

The following examples will serve to further illustrate the invention.

EXAMPLE I

A 73 gram portion (approximately 50 milliliters) of methyl sulfonic acid was dissolved in 100 milliliters of water. To this solution there was then slowly added 203 grams of lead carbonate. When the reaction had slowed down, as evidenced by the decrease in evolution of carbon dioxide, another 73 gram portion of methyl sulfonic acid dissolved in 100 milliliters of water was added to the reaction mixture. The reaction mixture was then stirred slowly until the reaction had almost ceased as evidenced by the decrease in evolution of carbon dioxide. Almost all of the lead carbonate was dissolved. The reaction mixture was then heated slowly to a temperature of about 80° C. to effect complete solution. The volume of the reaction mixture was reduced by evaporation to approximately 200 milliliters and was then set aside for crystallization at room temperature. The crystals formed were separated from the mother liquor and dried at room temperature on filter paper. Analysis showed the crystalline product to be $Pb(CH_3SO_3)_2 \cdot 1.667H_2O$ indicating that the product crystals were a mixture of lead methyl sulfonate and lead methyl sulfonate dihydrate.

EXAMPLE II

A base mud having a composition of 37.2 pounds of McCracken clay per barrel of water was prepared in conventional manner. Samples of said base mud containing 0.97, 1.94 and 2.90 pounds of lead methyl sulfonate per barrel of mud were prepared for tests. The lead methyl sulfonate used was prepared in accordance with Example I. Each of said muds was then tested for extreme pressure lubricating properties using the standard Baroid extreme pressure tester. The results of said tests are set forth in Table I below.

Table I

	Run Number			
	1	2	3	4
Drilling Mud Composition:				
Water, volume, bbls.	1	1	1	1
Clay, lbs./bbl. water	37.2	37.2	37.2	37.2
Additive, lbs./bbl. mud	0	0.97	1.94	2.90
Baroid Extreme Pressure Test Data:				
Maximum torque, inch-pounds	40	300	500	550
Film strength, p.s.i.	1,600	4,090	13,100	16,600

The results of the above tests show that the metal sulfonates of the invention are very effective extreme pressure additives for drilling fluids. The addition of the lead methyl sulfonate to the drilling mud in an amount of 2.9 pounds per barrel of drilling mud increased the maximum torque which could be applied without a seizure occurring from 40 to 550 inch pounds and increased the film strength of the mud at said maximum torque or load from 1600 to 16,600 p.s.i.

The Baroid extreme pressure tester employed in the above tests is a standard instrument which comprises a steel ring mounted on a vertically positioned shaft which can be rotated by means of an electric motor connected to the upper end of said shaft. Said steel ring is mounted on the lower end of said shaft, and in the test said ring rotates in a sample of the drilling fluid being tested. A steel test block mounted in the short section of an L-shaped bar is positioned adjacent said steel ring. Said L-shaped bar is pivoted at the hinge of the L and the long bar or section of said L comprises a torque arm or wrench for applying force at right angles to the hinge of the L. The torque or force so applied thus brings the steel block into contact with the rotating steel ring. The torque applied is read directly from a dial or scale incorporated in said torque arm or wrench. The film strength or pressure on the block at the lubricated area of friction is determined by dividing the force applied by the area of the scar on the steel block.

The following terminology is employed in making a test on said Baroid tester. A passing test is a five-minute run at a constant load or applied torque during which no seizure occurs. A passing test also exhibits a smooth and moderate wear on the test block. A seizure occurs when there is metal to metal contact between the rotating steel ring and test block surfaces, and denotes a complete breakdown of the extreme pressure lubricating ability possessed by the drilling mud. A seizure is identified by a rapid increase in the ammeter reading on the electric motor as opposed to a slow steady increase within the region of passing loads. When a seizure occurs there will also be an obvious change in pitch or sound of the running machine. The sound of normal wear is a steady humming sound, while a seizure has a sudden rasping sound.

After the apparatus has been assembled a test is carried out by applying increased torque at a rate of five inch-pounds per second until seizure occurs. At this point the load is quickly removed and the test or contact surfaces replaced. The test run is then repeated except that the applied torque or load is increased to within 50 inch-pounds of the previous load and held there, unless a seizure occurs, for five minutes. If a seizure occurs the test run is repeated with new contact surfaces and with a further reduction in applied torque or load of 50 inch-pounds. This procedure is repeated until a passing test as defined above is obtained.

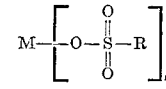
While it is not intended to limit the invention by any theory of operation, it is presently believed that extreme pressure additives are effective through a process of controlled chemical erosion whereby points of metallic contact are continually reacted with the extreme pressure additive and smoothed away, rather than being allowed to weld together and seize. The maximum torque therefore is a measure of the ability of the lubricant to prevent galling or seizure without either permitting or causing excessive wear. An additive which is too "vigorous" in preventing galling or seizure can give a high value for imposed torque or load and yet give a low value for film strength. In other words, such an additive would prevent seizure or galling but would not prevent high wear. It is very desirable that an extreme pressure additive possess both of these properties, i.e., high torque and high film strength.

Several of the metal sulfonates described above are strong poisons, particularly the arsenic compounds. Proper precautions should be observed in the handling of these materials.

While certain embodiments of the invention have been described for illustrative purposes, the invention obviously is not limited thereto. Various other modifications will be apparent to those skilled in the art in view of this disclosure. Such modifications are within the spirit and scope of the invention.

I claim:

1. An aqueous drilling fluid having enhanced lubricating properties comprising water, finely divided inorganic solids, and a small but effective amount, sufficient to provide said enhanced lubricating properties, of a metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

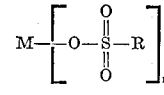
R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

n is the valence of said metal M and is an integer of from 2 to 3.

2. A well drilling fluid according to claim **1** wherein said sulfonate is present in an amount within the range of from 0.1 to 5 pounds per barrel of said drilling fluid.

3. A well drilling fluid according to claim **1** wherein said sulfonate is lead methyl sulfonate.

4. A water base well drilling fluid having enhanced lubricating properties comprising a mixture of: sufficient water to maintain said mixture fluid; sufficient finely divided inorganic solids to form a filter cake on the wall of the well; and a small but effective amount, sufficient to provide said enhanced lubricating properties, of a metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

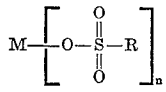
n is an integer of from 2 to 3.

5. A well drilling fluid according to claim **4** wherein said sulfonate is present in an amount within the range of from 0.1 to 5 pounds per barrel of said drilling fluid.

6. A well drilling fluid according to claim **5** wherein said sulfonate is lead methyl sulfonate.

7. An oil-in-water emulsion drilling fluid having enhanced lubricating properties comprising an oil-in-water emulsion containing finely divided inorganic solids, and a small but effective amount, sufficient to provide said en-

hanced lubricating properties, of metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

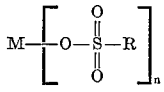
R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

n is an integer of from 2 to 3.

8. A well drilling fluid according to claim **7** wherein said sulfonate is present in an amount within the range of from 0.1 to 5 pounds per barrel of said fluid.

9. A well drilling fluid according to claim **8** wherein said sulfonate is lead methyl sulfonate.

10. In a process for the drilling of a well with well drilling tools wherein there is circulated in said well a a drilling fluid, the improvement comprising: circulating in said well as said drilling fluid an aqueous drilling fluid having enhanced lubricating properties comprising water, finely divided inorganic solids, and a small but effective amount, sufficient to provide said enhanced lubricating properties, of a metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

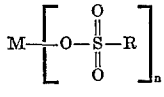
R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

n is an integer of from 2 to 3.

11. A process according to claim **10** wherein said sulfonate is present in said well drilling fluid in an amount within the range of from 0.1 to 5 pounds per barrel of said fluid.

12. A process according to claim **10** wherein said sulfonate is lead methyl sulfonate.

13. A process of drilling a well with a rotary bit which comprises forming a bore hole with said bit while circulating through said bit and through said bore hole in contact with the walls thereof a water base drilling fluid having enhanced lubricating properties comprising a mixture of: sufficient water to maintain said mixture fluid; sufficient finely divided inorganic solids to form a filter cake on the wall of the well; and a small but effective amount, sufficient to provide said enhanced lubricating properties, of a metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

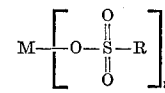
R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

n is an integer of from 2 to 3.

14. A process according to claim **13** wherein said sulfonate is present in said well drilling fluid in an amount within the range of from 0.1 to 5 pounds per barrel of said fluid.

15. A process according to claim **14** wherein said sulfonate is lead methyl sulfonate.

16. A process of drilling a well with a rotary bit which comprises forming a bore hole with said bit while circulating through said bit and through said bore hole in contact with the walls thereof an oil-in-water emulsion drilling mud having enhanced lubricating properties comprising: sufficient oil-in-water emulsion to maintain said mud fluid; sufficient finely divided inert solids to form a filter cake on the wall of the well; and a small but effective amount, sufficient to provide said enhanced lubricating properties, of a metal sulfonate characterized by the following formula



wherein:

M is a metal selected from the group consisting of iron, lead, tin, arsenic, antimony, bismuth, and germanium;

R is selected from the group consisting of alkyl, cycloalkyl, aryl, and aralkyl radicals having from 1 to 8 carbon atoms; and

n is an integer of from 2 to 3.

17. A process according to claim **16** wherein said sulfonate is present in said well drilling fluid in an amount within the range of from 0.1 to 5 pounds per barrel of said fluid.

18. A process according to claim **17** wherein said sulfonate is lead methyl sulfonate.

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