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METHOD OF INHIBITING CORROSION

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This invention relates to inhibition of corrosion and relates more particularly to inhibition of corrosion of ferrous metal by liquids containing corrosive compounds associated with petroleum hydrocarbons.

Crude petroleum oil and gas commonly contain hydrogen sulfide, organic acids, and other compounds which, in solution in water, are corrosive to ferrous metals and these same compounds are frequently contained, although to a lesser extent, in liquid petroleum products such as oils, gasoline, liquefied petroleum gases, and the like. Further, water is frequently produced concomitantly with crude petroleum oil and gas, and water may be contained in liquid petroleum products as a result of treatment in sweetening treaters, washers, and the like. Thus, the ferrous metal equipment of producing oil and gas wells, water disposal wells, and pipe lines for the transportation of crude petroleum oil and liquid petroleum products are frequently in contact with water solutions of hydrogen sulfide, organic acids, and other corrosive compounds associated with petroleum hydrocarbons thereby giving rise to serious corrosion problems.

It is an object of this invention to inhibit corrosion of ferrous metal in contact with water containing dissolved corrosive compounds associated with petroleum hydrocarbons. It is another object of this invention to inhibit corrosion of ferrous metal in contact with water in admixture with petroleum compounds. It is another object of this invention to inhibit corrosion of ferrous metal equipment in oil and gas wells, wells for the disposal of water produced concomitantly with oil and gas, and the like. It is another object of this invention to inhibit internal corrosion in pipe line systems for the transportation of crude petroleum oil and liquid petroleum products. These and other objects of the invention will become apparent from the following description thereof.

In accordance with the invention, corrosion of ferrous metal in contact with a liquid comprising water and containing dissolved corrosive compound associated with petroleum hydrocarbon is inhibited by admixing with the liquid sodium mercaptobenzothiazole in corrosion inhibiting amount.

I have found that the admixture of sodium mercaptobenzothiazole with liquids comprising water containing corrosive compounds associated with petroleum hydrocarbons is highly effective for inhibiting corrosion of tubing, casing, liners, pumps, valves, pipes, storage tanks, and other

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ferrous metal equipment employed in oil and gas wells, water disposal wells, and pipe line systems for the transportation of liquid petroleum hydrocarbons such as crude oil or liquid petroleum products. Sodium mercaptobenzothiazole is water soluble. Therefore, it will accompany the water in a liquid in which it is admixed and will concentrate in a free water phase where the water is in admixture with liquid petroleum hydrocarbons. Accordingly, sodium mercaptobenzothiazole will provide inhibition of corrosion of ferrous metal equipment at points in contact with water where corrosion tends to be most severe. By ferrous metal equipment, I mean any equipment made of iron or an alloy containing iron.

The process of the invention may be employed for the treatment of any liquid consisting of water or containing free or dissolved water which is or has been in contact with petroleum hydrocarbons and has dissolved therein corrosive compounds associated with these petroleum hydrocarbons. Included among these liquids are liquid petroleum hydrocarbons, such as crude petroleum oil and liquid petroleum products exemplified by oils, gasoline, and liquefied petroleum gases, natural gas from a well producing liquid water along with the gas, and waste water separated from oil or gas of which disposal is to be made by injection into a water disposal well. Thus, crude petroleum oil may be treated in the well with sodium mercaptobenzothiazole to inhibit corrosion of the well equipment. Similarly, sodium mercaptobenzothiazole may be employed to inhibit corrosion in natural gas wells. Where water separated from oil or gas is to be injected into a water disposal well, the water may be treated with sodium mercaptobenzothiazole if the oil or gas from which the water was separated was not treated previously in the well or if additional treatment is desired. Crude petroleum oil or liquid petroleum products to be transported in pipe lines may also be treated in accordance with the invention. Frequently, liquid petroleum hydrocarbons, such as crude petroleum oils and liquid petroleum products, will not contain a free water phase at the time they enter the pipe line system. However, they may contain dissolved water and a free water phase will subsequently form as a result of condensation due to cooling by lowering of atmospheric temperature or by passage through sections of the pipe line at a lower than normal temperature, such as sections of the pipe line located under a lake or river. Where condensa-

tion occurs in a liquid treated with sodium mercaptobenzothiazole, the sodium mercaptobenzothiazole will enter into solution in the water phase, thereby inhibiting corrosion at the points of the system in contact with the free water phase. This is particularly advantageous for the inhibition of corrosion at low points in the carrier pipe, as in valleys, dips, and the like, or in other spots of the system where free water will accumulate.

The concentration of sodium mercaptobenzothiazole to be employed may be between about 1 and 500 parts per million by weight of the liquid to be treated depending upon the corrosivity of the liquid. Within these limits, the concentration of sodium mercaptobenzothiazole to be employed will depend upon the amount of corrosive compounds in the liquid and the extent to which corrosion is to be inhibited. Generally, satisfactory results are obtained where the sodium mercaptobenzothiazole is employed in an amount between about 50 and 100 parts per million by weight of the liquid. However, the exact concentration to be employed in each particular case to obtain the desired degree of inhibition of corrosion with minimum concentration of sodium mercaptobenzothiazole may be determined by immersing test pieces of the same kind of ferrous metal whose corrosion is to be inhibited in samples of the liquid to be treated to which have been added varying amounts of sodium mercaptobenzothiazole, and comparing the extent of corrosion of each test piece after a suitable immersion time with the amount of sodium mercaptobenzothiazole in the samples of liquid.

Since sodium mercaptobenzothiazole is water soluble it may be added as a concentrate in water solution to the liquid to be treated. However, the sodium mercaptobenzothiazole may be added in the dry state or in admixture with a suitable liquid medium other than water, such as a portion of the liquid to be treated. Where water solutions of sodium mercaptobenzothiazole are employed, it is preferred to employ fresh water for preparing the solution. However, saline waters may also be employed although their use is to be avoided since salt in large concentrations causes some degree of precipitation of the sodium mercaptobenzothiazole. In this connection, where the liquid to be treated contains salt water, it is desirable to employ larger concentrations of sodium mercaptobenzothiazole than would be employed if the liquid contained non-saline water.

Where corrosion in an oil well is to be inhibited, the sodium mercaptobenzothiazole may be introduced into the well between the tubing and the casing. Gas wells may be similarly treated, the sodium mercaptobenzothiazole admixing with the water at the bottom of the well and inhibiting corrosion of ferrous metal equipment of the well contacted by the water lifted upwardly by the flow of gas. Crude oil or liquid petroleum products to be transported in a pipe line system may be treated by adding sodium mercaptobenzothiazole thereto prior to or at the time of entering the pipe line system or may be added subsequent to entering the pipe line system by injecting into the pipe line system at a desired point or points. Waste water injected into water disposal wells may be treated by admixing the sodium mercaptobenzothiazole therewith prior to injection of the water into the disposal well. If the crude oil or gas from which the water is separated has been previously treated with sodium mercaptobenzothiazole, the water may contain sufficient sodium mercaptobenzothiazole to inhibit corrosion and no further treatment will be necessary. However, if insufficient sodium mercaptobenzothiazole is contained in the water, an additional amount may be added.

The following examples will be illustrative of the results to be obtained by the process of the invention.

Example I

In an oil well in the Brownfield District in Texas producing on the average 38 barrels of crude oil and 5 barrels of water per day, the ferrous metal equipment in contact with the produced well liquids was being corroded at a rate of 0.0015 inch of penetration per year. This well was treated by pumping sodium mercaptobenzothiazole in water solution between the tubing and the casing in amounts such that the concentration of sodium mercaptobenzothiazole in the total well liquids was 100 parts per million by weight. The treatment was continued for six months. During the first three months of treatment the corrosion rate was reduced to 0.0005 inch of penetration per year, a decrease of 67 per cent, and during the second three months of treatment the corrosion rate was reduced to 0.0001 inch of penetration per year, a decrease of 93 percent.

Example II

In another well in the same district producing on the average 38 barrels of crude oil and 28 barrels of water per day, the corrosion rate was 0.0078 inch of penetration per year. Treatment with sodium mercaptobenzothiazole in the amount of 10 parts per million by weight of the total well liquids was instituted and continued for two months. The corrosion rate was reduced to 0.0037 inch of penetration per year, a decrease of 53 percent. Thereafter, the concentration of sodium mercaptobenzothiazole was increased to 100 parts per million by weight of the total well liquids and continued for a period of four months. The corrosion rate was reduced to 0.0023 inch of penetration per year, a decrease of 69 percent.

Having thus described my invention, it will be understood that such description has been given by way of illustration and example only and not by way of limitation, reference for the latter purpose being had to the appended claims.

I claim:

1. The process for inhibiting corrosion of ferrous metal in contact with a liquid comprising water, said water prior to contact with said ferrous metal having been in contact with petroleum hydrocarbon and as a result of said contact with said petroleum hydrocarbon having extracted from said petroleum hydrocarbon a water-soluble compound corrosive to said ferrous metal, which process comprises admixing with said liquid prior to contact with said ferrous metal as the sole corrosion inhibiting agent sodium mercaptobenzothiazole in corrosion inhibiting amount.

2. The process of claim 1 wherein said sodium mercaptobenzothiazole is admixed with said liquid in an amount between about 1 and 500 parts per million by weight of said liquid.

3. The process of claim 1 wherein said sodium mercaptobenzothiazole is admixed with said liquid in an amount between about 50 and 100 parts per million by weight of said liquid.

4. The process for inhibiting corrosion of ferrous metal in a petroleum hydrocarbon well in contact with a petroleum hydrocarbon well fluid containing water, said water prior to contact with

said ferrous metal having extracted from said petroleum hydrocarbon well fluid a water-soluble compound corrosive to said ferrous metal, which process comprises introducing into said well and admixing therein with said petroleum hydrocarbon well fluid prior to contact of said petroleum hydrocarbon well fluid with said ferrous metal as the sole corrosion inhibiting agent sodium mercaptobenzothiazole in corrosion inhibiting amount.

5. The process for inhibiting corrosion of ferrous metal in a petroleum gas well in contact with petroleum gas admixed with water produced concomitantly with said petroleum gas, said water prior to contact with said ferrous metal having extracted from said gas a water-soluble compound corrosive to said ferrous metal, which process comprises introducing into said well and admixing therein with said water as the sole corrosion inhibiting agent sodium mercaptobenzothiazole in corrosion inhibiting amount.

6. The process for inhibiting internal corrosion in a ferrous metal pipe line transporting liquid petroleum hydrocarbons containing water, said water having extracted from petroleum hydrocarbons a water-soluble compound corrosive to said ferrous metal, which process comprises admixing with said liquid petroleum hydrocarbons as the sole corrosion inhibiting agent sodium mercaptobenzothiazole in corrosion inhibiting amount.

7. The process for inhibiting corrosion of ferrous metal in a water disposal well in contact with water separated from petroleum hydrocarbons, said water as a result of said contact with said petroleum hydrocarbons having extracted from said petroleum hydrocarbons a water-soluble compound corrosive to said ferrous metal, which process comprises admixing with said water prior to contact with said ferrous metal as the sole corrosion inhibiting agent sodium mercaptobenzothiazole in corrosion inhibiting amount.

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