

UNITED STATES PATENT OFFICE

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METHOD OF PREVENTING CORROSION IN OIL WELLS

No Drawing.

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The present invention relates to the protection from corrosion of metal parts in contact with oil well liquids, and more particularly to a method of treating oil well liquids to render them non-corrosive and non-scale-forming.

The invention herein described was in part disclosed in my co-pending application Serial No. 14,938 filed March 12th, 1925 of which this application is a continuation in part.

It is the particular object of the present invention to provide a process for treating oil well liquids whereby the serious losses of material and time which are normally caused by the corrosive attacks by such liquids on casings, pumps, and other metal parts installed in the well are prevented or avoided.

Among the compounds present in oil well liquids which have been found to be responsible for the corrosion of metal parts in contact with such liquids are acidic salts such as ferrous and ferric chlorides and sulphates, and magnesium chlorides and sulphates. These acidic salts hydrolyze to some extent to form the metal oxide or hydroxide and mineral acid. Any oxygen present in the well liquids causes accelerated corrosion of metal parts in contact therewith. Sometimes very corrosive well waters give an alkaline reaction to methyl orange indicator, showing the absence in such liquids of free strong mineral acids. Most of these corrosion promoting compounds are acidic in character and many of them are very active in destroying iron and steel parts.

The present invention contemplates the prevention of corrosion of metal parts in contact with oil well liquids (particularly the brines or natural waters produced with the oil) containing one or more of such compounds. To accomplish this, chromium compounds, preferably in alkaline solution, are introduced into the oil well in such a manner as to be brought into intimate contact with the liquids in the well. These compounds act to neutralize acidic or corrosive components of the well liquids and to render the

metal parts passive or resistant to corrosive attack by the well liquids.

The invention also contemplates the prevention of scale formation on metal parts in oil wells by holding any precipitated matter which normally forms the scale in a form such that it will be carried out of the well with the water and oil pumped from the well.

If oil well waters or brines come in contact with carbonic acid or oxygen, or contain either one and come in contact with the other, or contain both carbonic acid and oxygen, iron oxide (hydrated) is formed upon contact of such brine with metal parts in the well; such oxide being deposited on the iron parts of the well as scale (rust). A further source of troublesome scale is strontium chloride or other soluble strontium salt which is contained in the top waters of wells in many localities. Upon admixture of strontium containing top waters with bottom waters containing sodium or calcium sulfate in solution, for example, strontium sulfate is formed. Normally the strontium sulfate is formed slowly because of the high concentration of the chloride ions, and accordingly deposits as a very hard compact scale. While strontium sulfate does not itself have any extensive corrosive effect, its deposition as a hard scale causes serious mechanical troubles. In general the scales encountered or formed during oil well operation, a few of which are referred to above, promote rather than inhibit the corrosion of metal parts in contact with the oil well liquids, as well as interfering with the proper operation of the pumping apparatus which may be installed at the bottom of the well.

It has been found that caustic soda has a very strong neutralizing effect on the acidic components of oil well brines, but that its use is generally disadvantageous for the reason that it reacts quickly and apparently selectively with calcium and magnesium salts contained in the brines, thus rapidly depleting the neutralizing strength of the caustic and forming undesirable precipitates of calcium and magnesium water insoluble salts. Accordingly if sodium hydroxide is used alone as a corrosion inhibiting treating agent

for the well liquids, it usually takes an undesirably large amount of the caustic soda to accomplish the desired corrosion inhibiting results, and furthermore undesirable precipitates are formed which add to the difficulties of pumping or otherwise operating the well.

As indicated above the present invention contemplates the use of chromium compounds, and preferably alkali metal chromium salts, for treating oil well liquids to inhibit the corrosion of metal parts thereby. The preferred treating agent consists of a water solution of sodium chromate preferably formed by mixing salts of chromous or chromic acid with a slight excess of caustic soda. The amount of excess of caustic soda employed in making up the sodium chromate solution is governed by the composition of the well liquids to be treated, and is normally so adjusted that the well liquids are rendered substantially neutral or preferably slightly alkaline by the treatment without, however, carrying the neutralization far enough to precipitate appreciable quantities of calcium or magnesium carbonates in cases where the well liquids contain such alkaline earths in the form of bicarbonates.

In place of sodium chromate other salts of chromous or chromic acid may in many cases be used to advantage, such for example as other alkali metal or ammonium chromates and dichromates. In employing an excess of alkali as above described, any dichromates used will be converted to chromates. If for any reason it is not desired to use an alkali solution of the treating agent, the dichromates may in general be used to advantage. In treating certain types of well liquids oil-soluble chromium compounds such as chromium resinate are in some cases advantageously employed. The invention therefore contemplates the addition to the well liquids of chromium either in the form of an acid radical as in the chromate or in the form of a basic metal ion as in chromium resinate.

The chromium as it is added to the oil well liquids, for example in the form of a caustic solution of sodium chromate, has been found to be very effective for reducing the corrosive action of the well liquids (as well as for preventing or retarding rust scale formation). The sodium chromate solution reacts slowly with any calcium and magnesium salts in the well liquids. No insoluble calcium or magnesium salts are usually formed for the reason that the sodium chromate is used in such small quantities that the solubility of the alkaline earth chromates in the large excess of brine is not exceeded. The caustic sodium chromate solution normally has sufficiently active neutralizing properties to pacify the acidic or corrosive properties of the oil well brines and to render inactive any oxygen present in the well liquids.

The sodium chromate solution acts to keep the metal surfaces in contact with the well liquids clean and its use therefore materially aids the pumping of the well in that the pump piston and packing operate much more efficiently in the working barrel, and the friction losses are held at a minimum. The action in turn aids in lessening the amount of power which is used in pumping and in lessening the strain on the pumping rods and associated parts.

Treatment of the well liquids with an alkaline solution of sodium chromate prevents the formation of rust or hydrated ferric oxide scale on the metal parts. By adding to the treating agent a small amount of an organic or inorganic colloid or colloidal forming material such as tannic acid, glue or sodium silicate, the treating agent may be made effective for inhibiting the formation of adherent hard scales of strontium sulfate and the like. Such colloidal or gelatinous component of the treating agent causes the scale forming materials to remain in suspension in the well liquids until they are carried to the surface by the action of the well pump.

Potassium and sodium dichromates are sometimes used to advantage, either alone or in alkaline solution. In general the chromate or chromium compound in alkaline solution is particularly effective for treating well liquids the corrosive action of which is chiefly due to mineral acids or acid salts with or without the presence of oxygen or carbon dioxide or both oxygen and carbon dioxide in the brine. In cases where the corrosive action of well liquids is essentially of the oxidation type and there is substantially no free acid present in the brine, the dichromate, chromate, chromous acid, or chromic acid may generally be employed alone to advantage because such reagents render the iron parts in contact with the well liquids passive without causing precipitation of insoluble calcium or magnesium carbonate.

When treating the liquids in the well according to the present invention, it has been found that it is necessary for best results and for the best protection of all the metal parts of or in the well that the corrosion inhibiting compound diffuses rapidly through the well liquids on being added thereto. This result is accomplished according to the present invention by making up the treating agent in a brine or salt water solution having a specific gravity substantially the same as the specific gravity of the water in the well to be treated. In making up the treating agent solution the desired specific gravity for the purposes herein described is imparted there- to either by adding to the water a salt such as sodium chloride which is relatively stable under the conditions obtaining in the well, or by using the natural water or brine obtained from the well to be treated. In the

latter case a calculated excess of caustic or other neutralizing compound is added to compensate for the calcium salts precipitated from the brine component of the solution.

5 The chemical or neutralizing agent may be added to the well in various ways. One satisfactory schedule of operation is to introduce 50% or more of the reagent solution between the casing and the pump delivery pipe
10 as rapidly as possible just after the pump is started. The remainder of the reagent is added in the same way but about fifteen minutes before the well is pumped off. However, when the well pumps continuously and
15 water is continuously brought into and removed from the well by the pump, it is preferred to add the chemical to the well continuously and in properly proportioned amounts.

20 The invention having been thus described, what is claimed as new is:

1. A method of preventing corrosion of metal parts by oil well liquids which comprises adding predetermined amounts of a
25 caustic solution of a salt of a chromium acid to said liquids before contacting the liquids with such metal parts.

2. A method of preventing corrosion of metal parts in contact with oil well liquids,
30 comprising adding to the well liquids a solution of a chromium compound in amounts sufficient to inhibit corrosion of the oxidation type without causing precipitation of insoluble alkaline earth salts.

35 3. A method of preventing corrosion of metal parts in contact with oil well liquids comprising treating such liquors prior to removal thereof from the well with a caustic solution of sodium chromate in amounts sufficient to inhibit corrosion of the oxidation
40 type without causing substantial precipitation of insoluble alkaline earth salts.

4. A method of preventing corrosion of metal parts by oil well liquids comprising
45 mixing with the well liquids a solution of a chromium salt having a specific gravity substantially equal to that of the well water.

5. A method of preventing corrosion of metal parts in contact with oil well liquids
50 comprising mixing with the well liquids an aqueous solution of sodium chromate having substantially the same specific gravity as the well water.

6. A method of preventing corrosion of
55 metal parts in contact with liquids from oil wells comprising mixing with said liquids an alkaline solution of an oil soluble chromium compound.

In testimony whereof I affix my signature.
60 JOHN CHARLES WALKER.