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METHOD OF REDUCING CORROSION
IN WELLS

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This invention relates to methods of reducing corrosion in oil and gas wells, and comprises the addition to the fluid stream of bicarbonates of the alkali metals, such as sodium and potassium bicarbonates, and mixtures of these materials with normal carbonates.

Many oil and gas wells suffer severe corrosion of the tubing and sucker rods because of the presence of acidic materials, such as carbon dioxide, acetic, propionic or other organic acids, along with water in the fluid stream. Wells of the "condensate" type, which produce small amounts of liquid hydrocarbons and water along with large quantities of gas, are particularly susceptible to corrosion, and because of the high pressures involved, present a very serious problem.

In the prior art, it has been proposed to add to the well stream a number of materials which tend to reduce the corrosion. Among them may be mentioned ammonia and other alkaline substances which neutralize the acids present. A serious disadvantage of the materials previously used, however, is the fact that alkalies react with calcium and magnesium salts present in the well stream to deposit insoluble salts which plug the wells, and adversely affect their productive capacity.

It is accordingly an object of the present invention to prevent corrosion in oil wells by treatment with bicarbonates of the alkali metals, or mixtures thereof with normal carbonates, whereby the formation of insoluble, plugging deposits will be avoided.

We have found that the bicarbonates of the alkali metals, and mixtures of bicarbonates and carbonates of alkali metals (frequently referred to as "modified carbonate"), while sufficiently alkaline to correct the acidity of all the acidic materials encountered, do not react with any material present in the well stream to form obstructive deposits. An example of the advantage of this process over that of the prior art is shown by our experience in the treatment of one well of the "condensate" type. This well had been treated with 6 to 8 pounds of sodium carbonate per day in water solution for three months, at the end of which time the well was almost completely plugged. It was necessary to treat the well with dilute hydrochloric acid before normal production was restored. Treatment with three pounds per day of sodium bicarbonate was then started, and has been continued with no evidence of plugging. In both cases, the reduction of the iron content of the water produced by the well indicated that the corrosion was reduced to a negligible rate.

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The amount of bicarbonate required for successful treatment of a well varies with the acidity of the water produced by the well, and its amount. Ordinarily it is not feasible to treat wells making several hundred barrels of water per day by our method. For wells making a few barrels per day, we prefer to add sufficient bicarbonate to bring the pH within the range of 6.0 to 8.0, as measured at the surface. For most wells of the "condensate" type, a dosage of from one to five pounds of sodium bicarbonate or modified carbonate per barrel of water is required to obtain the desired pH and reduction of iron. Dosage in excess of the minimum requirement, however, does no harm, contrary to experience with more alkaline materials.

Bicarbonates and modified carbonates may be added to the well stream by pumping or lubricating a solution down the annular space between casing and tubing, or by lubricating down the tubing in liquid or solid form. In the latter method, it is convenient to use the material made up in the form of cylindrical sticks, whose diameter is about one-half inch less than the minimum size of opening in the tubing or fittings. These sticks may be made up with several materials as binders, as shown in the following examples:

EXAMPLE 1

100 pounds of sodium bicarbonate is mixed with 4.7 pounds of ethyl silicate (neat ester, a product of the Union Carbide and Carbon Corporation). 3 pounds of water is then added and the mixture is pressed into sticks of suitable dimensions at a pressure of about 5000 p. s. i.

EXAMPLE 2

100 pounds sodium bicarbonate
5 pounds calcined magnesla
7.1 pounds magnesium chloride solution
(specific gravity 1.19)

These ingredients are mixed and formed in sticks at a pressure of about 5000 p. s. i.

EXAMPLE 3

100 pounds sodium bicarbonate
2.5 pounds calcined magnesla
3 pounds melamine resin (resin product of American Cyanamid Company, under name of Melmac 405 is satisfactory)
3.6 pounds magnesium chloride solution (specific gravity 1.19)

The melamine resin is first dissolved in the magnesium chloride brine, and then mixed with

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the other ingredients. The mixture is compressed into sticks of suitable form at approximately 5000 p. s. i.

A typical illustration of what we consider to be successful treatment of a well with sodium bicarbonate is illustrated by the case of the J. M. Moore 56 well in Moore's Field, Texas. This well produces approximately four million cubic feet of gas per day, along with approximately five barrels of water. The produced water possesses a pH of approximately 4.50 and an iron content of 250 to 300 P. P. M., indicative of a corrosive condition. The treatment consisted of pumping ten gallons of an aqueous mixture of sodium bicarbonate and water containing five pounds of sodium bicarbonate into the annular space of the well daily. The resulting effect on the produced water which showed an increase in pH and decrease in iron content, indicative of a reduction in corrosion rate, is given in the table.

Table

Elapsed Time	NaHCO ₃ Added	pH of Well Effluent	Iron Content of Well Effluent
Days	Pounds		P. P. M.
3	none	4.38	240
19	none	4.52	300
2	5.00	5.38	120
2	5.00	7.00	40
2	5.00	7.25	18
2	5.00	7.00	35
2	5.00	7.00	30
5	5.00	7.33	20
1	5.00	7.30	12
7	5.00	7.63	11
2	5.00	7.42	14

It is considered significant that whereas daily treatment was continued in this well for over seven continuous months, no evidence of any plugging of the tubing or producing formation developed during this time.

The use of sodium bicarbonate has its greatest advantage over other alkaline materials in treating wells producing waters with appreciable quantities of calcium salts. However, we have found that many wells of the condensate type, which produce water with little or no calcium salt content frequently produce after a time quantities of brines high in calcium concentration which calcium is easily precipitated by the more alkaline materials. The use of sodium bicarbonate or modified carbonate, therefore, is desirable even though the aqueous production of a well is low in calcium salts, because the concentration of such salts may increase materially within a short period of time, but without resulting calcium deposition.

What we claim is:

1. A method of reducing corrosion in a well which consists in disintegrating in the well stream compressed shapes of a mixture produced

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by dissolving melamine resin in magnesium chloride brine in the proportions of about 3 pounds melamine resin to 3.6 pounds magnesium chloride solution of specific gravity 1.19, then mixing such solution with sodium bicarbonate and calcined magnesia in the proportion of about 100 pounds sodium bicarbonate to 2.5 pounds calcined magnesia.

2. A method of reducing corrosion in a well caused by naturally occurring acidic materials produced with the well water, and without forming insoluble, plugging deposits in the well, which consists essentially in adding to the well stream an amount of a bicarbonate of an alkali metal at least sufficient to bring the pH of said produced water, measured at the surface, within the range 6.0 to 8.0.

3. The method of claim 2, wherein the alkali metal bicarbonate is sodium bicarbonate.

4. The method of claim 2, wherein a solution of the alkali metal bicarbonate is introduced into the annular space between the casing and tubing of the well, and mixes with the well stream at the lower end of the tubing.

5. A method of reducing corrosion in a well caused by naturally occurring acidic materials produced with the well water, and without forming insoluble, plugging deposits in the well, which consists essentially in introducing into the well stream a solid containing an alkali metal bicarbonate, said solid being disintegratable in the well fluids, the amount of said alkali metal bicarbonate being at least sufficient to bring the pH of said produced water, measured at the surface, within the range 6.0 to 8.0.

6. The method of claim 5, wherein said disintegratable solid comprises about 100 pounds of sodium bicarbonate, about 4.7 pounds of ethyl silicate and about 3 pounds of water.

7. The method of claim 5, wherein said disintegratable solid comprises about 100 pounds of sodium bicarbonate, about 5 pounds of calcined magnesia and about 7 pounds of magnesium chloride solution having a specific gravity of 1.19.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,968,722	Stone	July 31, 1934
2,038,956	Parkhurst	Apr. 28, 1936
2,429,593	Case	Oct. 28, 1947

OTHER REFERENCES

"Corrosion and Preventive Methods in Katy Field," R. C. Buchan, pp. 159-172, Petroleum Engineer (1947).