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TREATMENT OF WELLS

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The invention relates to an improved method of removing acid-soluble deposits from the casing or tubing of water wells, brine wells, or of oil and gas wells when the latter also produce water or brine, particularly in the case of wells drilled into calcareous formations. Such deposits are formed as a result of the precipitation of carbonates, sulphides and the like, as a hard adherent cement-like scale in the pipes. These deposits, of course, restrict the flow of the well or otherwise interfere with its operation, and must be removed from time to time.

Owing to their cement-like nature such deposits are very difficult to remove from casing or tubing by the usual mechanical procedure, according to which the tubing or casing is withdrawn from the well and hammered to cause the deposit to crack off. This procedure, moreover, is costly and time-consuming. The deposits may also be removed by the dissolving action of acid introduced into the well, but such procedure requires a large quantity of acid sufficient to fill the tube and casing and, in addition, to make up for what may be absorbed by the rock formation surrounding the well.

The principal object of my invention is to provide an economical method for removing acid-soluble deposits from the cavity, casing, or tubing of wells by treating with acids without the necessity for employing large amounts thereof. Other objects and advantages will appear as the description proceeds. To the accomplishment of the foregoing and related ends, the invention, then, consists in the method hereinafter fully described and particularly pointed out in the claims.

My invention is based upon the fact that, when a suitable foam producing and stabilizing agent is added to the acid, the gas produced by the action of the acid upon carbonates, sulphides and the like causes the acid to foam and greaty expand in volume. A relatively small volume of acid when thus caused to foam and, therefore, increase in apparent volume, suffices to occupy the space in the well cavity, tubing, and casing. As a consequence such deposits therein may be dissolved with a much smaller volume of acid than that required to fill the space in the well. I have found also that such foaming acid does not readily penetrate into the surrounding earth, so that loss from such cause is substantially prevented.

In carrying out the invention I employ any liquid acid capable of dissolving and decomposing the deposit and which may be made to foam by the gas liberated in such decomposition, such as solutions of nitric acid or hydrochloric acid or mixtures of such acids. Hydrochloric acid is generally preferred owing to its relatively low cost. A concentration from about 2 up to 25 per cent, preferably 5 to 10 per cent, is suitable for the purpose, although other concentrations may be used. A relatively small quantity of an agent capable of inhibiting the action of acids on metals may be added to the acid, if desired, whereby danger of injury to the tubing or other metallic parts of the well may be substantially prevented. Suitable inhibitors for the purpose are known for the pickling of metals, and their use is also disclosed in Patent No. 1,877,504. In accordance with my present invention I mix with such inhibited or uninhibited acid solution, as the case may be, a relatively small quantity of a foam producing and stabilizing agent. Among those suitable for the purpose are gelatin, saponin, gum arabic, casein, peptone, licorice, and the like. The proportion of such agent to be used may be determined experimentally. For example, a piece of limestone or some calcium carbonate may be introduced into a quantity of the selected acid containing varying amounts of foam producing and stabilizing agent until a suitable degree of foaming is had. Usually from 0.1 to 5 per cent of the weight of the acid is a sufficient amount of foaming agent, but other proportions may be used, if desired. To be effective for the purpose such foam must be relatively stable, that is capable of existing for a sufficient time until the action of the acid on the deposit is completed. Ordinarily foam produced as described will remain as such for one-half hour or more. In general, I prefer to employ from 0.5 to 1 per cent of gum arabic or saponin in aqueous hydrochloric acid containing from 5 to 10 per cent of HCl and a relatively small amount of an inhibitor, as aforementioned, to protect metal equipment from attack by the acid.

The so prepared inhibited or uninhibited acid solution is then introduced into the well in amount calculated to dissolve the deposits. The acid solution may be introduced into the tubing or the annular space between the casing and the tube, depending upon the particular location of the deposits to be removed. As soon as the acid reaches the deposit it decomposes it, thereby liberating gas which may be carbon dioxide, hydrogen sulphide, etc., depending upon the composition of the deposit. The liberation of the gas causes the acid to foam in the presence of the foaming agent, thereby greatly expanding the volume of the acid and the resulting spent acid.

The so formed foaming liquid rapidly fills the space in the well and thus holds the acid in contact with the deposit on the walls. The acid will also reach the base of the well in time but does not readily pass out of it into the earth formation due to the relatively small hydrostatic head of the foaming acid solution standing in the well and the difficulty of forcing foam into the pores of the earth. After the deposits are sufficiently dissolved the spent solution may be withdrawn from the well by pumping or the like.

It is more convenient in some cases to introduce the foaming agent into the well separately from the acid as a solution in water or other suitable solvent, since this does not involve the premixing of a relatively large volume of acid with a small amount of foaming agent. In these cases the foaming agent may be dissolved in water or the like to form a solution of suitable concentration, for example, ¼ to 1 pound per gallon or more and several gallons thereof introduced into the well ahead of, or simultaneously with, the acid solution so that the two solutions mix together in the well.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made as regards the method herein disclosed, provided the step or steps stated by any of the following claims or the equivalent of such stated step or steps be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In a method of removing from a well by treatment with an acid a deposit soluble in acid with liberation of gas, the step which consists in introducing into the well an agent capable of causing an acid solution to foam when the same acts upon the deposit.

2. In a method of removing from a well by treatment with an acid a deposit soluble in acid with liberation of gas, the steps which consist in introducing into the well an acid solution and an agent capable of causing said solution to foam when the same acts upon the deposit.

3. In a method of removing a carbonate deposit from a well by treatment with an acid, the step which consists in introducing thereinto an agent capable of causing an acid solution to foam when the same acts upon calcium carbonate.

4. In a method of removing a carbonate deposit from a well by treatment with an acid, the step which consists in introducing thereinto an aqueous solution of an agent capable of causing an acid solution to foam when the same acts upon calcium carbonate.

5. In a method of removing a carbonate deposit from a well, the steps which consist in introducing thereinto an agent capable of causing an acid solution to foam when the same acts upon calcium carbonate and then introducing an acid solution.

6. In a method of removing a carbonate deposite from a well, the steps which consist in introducing thereinto an aqueous solution of an agent capable of causing an acid solution to foam when the same acts upon calcium carbonate and then introducing an acid solution.

7. In a method of removing a carbonate deposit from a well, the step which consists in introducing thereinto an acid solution containing an agent capable of causing the solution to foam when the same acts upon calcium carbonate.

8. In a method of removing a carbonate deposite from a well, the step which consists in introducing thereinto an acid solution containing an agent selected from the group consisting of gelatin, saponin, gum arabic, casein, and peptone.

9. In a method of removing a carbonate deposit from a well, the step which consists in introducing thereinto hydrochloric acid solution containing an agent capable of causing the solution to foam when the same acts upon calcium carbonate.

10. In a method of removing a carbonate deposit from a well provided with the usual casing and tube, the step which consists in introducing into the annular space between said casing and tube an acid solution containing an agent capable of causing the solution to foam when the same acts upon calcium carbonate.

11. In a method of removing a carbonate deposit from a well, the step which consists in introducing thereinto hydrochloric acid solution containing from 5 to 25 per cent of HCl and from 0.1 to 5 per cent of an agent selected from the group consisting of gelatin, saponin, gum arabic, casein, and peptone.

12. In a method of removing a carbonate deposit from a well, the steps which consist in introducing thereinto hydrochloric acid solution containing an agent capable of causing the solution to foam when the same acts upon calcium carbonate, and a relatively small amount of an inhibitor of the action of the acid upon metals.

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