The Use of Solvents to Control Paraffin in Rod-Pump Wells and Flow-Lines

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The accumulation of paraffin deposits in pumping wells and flow lines presents a production and transportation problem that is very costly to the oil industry. This problem has been attacked in many ways and, until a few years ago, the removal of such deposits was accomplished by mechanical means only. These usually involved lost time, extra labor, and special tools, all of which were expensive to the operator. Because of the high cost of mechanical methods, it was found that, in many cases, the use of chemical solvents was a more economical way to remove paraffin deposits. Such solvents, when properly applied, removed paraffin deposits from the well and flow line, with far less expense to the operator.

Paraffin Deposits

We have talked briefly of the problems and methods of paraffin removal but actually, what is it? Paraffin, as used in oil field terminology, is waxy or asphaltic material deposited onto producing equipment from the crude oil. This deposit is usually brown or black in color and results from changes in temperature, and loss of the more volatile components from the oil, such as gas. As a result, the heavier paraffin deposits usually occur in the top few hundred feet of the well and the first few joints of the flow line.

The different types of paraffin encountered vary greatly in chemical composition and characteristics. In some fields, these deposits are almost pure paraffin, which dissolves with little difficulty when a suitable solvent is selected and applied properly. Sometimes, however, the deposits contain additional substances, such as asphalt, silt, sand, or gums, that make removal more complicated. Also, when deposits have been built up gradually over a period of several months, they are usually very hard and dense. In such cases, the procedure requires more time than if the deposit is soft and plastic, and more than one application of solvent may be necessary.

Field Testing

Before attempting a paraffin removal treatment, a sample of the paraffin should be obtained from the well and tested in several different type solvents. The results of these tests will indicate which is the best solvent to use. The easiest and most convenient method to field-test paraffin is by means of a testing kit, such as shown in Figure 1. The kit consists of an electric motor, to which is attached an eccentric arm that raises and lowers a rocker arm. Suspended on wires from this rocker arm are wire screens on which are placed samples of the paraffin to be tested. These screens are alternately raised and lowered, dipping the paraffin into test tubes filled with the various solvents to be tested.

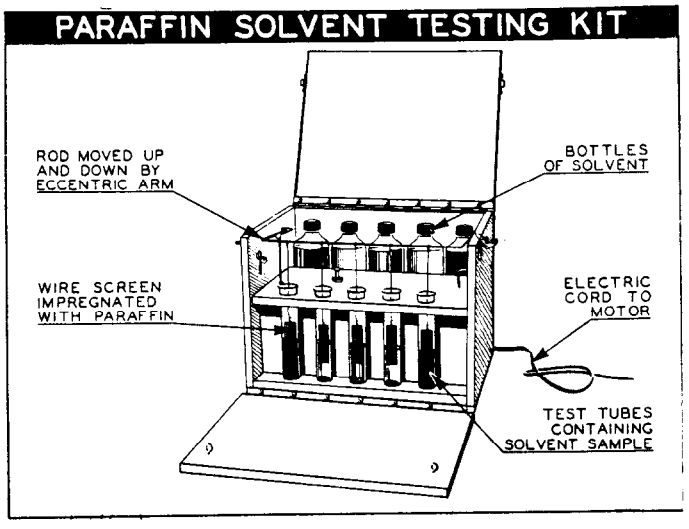

FIGURE 1

Paraffin Solvents

A number of different organic solvents are on the market for paraffin removal. Each has its own specific advantages and uses. In field application they are frequently used in combination with white gasoline or kerosene, in cases where the paraffin is not too difficultly soluble.

One commercial solvent is achlorinated hydrocarbon that is extremely effective on pure paraffins; however, it is not too effective on asphaltic materials. Another is a proprietary solvent containing a high proportion of organic thio-compounds. This solvent has superior dissolving and dispersing properties for asphaltic paraffin accumulations.

An added advantage of these two solvents is their high specific gravities. In order to get any appreciable penetration through the paraffin and oil present in the well, the solvent used must be heavier than the paraffin or oil encountered.

White gasoline and kerosene are sometimes used for paraffin removal, however their solvent action is limited. These solvents are very similar chemically to the paraffin they are to dissolve, as they belong to the same chemical family. Gasoline and kerosene are the lighter members in the family while solid paraffins are heavier members. Due to their light weight (about 6.2 lbs./gallon for gasoline and 6.8 lbs./gallon for kerosene) poor penetration through the oil and paraffin is usually obtained. However, these agents are useful, in many instances, for blending with commercial solvents. As high as 50 percent gasoline or kerosene has been used successfully, and in rare instances up to 75 percent gasoline or kerosene has been employed. The ease with which the specific paraffin accumulation will dissolve is understandably a factor in determining the extent of blending that is feasible.

In some instances wetting agents are added to solvents to increase their ability to penetrate the paraffin deposit. This can be especially helpful where emulsified water is present in the deposit.

Treating Techniques

After the best solvent has been selected from the paraffin test, the proper treating procedure should be determined. There are several methods of treating a pumping well.

A. Where considerable gas is pumped with the oil: Release back pressure at the trap and allow the tubing to partially empty itself. Lift the stuffing box, insert a funnel and pour the solvent in between the polish rod and the walls of the tubing, leaving the well shut-in for 6 to 8 hours.

B. Where there is insufficient gas to unload the tubing: Lift the rods sufficiently to unseat the standing valve, permitting the oil to recede down the hole. Introduce the solvent into the annular space between the polish rod and the tubing. The well should then be shut-in for 6 to 8 hours.

C. Where the pump leaks at the bottom of the hole sufficiently to permit the oil to recede down the tubing: Remove the stuffing box and introduce the solvent into the annular space between the polish rod and the tubing. The well should then be shut-in for 6 to 8 hours.

D. The more popular method of treating pumping

TYPICAL WELLHEAD HOOKUP FOR INTRODUCING PARAFFIN SOLVENT

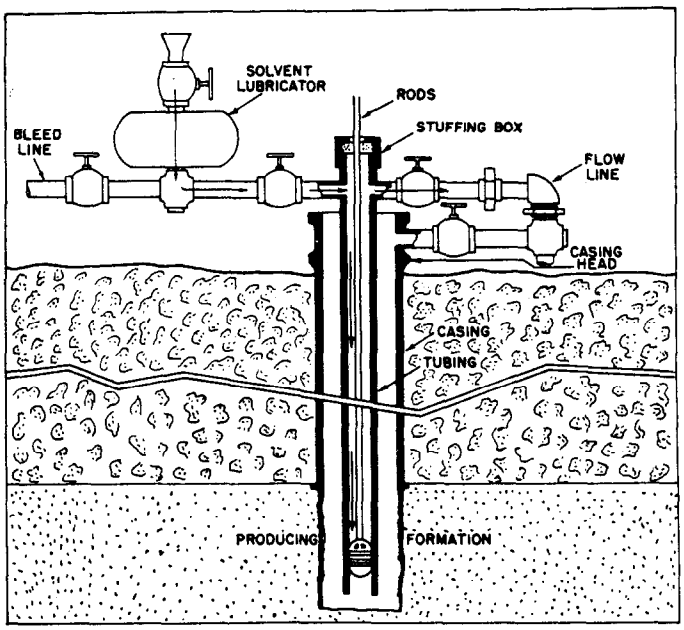

FIGURE II

wells is to inject the solvent through a lubricator as shown in Figure 2. The solvent is poured into the lubricator and the top valve is closed. The valve to the tubing is then opened and the solvent will gravity into the tubing when the pressure equalizes. This method saves time and the lubricator can be easily installed.

E. If the well is heavily parafinned and there is reason to believe that the pay face has become partially plugged, the circulation method should be used (Figure 3). The solvent is injected down the annular space and the well is shut-in over night. The flow line is then tied into the casing and the well circulated for 24 hours. In using the circulation method be sure the casing pressure is kept below 125 psi so that the pump mechanism will seat. This can be accomplished by running a vent from the casing. In this type of treatment, from 30 to 50 gallons of solvent, mixed with 100 to 150 gallons of kerosene or white gasoline are used. This method not only cleans the tubing and pay face, but in many instances, increases the production of the well.

PARAFFIN REMOVAL FROM FACE OF PAY AND TUBING

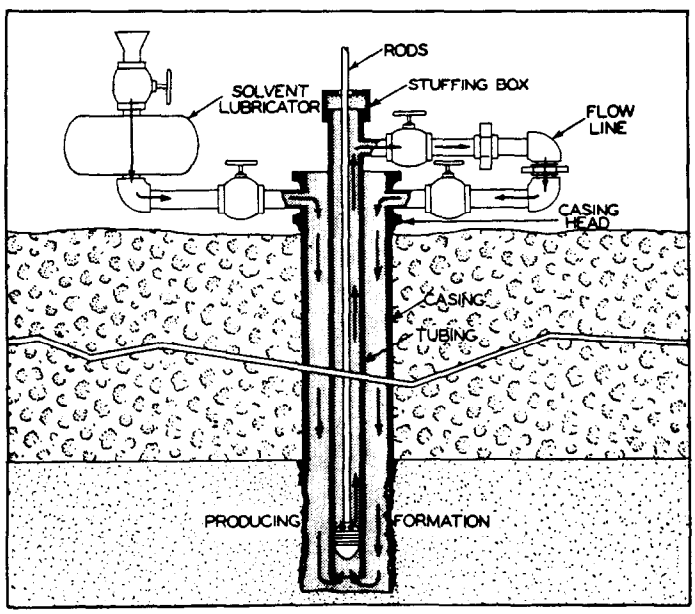

FIGURE III

In cleaning lead lines the solvent should be injected thru a lubricator or upright nipple as near the well as possible. Large slugs of the solvent should be used. The amount used will depend on the size of the line, the length, and the amount of deposit. The solvent slugs should be forced through the line by cracking the valve at the well and letting gas force the solvent through, or by pumping oil in behind the solvent. The solvent should then come in contact with the paraffin at all points along the line. The longer the solvent can stay in contact with the paraffin, the better will be the results. A minimum of 24 hours should be allowed for a line 1500 feet long.

In cleaning a badly plugged line, use a small slug of solvent first to open the line gradually and prevent clogging. Then follow with a larger amount of solvent. In cleaning lead lines where large volumes are needed, mix 1 part of solvent with 3 parts of kerosene or white gasoline.

Quantities of Solvent Used

It is impossible to recommend any definite amount of solvent, as the length of the paraffin accumulation and its thickness will vary on nearly every well. It has been found, however, that wells which paraffin up every two weeks can be kept clean by using 1 to 2 gallons of solvent per week per well. The pumper on the lease can usually tell whether this amount can be increased or decreased by checking his pressure gauges for restriction. This is not an expensive operation when we consider that the average price for commercial paraffin solvent is about $2.25 per gallon. The additional expense of extra labor or tools is avoided also. Thus, solvents become a preventive measure in the elimination of more expensive work-over operations necessitated by the accumulation of paraffin deposits.

It should be noted that wells or flow lines that are completely plugged due to paraffin deposits, cannot be helped by use of solvent. In order for solvent to work on paraffin accumulations, they must be able to reach the paraffin and remain in contact with it for several hours. By treating wells and flow lines at regular intervals, serious plugging, requiring the use of excessive amounts of solvent, can be avoided.

Summary

In closing, I would like to call to your attention those things which will make paraffin control in pumping wells and flow lines a success. First, obtain a sample of paraffin from the well or flow line that is causing the trouble and test using different types of solvents. Next, apply the selected solvent by one of the above-discussed methods. After the solvent has been injected and left in contact with the paraffin deposit for the required shut-in time, it can be turned back to production. Finally, and this is very important, set up a regular treating schedule and follow it closely. If this procedure is followed it should, in most cases, eliminate further paraffin difficulties.