

1

2

3,172,473

METHOD OF IMPROVING WELL FLOW

Daniel L. Crowley, Forest Hill Gardens, Frank J. Smith, Scarsdale, and William J. Jennings, Brooklyn, N.Y., assignors to Crowley Tar Products Company, Inc., New York, N.Y., a corporation of New York
No Drawing. Filed June 28, 1962, Ser. No. 205,858
8 Claims. (Cl. 166—41)

This invention relates to a process of improving the production of oil and gas wells, particularly oil wells for the production of heavy asphaltic oils such as California crudes.

In this specification, all parts and percentages are given on a weight basis.

In many wells, the decline in the rate at which oil or gas or both is obtained is due to the formation of clogging deposits of asphaltic or other carbonaceous sludges on the pay formation, pumps, tubing, screens, strainers, lower casing walls and other parts of the well. To increase production, cleaning becomes necessary. Heretofore, cleaning has been accomplished by shutting down the well, removing the equipment and thereafter swabbing the casing and other parts requiring cleaning. Some of the equipment is cleaned by chemical means and usually a substantial portion of the equipment is replaced with new equipment.

The introduction of solvents such as hydrogenated aromatics, e.g., tetralin, gasoline, benzene, toluene, kerosene and cyclohexane, into the well for the purpose of removing clogging deposits has been proposed. Solvents heretofore used left much to be desired, particularly in the case of the unblocking or cleaning of wells containing asphaltic sludges which blocked or impaired flow.

It is a principal object of the present invention to provide a process of improving well flow by unblocking rock formations and/or cleaning well equipment such as casing pumps, screens, strainers, pipes and other parts of the well, which process effects increased flow from the well and does so with appreciably greater effectiveness than procedures heretofore employed involving the introduction of solvents, such as those hereinabove enumerated, into the well.

Other objects and advantages of this invention will be apparent from the following detailed description thereof.

In accordance with this invention, the well, including the equipment such as the pumps, strainers, well casing, conduits, storage tanks and other parts, is treated with an aromatic fraction having a boiling range of from 250° F. to 750° F., and containing at least 15% mixed alkyl naphthalenes having 1, 2 or 3 carbon atoms in the alkyl groups. The preferred fraction is that obtained by the fractional distillation of coal tar or aromatic petroleum fractions to produce a cut having an initial boiling point of 400° F., 50% of which boils off in the range of from 450° F. to 490° F. and 90% of which boils off in the range of from 510° F. to 560° F., which has a dry point within the range of 650° F. to 730° F., a total aromatic content of at least 90% and a content of mixed alkyl naphthalenes of at least 50% by weight. Instead of such fraction, a mono- or polyalkyl- naphthalene, or mixture thereof, in which the alkyl groups contain from 1 to 3 carbon atoms, can be used. As a practical matter, mixtures are used because mixtures of mono- and dialkyl-naphthalenes are readily available and the expense of isolating a particular isomer from the mixture could render the process economically unattractive, particularly since the mixture is effective to accomplish the unplugging and cleaning of the well. The expression "flow stimulant" is used herein to mean the aromatic fractions hereinabove

disclosed containing a minimum of 15% of an alkyl naphthalene or mixture of alkyl naphthalenes, preferably a minimum of 50%, as well as the various alkyl naphthalenes, particularly methyl and dimethyl naphthalene and mixtures thereof.

The invention is practiced by introducing the flow stimulant into the well, well casing, piping or other clogged parts thereof. The exact amount introduced is not critical as long as it is sufficient to effect removal of the clogging deposits. For example, the introduction of 20 barrels (each containing 42 gallons) or more into the well by pumping same therein, without interrupting the operation of the well, so that the flow stimulant passes through the casing, screens and other equipment at the base of the well, mixes with the crude in the well and the resultant mixture withdrawn from the well, invariably gives good results. If one such treatment does not give an adequate increase in flow rate, the repetition thereof one or more times will be found to be effective.

The flow stimulant is effective at atmospheric temperatures. It is more effective at higher temperatures such as usually exist at the bottom of the well. It can be used effectively at any temperature at which under the ambient pressure conditions it remains in the liquid phase.

Alternatively, from 50 to 300 barrels or more of the flow stimulant is pumped into the well after shutting off the well. The amount thus introduced should be sufficient to fill not only the casing but to force the flow stimulant into contact with the rock formation. The flow stimulant is permitted to remain within the well for a soaking period of one to three days' duration or longer. The well is then placed in operation again, whereupon the flow stimulant along with the crude is pumped from the well.

Clogged equipment containing sludges of asphaltic character and other clogging material can be cleaned readily by bringing the clogged portion of the equipment or the entire equipment where feasible into contact with the flow stimulant to give the flow stimulant the opportunity to contact the clogging material and condition it for removal along with the flow stimulant when the latter is removed.

The action of the flow stimulant is not that of solvency alone. The flow stimulant not only has a solvent action but also a mixing, agitation and dispersion effect on the sludges, wax, asphaltene and other clogging deposits, which action is unique and contributes markedly to the effectiveness of the flow stimulant. Surprisingly, when the flow stimulant is mixed with sludges, an action occurs, which action can aptly be characterized as internal mixing, agitation and spontaneous dispersion of the sludges within the liquid phase of the flow stimulant. Strangely, the mere contact of the sludges with the liquid flow stimulant causes self-agitation and spontaneous dispersion of such sludges within the liquid flow stimulant. Thus, the solvent action of the flow stimulant is augmented, and in the case of sludges which are partially or sparingly soluble in the flow stimulant, they are effectively dispersed in the liquid flow stimulant and removed from the well formation and equipment when the flow stimulant is removed, say upon being pumped from the well or upon resumption of flow from the well.

Why the flow stimulant exercises the above described phenomena of internal mixing, agitation and dispersion of the sludges and other clogging deposits therein is not fully understood. Mixing of the flow stimulant with sludges, waxes and asphaltene materials generally, demonstrates that such materials are simultaneously dissolved and suspended or dispersed in the liquid flow stimulant and this action is vigorous, spontaneous and evident even under visual observation. On the other hand, mixing of the same deposits under the same conditions with

xylene or other aromatic solvents such as toluene or benzene, known to be excellent solvents for such sludges, does not show similar internal mixing, agitation and dispersion phenomena.

One explanation, advanced to facilitate a better understanding of this invention, to which explanation, however, the invention is not limited, is that the internal mixing, agitation and spontaneous dispersion which takes place when the sludges are brought into contact with the flow stimulant and does not take place when such sludges are brought into contact with available solvents such as xylene, is that the different inter-facial forces which exist between alkyl naphthalenes or fractions containing same and the sludges on the one hand and between solvents such as xylene and such sludges, on the other hand, is responsible for the differences in behavior.

The flow stimulant works best in effecting the removal of sludges and other clogging materials which are lighter than the flow stimulant, so that the sludges tend to float on the body of the flow stimulant introduced into the well. When the sludges come in contact with the flow stimulant, a small portion dissolves, thus creating a local region of high sludge concentration. Inter-facial tension or surface tension differences come into play to relieve this concentration, moving the high concentration centers away from the mass of sludge. With the sludge floating on the surface of the liquid flow stimulant, the high concentration centers are relieved in at least two ways. First, by the forces which tend to move the high concentration material away from the main body of the sludge. Secondly, since the sludge is floating, it is free to move over the surface of the body of flow stimulant. This it does vigorously, as the result of the forces which tend to move portions of the high concentration of sludge away from the main body of sludge. In thus moving away from the main body, fresh portions of the main body are exposed to the action of the flow stimulant as are also the portions which move away. Moreover, in that the sludges float, the maximum surface area thereof is exposed to the action of the liquid flow stimulant.

Where the flow stimulant is used with sludges or other clogging deposits which are heavier than the flow stimulant, such sludges sink to the bottom of the body of flow stimulant. Currents are immediately set in motion in the body of flow stimulant, which is evidenced by vigorously moving dark-colored "tails" darting out in all directions. These "tails" are portions of the sludge passing into solution or suspension in the flow stimulant, is evidenced by the rapid disappearance of the sludge in the main body of the liquid flow stimulant.

The following example is given to illustrate the practice of the invention; it will be understood the invention is not limited to this example;

An oil well producing a heavy asphaltic California crude which had reached a relatively low rate production was shut down and 250 barrels of an alkyl naphthalene fraction consisting essentially of monomethyl and dimethyl naphthalenes having the following specifications,

A.P.I. gravity	5-15.
Total aromatic content	90% minimum.
Total mixed alkyl naphthalenes	50% minimum.
Boiling range:	
IBP	400° F.
50%	450°-490°.
90%	510°-560°.
Dry point	650°-730°.
Viscosity SSU at 100° F.	45 maximum.

were pumped into the well, filling the well casing and the surrounding rock formation. The alkyl naphthalene fraction was left in the well for 48 hours and thereafter pumping was again started to remove the well contents. Upon removal of the alkyl naphthalene fraction, the flow of oil took place at an increased rate, approaching the original

rate of production and several times the reduced rate when the well had been shut down for cleaning.

Conventional additives such as wetting agents, emulsifying agents, anticorrosive agents and the like, can be incorporated in or admixed with the flow stimulant.

It will be noted that the present invention provides a process of improving well flow by unplugging rock formations and/or cleaning the well equipment including piping, casing, strainers, storage tanks, etc. and does so with appreciably greater effectiveness than heretofore known solvent procedures employed in the cleaning of wells.

While the invention has been described and explained with particular reference to oil wells, it is to be understood that it is not limited to such specific use but can be used in the cleaning and improving flow of gas wells, removal of sludges from pipe lines, storage tanks and other equipment in which sludges and other objectionable deposits form.

The invention is not to be limited to the present description except as defined by the appended claims.

What is claimed is:

1. The method of treating a well to facilitate the production thereof, the step which comprises introducing into the well bore a liquid aromatic fraction containing at least 15% alkyl naphthalene, in which the alkyl group contains from 1 to 3 carbon atoms, maintaining said liquid aromatic fraction in the well in contact with solid material which tends to block flow from the well until such solid material is dispersed in said liquid aromatic fraction, and thereafter withdrawing the dispersion thus produced.

2. The method of treating a well to facilitate the production thereof, the step which comprises introducing into the well bore a liquid aromatic fraction containing at least 50% of a mixture of alkyl naphthalenes, in which the alkyl group contains from 1 to 3 carbon atoms, said fraction having an initial boiling point of about 400° F., about 50% of which boils off within the range of 450° F. to 490° F., about 90% of which boils off within the range of 510° F. to 560° F., and having a dry point within the range of 650° F. to 730° F., maintaining said liquid aromatic fraction in the well in contact with solid material which tends to block flow from the well until such solid material is dispersed in said liquid aromatic fraction, and thereafter withdrawing the dispersion thus produced.

3. The method of treating a well to facilitate the production thereof, the step which comprises introducing into the blocked portion of the well an alkyl naphthalene, in which the alkyl group contains from 1 to 3 carbon atoms, in the liquid phase, maintaining the liquid alkyl naphthalene in contact with the blocked portion of the well to effect dispersion in the liquid alkyl naphthalene of material which causes the blocking of flow from the well, and thereafter removing the dispersion thus produced from the well.

4. The method of treating a well to facilitate the production thereof, the step which comprises introducing into the blocked portion of the well an alkyl naphthalene consisting essentially of monomethyl and dimethyl naphthalene in the liquid phase, maintaining the liquid alkyl naphthalene in contact with the blocked portion of the well to effect dispersion in the liquid alkyl naphthalene of material which causes the blocking of flow from the well, and thereafter removing the dispersion thus produced from the well.

5. The method of cleaning well conduits, pipe lines, storage tanks, and the like, containing objectionable carbonaceous deposits, which comprises introducing into contact with said deposits a liquid aromatic fraction containing at least 15% alkyl naphthalene, in which the alkyl group contains from 1 to 3 carbon atoms to effect the dispersal of the deposits into said aromatic fraction, and thereafter removing the liquid aromatic fraction containing the dispersed deposits from the locality of said deposits to effect said cleaning.

5

6

6. The method of cleaning well conduits, pipe lines, storage tanks and the like containing objectionable carbonaceous deposits, which comprises introducing thereinto a liquid aromatic fraction containing at least 50% of a mixture of alkyl naphthalenes, in which the alkyl group contains from 1 to 3 carbon atoms, said fraction having an initial boiling point of about 400° F., about 50% of which boils off within the range of 450° F. to 490° F., about 90% of which boils off within the range of 510° F. to 560° F., and having a dry point within the range of 650° F. to 730° F., maintaining said liquid aromatic fraction in contact with said objectionable carbonaceous deposits until they are dispersed in said liquid aromatic fraction, and thereafter removing the liquid aromatic fraction containing the dispersed deposits.

7. The method of removing objectionable carbonaceous deposits from well conduits, pipe lines, storage tanks and like confined areas, which comprises introducing into said confined areas an alkyl naphthalene, in which the alkyl group contains from 1 to 3 carbon atoms, in the liquid

phase to effect dispersal of said carbonaceous deposits in said alkyl naphthalene and removing the said alkyl naphthalene containing said deposits from said confined area.

5 8. The method of removing objectionable carbonaceous deposits from well conduits, pipe lines, storage tanks and like confined areas, which comprises introducing into said confined areas an alkyl naphthalene consisting essentially of monomethyl and dimethyl naphthalene in the liquid phase to effect dispersal of said carbonaceous deposits in said alkyl naphthalene and removing the said alkyl naphthalene containing said deposits from said confined area.

15

References Cited in the file of this patent

UNITED STATES PATENTS

2,139,595	Lerch	Dec. 6, 1938
2,240,964	Tijmstra	May 6, 1941
2,403,972	Friedman	July 16, 1946
2,711,392	Irwin	June 21, 1955

20