Patented Mar. 30, 1948 2,438,682

UNITED STATES PATENT OFFICE

2,438,682

METHOD AND MATERIALS FOR CLEANING OIL WELLS AND EQUIPMENT

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No Drawing. Application August 7, 1945, Serial No. 609,491

6 Claims. (Cl. 252—8.55)

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This invention has to do with method and materials for cleaning oil wells and oil producing equipment. Specifically it is concerned with the removal of deposits and accumulations of mineral wax, paraffin and asphalt from oil bearing rocks and sands at the horizon in the earth's crust from which crude petroleum is produced, and the removal of such accumulations in pipes, tanks and oil producing apparatus generally, including pumps and oil well equipment. The employment of the cleaning method and materials results in the dispersal of solid and semi-solid accumulations of paraffin and asphalt in such manner that they are suspended and/or dissolved in the crude oil to the extent that they no longer form objectionable deposits; and the oil, of which they become a part upon dispersal, may be easily extracted from the earth, caused to flow through pipes and pumping apparatus and be discharged into storage tanks and pipe lines without a recurrence of the undesirable accumulations.

In the recovery of crude petroleum from strata of the earth in which the oil is found, such as from formations of sand and/or of rock, it has been a common experience to find that a productive oil well will cease to yield oil in commercial quantities after a period of time because the interstices, voids and openings within the oil bearing formations become blocked and clogged with paraffin and/or asphalt, so that in numberless cases the oil wells have been abandoned.

Ordinary methods used in attempts to clean out the formerly productive strata have, for the most part, been quite unsatisfactory. In some instances the heat of steam, piped to the oil producing strata below the earth's surface, has been used to melt solid deposits of the paraffin and asphalt and allow them to be discharged through the tubing of the oil well. However, such deposits usually solidify again in the pipes and tanks through which they are conducted or in which they are stored above ground; and this is a common occurrence, especially in cold weather. Electrical heating equipment has been tried, and with much the same results. Either method is considered altogether too expensive for successful commercial use.

Further attempts have been made to treat the oil bearing formations with acid in order to cause the oil to flow again. Such treatment has little or no effect on sand formations, because acid does not react favorably on compounds of silica. The paraffin present inhibits the action of the acid, and in some cases nullifies it altogether.

Slightly better results were had in treating limestone formations with acid. But, again, the presence of paraffin severely limited the effectiveness of such treatment.

Cutting and scraping tools have been resorted to to remove paraffin from oil well tubing, casing

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and flow lines. Usually this requires the disconnection of every length of pipe; and it is quite expensive and slow. Obviously the oil bearing formations below the earth's surface cannot be cleaned successfully with any such mechanical devices.

Asphalt or petroleum tar has been found even more tenacious and difficult to remove than paraffin, being heavier bodied and often found in hard and incrusted deposits.

When paraffin and/or asphalt accumulates in the bottom of large oil storage tanks, it frequently gets so thick and heavy that a large percentage of the oil produced is thus wasted, thickened deposits being unfit for delivery into pipe lines.

Pumps, oil lifting and delivery apparatus, sucker rods, and all paraphernalia used for lifting and delivering oil frequently get so fouled up that all of this equipment has to be taken down, disassembled and laboriously cleaned by hand before it can be further used.

In short, the occurrence of undesirable deposits of paraffin and asphalt in the production of oil, beginning in the oil bearing formations of the earth and continuing through every stage of production, storage and delivery until the oil reaches the pipe lines for transportation, presents a problem of major importance and of great cost and expense in the recovery of oil. Method and means for solving this problem chemically, and of eliminating excessively expensive heat treatments and ineffectual scraping operations and much manual effort, are of great value in the petroleum industry.

The primary object of this invention and discovery is to clean and remove and dissolve excess deposits and unwanted accumulations of paraffin and asphalt from oil wells, from exposed surfaces of oil bearing formations of the earth, from pipes and casing and tubing from oil pumping and lifting apparatus, and from flow lines and storage tanks.

An object of primary importance is to change the ordinarily insoluble paraffin and asphalt deposits into free flowing fluids, readily miscible with crude petroleum to the extent that they become a part thereof.

A further object is to cause paraffin and asphalt to be again dissolved in live crude oil so that it may be lifted, stored and transported, remaining in solution in the oil all the while.

A further object is to promptly cause deposits and accumulations of paraffin and asphalt to be so suspended in crude oil that they may be readily pumped and piped with the oil without thereafter forming objectionable deposits.

An object of major importance is to effect the foregoing objects through chemical action and

without the use of applied heat and without manual labor.

The method which I employ to effect the foregoing objects is that in which a chemical preparation, which I have compounded, is introduced into the oil wells, pipes, pumps, apparatus, storage tanks, and other equipment used in the production, piping, pumping and storing of crude oil, to free and suspend and dissolve the paraffin and asphalt deposited therein so that it may readily flow away with the oil.

I practice this method by introducing a few gallons of my compound into the top of oil well casing or tubing, then allowing chemical reaction to occur and continue for a period of several hours, usually over night. Pump rods which cannot be moved within oil well tubing because of the presence of paraffin and/or asphalt adhering tenaciously to the rods and tubing will be found free and capable of movement after the treatment has continued for a few hours. Then by adding more of the chemical preparation and starting the pump to operate, I cause the discharge of these undesirable accumulations through a valve at the top of the casing or tubing, allowing the first deposits removed to be discharged on the surface of the ground around the oil well.

After pumping operations have continued for a brief period, the discharge becomes so liquefied that it may be safely turned into the flow lines and discharged into the storage tank.

If the tank already has an excessive accumulation of these deposits, they may be liquefied by introducing a quantity of the preparation into the tank. The incoming fresh oil from the well is mixed and reacts with the chemical to suspend and eventually dissolve the paraffin and asphalt.

Thus, by treating the oil well itself and the flow lines and tanks with the chemical compound they are all freed from the undesirable deposits of paraffin and asphalt therein; and they are rendered clean and capable of normal use without obstruction.

By use of this method the solids of petroleum are made fluid and dissolved in the normal petroleum liquid to such an extent that the crude oil into which they are returned will be freely admitted to the pipe lines as commercial crude oil. Thus, these solids are no longer waste materials, expensive to eliminate. They are translated again into their original state as component parts of saleable oil, at great profit and advantage. What was once a problem and expense is made an asset and a matter of profit by the employment of the method and materials here disclosed.

The chemical compound used is non-inflammable; and it does no injury or damage to the casing, tubing, rods, pumps, pipes or tanks. They are all rendered clean, and their surfaces are freed from these undesirable accumulations; and there is no harmful effect on the metallic surfaces of the equipment treated.

My method requires the use of fresh or free flowing crude oil to be mixed together with the chemical compound to create an effective agent for detaching the solid deposits of petroleum and dissolving them.

The crude petroleum may be introduced by pouring or pumping it into the vessel to be cleaned or into a conduit leading to the surfaces to be cleaned. The petroleum may be supplied before or after the other ingredients used have been applied to the surfaces or substances to be treated. When petroleum already occurs, as in an oil well, flow lines, pipes, tanks and equipment, then the chemicals are simply poured into the liquid petroleum. The cleaning and dissolving action begins at once.

The chemical compound, which I have prepared, is made by mixing one or more of the basic hydroxides of the metals of greater activity in the "electromotive series," such as those of sodium and/or potassium, in aqueous solution, together with one or more chemicals of the benzene ring, such as phenol, cresol or naphthol. I use only chemicals of the benzene ring, which may be created by the displacement of an original hydrogen atom with the hydroxyl radical. These are phenols, considered as a class. They are hydroxy derivatives of aromatic hydrocarbons. They are hydroxyl compounds, or phenols, in the broad sense of the latter word.

Of the metallic hydroxides I use only those of the more common metals which are most active in the "electromotive series," in their ability to liberate hydrogen from acid containing it. Of these I have found that those of sodium and potassium are the most active; and they are quite effective as components of this compound.

It is rather more effective to use a strong solution of metallic hydroxide, although that is a matter of convenience. Likewise, the strength of the phenol or hydroxyl compound used is a matter of convenience, the stronger preparation being found more quickly effective. Of course, the stronger solutions require less bulk in shipping. They may be further diluted on the job, after delivery, then used in such strength as the operator finds effective to suit his needs.

The metallic hydroxide may be procured in concentrated commercial form; and to this should be added enough water to dissolve it. The compound is then added to the solution. They both are dissolved.

Either of the hydroxides named may be used in the preparation, or both may be used together. I prefer the combination. I have found that potassium hydroxide is more effective in cleaning the exposed surfaces of limestone formations from which oil is being produced; and sodium hydroxide is more effective on sand formations. As a commercial preparation for general use, I employ about equal parts of these hydroxides; but these proportions may be varied to suit conditions as they are found.

If all of the hydroxide is not readily dissolved in the quantity of water added, it may be more quickly dissolved by heating the mixture. Or it may be readily dissolved by adding the hydroxyl compound, there being a chemical heat from the reaction which hastens the making of the solution.

Any one of the three hydroxyl compounds named may be used in the mixture; or two or three of them may be used together in the mixture. When two or more are used together, the proportion between them is not very important.

The important thing is to use one or both of the hydroxides with one or more of the phenols or hydroxyl compounds; and the most desirable proportion by weight is two parts of hydroxide to one part of the latter; and in determining proportions the weight of the water added is not taken into account.

However, the proportions may vary. For instance, the mixture of the chemicals, each in concentrated commercial form, may employ from

10% to 90% of hydroxide and from 10% to 90% of hydroxyl compound or phenol.

For the purpose of defining the two hydroxides named, as a class, it will be noted that the molecular weight of sodium hydroxide is generally accepted as being approximately 40, and that of potassium hydroxide as 56. There appears to be only two more active metals in the "electromotive series" than potassium and sodium; and these are lithium, the hydroxide of which has a molecular weight of 24, and rubidium, the hydroxide of which has a molecular weight of 102.

Therefore, it may be said that, of the "electromotive" metals more active than hydrogen, there will be used in this compound only such hydroxides, of said metals, that have a molecular weight between 39 and 57.

In speaking of phenol when used in this specification it is intended to comprehend its broadest sense, meaning to include the phenols as a class (the hydroxy derivatives of benzene, naphthalene and other aromatic hydrocarbons).

In speaking of a mixture as consisting essentially of certain substances, I mean that it is necessary to have these substances in the mixture and that they are essential thereto and that the mixture is essentially these substances; but I do not intend to exclude minor amounts of other ingredients which have no effect in producing the ultimate objects of the use of the mixture or of the method employing it. Inert materials, coloring, odors and non-essential substances may also be present in my mixture.

The method here delineated and the materials here disclosed have been found very effective in greatly increasing the recovery of petroleum from oil wells which have become congested with solid and semi-solid deposits from petroleum. Wax, paraffin, asphalt and tar are the great offenders; and through my invention and discovery these may be liquefied so that they will again flow with the oil and become a part thereof. A great economic loss of petroleum products is prevented.

Conduits and oil producing and storing and transporting equipment are cleaned and rendered free of obstructions and kept so. Waste is eliminated. A great saving of time, labor, and expense results from the employment of my discovery; and oil field materials, machinery and equipment are given longer life through its use.

I claim:

1. The method of liquefying solids deposited from petroleum, in which said deposits are treated with a mixture consisting essentially of a chemical selected from the group consisting of sodium hydroxide and potassium hydroxide, said chemical representing from 10% to 90% of the mixture, a phenol representing from 90% to 10% of the mixture, and sufficient water to dissolve the mixture, said treatment being accomplished in the presence of crude oil.

2. The method of dissolving the solids of paraffin and asphalt deposited from petroleum and re-introducing said dissolved materials into stable union with crude petroleum, which consists of the treatment of such solids by a mixture consisting essentially of a substance selected from the group consisting of sodium hydroxide and potassium hydroxide, said substance representing from 10% to 90% of the mixture, and a phenol representing from 90% to 10% of the mixture, and sufficient water to dissolve the mixture, such treatment being made in the presence of crude oil and continuing until said solids are dissolved.

3. The method of removing paraffin and asphalt deposited from petroleum by treating such deposits with a mixture consisting essentially of a substance selected from the group consisting of sodium hydroxide and potassium hydroxide, said substance representing from 10% to 90% of said mixture, a phenol representing from 90% to 10% of said mixture, and sufficient water to dissolve the mixture, said treatment being made in the presence of crude oil.

4. The method of dissolving and recapturing solids deposited from petroleum by treating them with a mixture consisting essentially of a substance selected from the group consisting of sodium hydroxide and potassium hydroxide, said substance amounting to from 10% to 90% of the mixture, a phenol amounting to from 90% to 10% of the mixture, and sufficient water to dissolve the mixture, said treatment being carried on in the presence of crude oil until said solids are dissolved therein.

5. The method of dissolving and recovering solids deposited from petroleum by treating them with a mixture consisting essentially of a substance selected from the group consisting of sodium hydroxide and potassium hydroxide, said substance representing from 10% to 90% of the mixture, cresol representing from 90% to 10% of the mixture, and sufficient water to dissolve the mixture, said treatment being carried on in the presence of crude oil until said solids are dissolved therein.

6. The method of dissolving and recovering solids deposited from petroleum by treating them with a mixture consisting essentially of a substance selected from the group consisting of sodium hydroxide and potassium hydroxide, said substance representing from 10% to 90% of the mixture, naphthol representing from 90% to 10% of the mixture, and sufficient water to dissolve the mixture, said treatment being carried on in the presence of crude oil until said solids are dissolved therein.

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