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REMOVAL OF WATER BLOCKS FROM OIL AND GAS WELLS

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This invention relates to a process for removing a water block around a hydrocarbon-producing well.

In the production of oil and gas from a producing well in a hydrocarbon-bearing stratum, the zone around the well bore sometimes develops a condition of reduced permeability which results in a decrease in production of hydrocarbon from the well. One cause of this reduced permeability is the accumulation of water in the producing formation in the region adjacent the well bore. This water accumulation, conventionally designated "water block," may be due to injected water, as from drilling or workover operations or to interstitial water gradually appearing around the well bore. One method commonly proposed for the removal of such a water block comprises injecting into the blocked stratum a water-miscible solvent, with or without certain additives, to effect solubilization and displacement of the water. However, this method is rather ineffective in most instances in view of the fact that the proposed technique displaces the water in the water block deeper into the formation. Later when production is resumed the water returns to block the well again.

This invention is concerned with a method of effectively overcoming the water block problem.

Accordingly it is an object of the invention to provide an effective process for removing a water block around a hydrocarbon-producing well. Another object is to provide a process which alleviates water block and which increases the production of hydrocarbons from a well. Other objects of the invention will become apparent upon consideration of the accompanying disclosure.

A broad aspect of the invention comprises fracturing the hydrocarbon-bearing stratum around a production well bore with a water-miscible liquid solvent without a propping agent in the fracturing fluid by injecting the fracturing fluid into the well at sufficient pressure within the stratum to be fractured so as to effect partition and fracturing of the stratum and injection of the fracturing fluid solvent into the stratum beyond the water block so that the solvent spreads into the porous stratum behind the water in the block, whereupon the injection pressure is reduced so that the fracture(s) closes and traps the solvent in the stratum behind the water block. The well is then opened to production so that the fluid pressure toward the producing well, with the aid of the solvent, flushes the water into the well and same is recovered in the produced fluids, thereby eliminating or at least alleviating the detrimental effect of the water block. Once the fracture is closed, the solvent is unable to return through the closed fracture and the resumption of hydrocarbon production causes the solvent to be forced toward the well bore through other portions of the water-blocked formation, thereby displacing the water into the well and thus removing the water block.

Water-miscible solvents suitable for use in the process include ketones such as acetone, methyl ethyl ketone, methyl propyl ketone, diethyl ketone, etc.; alcohols such as ethanol, methanol, n-propyl alcohol, isopropyl alcohol, n-butyl alcohol, secondary-butyl alcohol; ethers, particularly cyclic ethers, dioxane, tetramethylene oxide, furan, etc.; ether alcohols, such as methyl Cellosolve, Cellosolve, isopropyl Cellosolve, the carbitols, etc.; and esters such as butyl acetate, glycol diacetate, carbitol acetates, and Cellosolve acetates. Most of the foregoing solvents are both oil and water soluble and have a favorable effect on the stratum containing water and oil. Other solvents conventionally used in the art are operable in the process. The injected solvent may also contain surfactants or wetting agents in small concentration such as about one weight percent of the solvent, more or less than this amount being useful. Any well known surfactants or wetting agents may be utilized such as the amines, trimethylamine or triethanolamine; esters including naphthalene sulphonic ester, oleic acid sulphate, oleo glyceryl sulphate; sulphonated oils such as sulphonated castor oil; or alkyl sulphates such as those commercially known as Gardinols. Other sulphates or wetting agents may also be used in the process.

In some applications of the process, the solvent may be treated with a gelling agent so that fracturing can be achieved at relatively low pumping rates. Any conventional gelling agent for use in fracturing fluids conventional in the art are applicable. Commonly utilized gelling agents include fatty acid soaps such as sodium stearate and sodium oleate. When using a gelling agent only an initial slug of the solvent containing the gelling agent is injected to initiate the fracturing after which the injected solvent free of gelling agent follows the gelled solvent to the stratum.

It is also feasible to dilute the solvent with a less expensive solvent such as kerosene. The injection of a mixture of kerosene and watermiscible solvent is less expensive and the kerosene additive has a beneficial effect in flushing hydrocarbons from the stratum when production is resumed. Other light hydrocarbons may be utilized in lieu of or in admixture with kerosene. The hydrocarbon portion of the injected fluid should be in the range of about 10 to 60 percent of the injected fluid.

The amount of solvent to be injected depends upon the extent of the water block outward radially from the well bore and vertically in the stratum. The amount used is generally in the range of 1 to 10 percent of the pore volume occupied by the water block. In any case sufficient solvent should be injected to occupy an annular zone along the outward fringe of the water block and this annular zone should have a radial depth of at least 6 inches to a foot or more.

Certain modifications of the invention will become apparent to those skilled in the art and the illustrative details disclosed are not to be construed as imposing unnecessary limitations on the invention.

I claim:

1. A process for removing water block around a producing well in a hydrocarbon-bearing stratum and producing hydrocarbons from said well, comprising the steps of:

(1) fracturing said stratum outwardly from said well by injecting a water-miscible solvent free of propping agent into said stratum at fracturing pressure so as to fracture said stratum to an area behind said water block;

(2) continuing injection of said solvent thru the fracture resulting from step (1) so as to deposit a substantial pore volume of same in the permeable stratum behind said water block;

(3) thereafter, reducing the injection pressure so as to allow the formed fractures to close and trap said

solvent in the stratum behind said water block; and

(4) thereafter, opening said well to production and producing hydrocarbons therefrom so as to cause said solvent to flush water of said block into said well.

2. The process of claim 1 wherein a normally liquid hydrocarbon is mixed with said solvent.

3. The process of claim 1 wherein a slug of gelled solvent is injected followed by injection of ungelled solvent.

4. The process of claim 1 wherein a surfactant is incorporated in said solvent.

5. The process of claim 1 wherein kerosene is admixed with said solvent.

6. The process of claim 1 wherein said solvent is an alcohol of 1 to 4 carbon atoms.

7. The process of claim 1 wherein said solvent is a ketone.

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