Operational Problems in West Texas Water Floods

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ABSTRACT

This paper is presented to clarify a few of the general problems encountered in water flood operations. The production personnel are responsible for the production of the water supply wells, operation of a water plant and distribution system, and supervision of water injection wells. These duties are in addition to their usual occupation - that of operating production wells. Consequently, it is necessary to educate the operators for their double responsibilities.

INTRODUCTION

The principal formation under flood in the Permian Basin is the Yates sand, of Permian age. This formation varies from a clean to a shaly sand and ranges in depth from 3300 feet in the northern area to 1300 feet in the southern portion. The Queen sand, also of Permian age, is being flooded in several areas.

After water injection has commenced, it is imperative that continuous operation be maintained. All critical spare parts for the water plant, water supply wells, producing and injection wells should be readily available as downtime can be very costly. For example, should the pump in the water supply well fail the plant would be down, due to a lack of water, and the injection wells would not receive water. It is undesirable to have excessive storage capacity at the plant, as this increases the possibility of bacteria growth or other harmful effects. If the downtime is prolonged, the oil production is noticeably decreased and in some instances this decrease has been permanent. Also, during the early stages of flooding, many injection wells will go on vacuum when the plant shuts down and there is a possibility that the well formations will cave or slough-in, thereby shutting off further injection when operation is resumed.

WATER SUPPLY WELLS

The first, and perhaps largest, problem has been the location and development of an adequate water supply. Where available, we prefer to use the fresh to brackish water found in the shallow sands and gravels. This water is generally easier to treat and inject. In these shallow wells, our practice has been to drill a 20 inch hole, run 10 3/4 inch OD casing, slotted opposite the water sands, and gravel pack the annulus to the surface. Several floods are utilizing the Rustler formation for injection purposes. This water has a high saline content and usually contains hydrogen sulfide. It is extremely corrosive unless properly treated and handled.

Construction of a Rustler water well consists of setting 8 5/8 inch OD or 10 3/4 inch OD casing on top of the pay, drill in and acidize. It is advisable to run an all bronze pump with plastic coated column pipe and shafting in the Rustler water wells.

A standby water supply well is a prime requirement for good operations. Occasionally it is necessary to work over the water well or the equipment and a standby well is necessary to prevent shutting down the plant.

WATER PLANT

The two principal functions of a water plant are to treat or condition the raw water and to furnish water at sufficient pressure for injection.

Treatment of the water generally consists of filtration for removal of suspended solids and addition of chemicals for corrosion and bacterial control. In filtration, it is necessary that the filter media be cleaned or backwashed at sufficient intervals to maintain a satisfactory flow rate. In addition, the filters should be frequently inspected for channeling or plugging. Regarding the chemical treatment, recommendations of the water analyst should be diligently followed.

Considerable difficulty in plant operations has been encountered in the injection pumps. The best way to overcome this problem is to install the best possible pump at the start of the flood.

From our experience, we would recommend that an injection pump be equipped with an aluminum-bronze fluid end, ceramic plungers, and stainless steel or monel valves and seats. This installation should require a minimum of replacements and repairs. As with all continuously operated equipment, constant observation as to proper lubrication and packing is necessary.

WATER INJECTION SYSTEM

If properly designed and installed, the injection system should present a minimum of problems. We prefer to lay a trunk line from the plant across the project with lateral lines to the well. This type system reduces the amount of lines to maintain and is more efficient for metering the amount of water injected into each well. The lines should be large enough to handle the necessary water volume and of sufficient strength to withstand maximum expected pressures. For combatting internal corrosion, the pipe should be cement lined or plastic coated. External corrosion should be controlled by coating with tar or using similar protection. In addition, all lines should be buried at a depth sufficient to prevent freezing.

WATER INJECTION WELLS

Our recommendation for injection well completion

is to set casing on top of the pay, drill in open hole, shoot the pay zone with nitroglycerine and clean out with cable tools. The well is equipped with tubing set approximately one foot off bottom. This tubing is used for backwashing the well to maintain a clean hole to bottom. The most common problem in the injection wells is that of decreasing injection rates caused by plugging. This plugging is due, in the main, to corrosion products or solids suspended in the water. This problem can be corrected by acidizing, fracturing or reshooting. Another problem is that of casing corrosion with leaks developing that permit the loss of water to a thief zone or allow it to recirculate to the surface. To repair this condition, run a string of cement lined or plastic coated tubing, equipped with a tension operated packer, and set in the casing below the leak.

PRODUCTION WELLS

Completion of the producing wells is the same as that of injection wells. The wells are equipped with tubing and rods with the perforations set as low as is practical. In some instances the perforations have been set in the bottom of the shot hole and in other instances it is necessary to set them at the top, depending mainly on the hole condition. For maximum production, the wells are pumped continuously maintaining a slight "fluid pound". Pumping constantly, in addition to maintaining low fluid levels, reduces the chances of sanding up the subsurface equipment.

Another production problem is the formation or deposition of scale calcium carbonate and calcium sulfate on the pumping equipment and the well bore. Treatment, by the addition of chemicals down the casing annulus, is generally satisfactory for preventing the deposition on the pumping equipment. However, it is recommended that the equipment be checked and cleaned periodically. It is doubtful that chemicals can maintain a clean well bore and it may be necessary to fracture treat or reshoot the well to remove scale formations.

LEASE EQUIPMENT

A water flood tank battery consists of a gunbarrel, test tank, and the necessary storage tanks. All the producing wells have individual flow lines to the battery. The wells are tested as often as possible, and it is recommended that each well be tested weekly for both water and oil production. The oil treats out very well by the addition of chemical and passing through a gunbarrel. Occasionally, it is necessary to treat with heat. Produced water, a growing problem, is disposed of in evaporative pits or injected into disposal wells. In some instances the water has been reinjected, but this requires considerable treating skill and equipment.

CONCLUSION

There are many other problems occuring in water flood operations. For successful water flood operations the operating personnel should be properly trained and educated to care for the equipment and to maintain continuous operations. A large portion of the problems can be eliminated by sound engineering prior to installation.