Plan For Salt Water Disposal

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During the past decade both industry and government have become more aware of the importance of fresh water and of the need to protect fresh water supplies from pollution. This awareness has been demonstrated most recently to the oil industry with the issuance of "no pit" orders by the Railroad Commission of Texas and the New Mexico Oil Conservation Commission. These orders prohibit surface disposal of oil field waters in most areas of West Texas and Southeastern New Mexico.

Thus, salt water disposal has become an integral part of the planning and cost of lease operation for the industry. Since salt water disposal is an added expense for lease operations, it is essential that these facilities be properly designed, installed and maintained so as to keep the costs reasonable. Generally the less complicated the installation and operation of a system, the more economical the cost of operation.

A salt water disposal system may logically be separated into three components, i.e., disposal well, accumulation facilities and gathering lines. The cooperative system to serve an entire pool provides for the most efficient handling of salt water. The remarks to follow will be somewhat oriented toward larger volume systems; however, most of the material will apply to small systems as well as to the larger volume system.

The disposal well is the "heart" of the system and will be given first consideration. Disposal wells are obtained either by recompleting an abandoned oil well or by drilling a new well specifically for disposal. It is usually more desirable to utilize an abandoned oil well that has casing already cemented, since this is a major portion of the cost involved in the completion of any well. However, there are certain disadvantages to using an abandoned well which are (1) the expense of drilling deeper is frequently almost as great as the cost to drill a new well; (2) the casing is often too small to accommodate tubing large enough to furnish adequate capacity and; (3) many times, the well is not satisfactorily located with respect to the topography of the area.

In selecting the well location, both the topography and the geology should be considered. Where possible, the disposal well should be located topographically so that all water being gathered will flow by gravity to the disposal well. Geologically, the well should have sufficient formation available to assure disposal. Where large volumes of water are being produced, the formation should have the characteristics required for good disposal.

As soon as possible after the completion of the well, an accurate injection test should be taken to determine whether or not the well has sufficient capacity to justify installing the gathering system as designed. If the well will not handle the ultimate water production, the design should be altered to connect only the leases which can be properly handled.

Because of the corrosive nature of most oil field waters, the disposal well should be tubed with a corrosion-resistant material. Steel tubing lined with cement, plastic coatings or extruded plastic tubes can be used. Some glass-fiber reinforced plastic tubing is used where depths and pressures permit. Where stimulation will be necessary to maintain high injection rates and low pressures, it is generally better to use the plastic linings which are resistant to acids.

Experience has shown that packers are subject to corrosion and are only necessary on low fluid level wells. The outside of the tubing and the inside of the casing can be protected with oil. This is done by balancing a column of oil in the annulus against the water in the tubing. The gravity of the oil to be used will depend upon the setting depth of the tubing, the static water fluid level and the specific gravity of the water. This method not only protects the well equipment but provides a casing-head pressure which is very valuable in determining the condition of the disposal formation. Any change in well conditions is reflected by the casing pres-

sure. Once the casing pressure has been established for a given rate, any increase in pressure for that same rate means the formation is becoming plugged; and any decrease in pressure for the same rate means more head is being lost to friction in the tubing or the formation capacity is increasing. A sudden loss of pressure would indicate a tubing or casing leak.

Accumulation or terminal facilities should be installed at the disposal well location to provide for the settling of suspended solids and the accumulation of oil, to allow for fluctuations in production and to permit periodic testing of the well. If sufficient tank capacity is provided and the flow properly dispersed and slowed, no other terminal equipment may be required.

Redwood tanks have proven to be best suited for accumulation tanks since wood is noncorrosive. Steel tanks can be used but should be lined. Tank fittings made of asbestos cement material have given excellent service. This includes inlet spreaders which are used to reverse and slow the flow as the water enters the tank, the tank outlet boot or siphon that prevents oil and floating solids from entering the well and the tank float which controls the fluid level in the tank by operating a dump handle valve. Where pressure injection is necessary, electrical devices will have to be substituted for the mechanical tank float to control the fluid level. When pumping is necessary, all equipment should be fitted with corrosion-resistant materials and all piping and valves should be lined.

A gathering system should be designed and installed to take advantage of gravity and the natural drainage system in an area. The gathering lines should be surveyed and profiled to determine their length and to be certain that the line does not cross the hydraulic gradient. Profiles also aid in locating line troubles during operation.

Since a closed piping system is used, there is some latitude in the design. Lines may actually go uphill for short distances but in general the lines should be laid to grade for best performance. Where high points are necessary in a line it should be adequately vented. It is important that oil and gas be kept out of the gathering system. This is particularly true of gas as it can very effectively block a line.

Corrosion-resistant materials should be considered for the gathering lines. Materials commonly used include asbestos cement, plastic, glass-fiber reinforced plastic and plastic or cement-lined steel. In gravity or low pressure lines, asbestos cement and plastic pipe give excellent service and are the most economical in cost. Plastic pipe is particularly sensitive to heat and its application under such conditions should be carefully designed and installed.

A friction factor of C/100 as applied in the Hazen-Williams Formula is recommended for the sizing of the gathering lines. All the materials mentioned above have a smoother surface when new; however, after they have been in service, material will collect on the pipe surface. This does not mean that the value of the C factor can not be increased above 100 but it becomes impractical to constantly maintain it at a higher value.

Junction points for the gathering lines should be located at accessible locations such as tank battery locations or along roads. Changes in line size should also be made at such locations to assure that they are accessible to equipment used in the cleaning of lines. Scraper traps and full opening valves should also be installed in each junction to facilitate line cleaning.

A well-designed salt water disposal system should provide as near continuous operation as possible. Shutdowns or interruptions of any kind due to gas or oil locked lines and inadequate line capacities are time consuming and expensive to the oil operator. This is why a special effort should be made to properly design a system and to use experienced personnel for the installation of gathering lines. Proper supervision of all phases during the construction of a system can eliminate many of the problems for the operator.

Not all operational difficulties of a salt water disposal system are the fault of the system. Quite often, poor operating practices of the oil producer cause the trouble. The fault may be the delivery of oil, paraffin or gas to the system and large heads of water delivered intermittently, instead of a steady flow. Scale deposition in the gathering lines is also a major source of trouble. The gathering lines should be inspected periodically and any evidence of scale deposition

should be carefully analyzed. A chemical treatment or mechanical removal program should be initiated and maintained where necessary to keep the system operating efficiently. Also, the terminal facilities should be monitored at frequent intervals to insure that undue quantities of solids or oil do not accumulate and enter the disposal well.

A salt water disposal system requires good engineering design, proper material selection and continual experienced supervision in order to give efficient, economical and uninterrupted operation throughout the life of an oil field.