Application of Paraffin Treating Chemicals

By BUFORD CRANFORD
Brake-Sol, Inc.

ABSTRACT

This paper will be concerned only with the control of paraffin through use of chemicals. The particular problems created by the paraffin deposit, or their degree of severity, will vary but will be common to certain areas of similar conditions. It is necessary, therefore, that the treating programs be flexible and adapted to the particular condition. Before such a program is designed, a complete survey of the problem should be made.

It is no longer necessary to take a "learn to live with it" attitude toward paraffin conditions. New chemicals and improved methods of application have paved the way for better control of the old problem of paraffin or wax. The solutions to this problem range from corrective treating to preventive treating. Suspension additives in paraffin treating chemicals have helped to make this possible. Safety hazards have been eliminated by use of chemicals with nontoxic, non-corrosive, and high flash point properties. Systematic treating programs reduce cost by giving maximum benefit from the chemical used. More efficient operation is possible through use of chemical injectors in treating programs.

Greater demand for wax products and wax coating has increased the need for high paraffin content crudes at the refineries. It might be pointed out that increased uses of refined paraffin for wax products has brought the price per barrel to $7 in some areas. The problem has been that of getting the crudes to the refinery. Aforementioned benefits, as well as increased field service by chemical companies and suppliers, give a resource that has not been available in past years.

PARAFFIN DEPOSITION

In order to select the type of application or treating program that will best fit the particular problem, the following factors are offered as guide-posts.

A. Drop out point
B. Rate of build up
C. Consistency of the deposit.

Drop Out Point

The separation of the paraffin from the crude oil usually occurs a few feet upstream from the actual deposition. Factors that contribute to this drop out point are primarily changes in temperature and pressure. Drop out may occur any place in the producing system, from the time the oil enters the well bore until it is processed at the refinery. There may be one or more drop out points in each producing system. Location of this point is important in determining the best place for chemical injection.

Rate of Build Up

The rate of build up may be faster at one drop out point than others, or relatively even through the rest of the system. Surface temperatures affect the rate of build up to a varied degree. It has very little affect on a down hole problem. Surface temperatures may retard build up but accumulation may still occur. In such cases treating programs should only be altered, not discontinued. This will keep the problem from getting out of hand at the first seasonal drop in temperature.

Consistency Of The Paraffin

The changes that occur in the consistency of the paraffin after deposition increase the severity of the problem. After a paraffin deposit has begun to form, it also collects other materials such as salt crystals, calcium, rust, sand and other residues. By dissolving or preventing paraffin build up, these materials are allowed to continue in the stream and settle out in the tanks. Paraffin deposits also form traps for highly corrosive water (see Fig. 1). Color is not a true

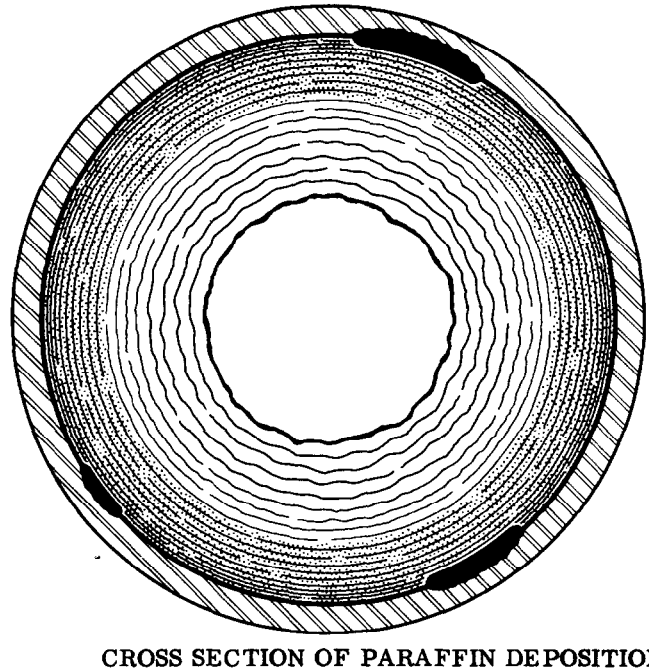

Fig. 1 CROSS SECTION OF PARAFFIN DEPOSITION SHOWING TRAPPED MATERIAL AND CONSISTENCY

indication of the treatability of the paraffin. Color denotes more the oil and impurity content. A drying effect is caused by gas passing over the deposit, pulling off the light ends. Water contact, unless at high temperatures, tends to set up the paraffin into a more plastic state.

THE PROBLEM

As with other problems in the oil patch, it is desirable to have as much information about past paraffin conditions as possible. Information available on the particular well or lease is too often incomplete and vague. Past histories on wells and leases are difficult to obtain, but checks should be made prior to setting up the treating program. Because of differences in individual wells, records should be kept on each for a short period of time, or until a trend or character of the problem is defined.

Suitable surveys can be conducted with equipment commonly used for other purposes. In order to capitalize on this fact, it is necessary to provide space or make notations on reports used for these other purposes. The procedures and methods of assembling the information will differ, but the following check points are offered.

Check Points

A regular pressure gage is one of the most common to apply to flow line problems. All lines should be checked to determine normal pressures. Periodic readings on pressure will assist in determining the rate of build up. In running any type of wire line tools, pressure bombs, temperature surveys, etc., a definite check can be made on drop out points and rate of accumulation in tubing of flowing wells. A thorough check during tubing and rod jobs can give much desired information. Grind outs of the oil at the well head and stock tanks will give some indication of increases or decreases in paraffin drop out. Power oil, stock, and storage tanks should be thiefed periodically to determine rate of bottom build up and consistency of the bottoms. By checking chokes, bull plugs, unions, and other connections, a more complete picture can be made. If mechanical methods of removal are being used, records of operation time and pressures used can be sources of information to check the nature of the problem.

TREATING TANK BOTTOMS

One of the most widely used applications for paraffin treating chemicals is reclaiming tank bottoms. This includes field stock tanks of a few hundred barrels capacity, to pipeline storage tanks of several thousand barrels capacity. Chemicals having suspension qualities are more adaptable to this type of treating. Such treating can be done without heat.

In all cases, it is necessary that sufficient fresh oil be used to absorb the paraffin in the bottom. It is recommended that at least twice as much fresh oil as bottom be in the tank when treating is started. The tank should be rolled again after it is about three-fourths full for additional absorption. The chemical acts as a catalyst. A full tank can be treated, but it is sometimes harder to get the bottom torn up as well as in the preceding method. In order to get maximum recovery, the chemical must be dispersed into the bottom by thoroughly tearing it up. This can be accomplished by a simple portable rolling hook up (see Fig. 2).

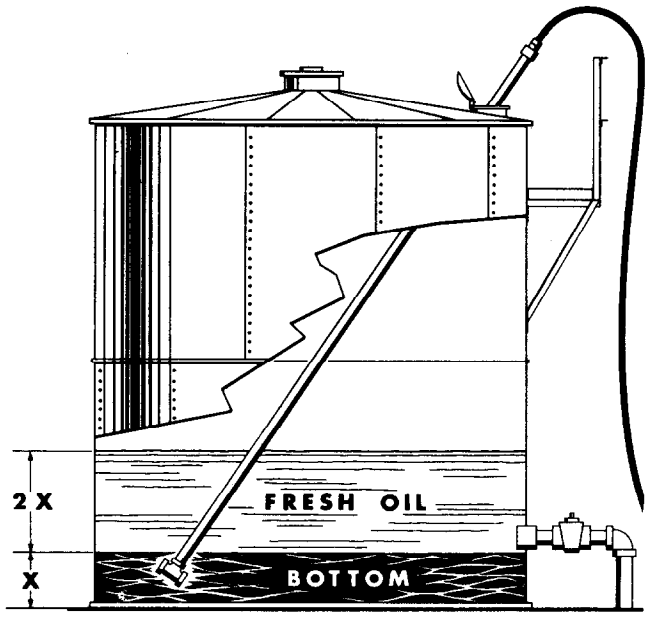

Fig. 2 PORTABLE ROLLING HOOK-UP

Chemical And Heat

If it is desirable to recycle tank bottoms back through the heater treater, it has been found that the combination of chemical and heat is beneficial, up to a certain temperature. In one field where this was checked, it was found that after the crude oil was heated over 140° F, it decreased the effectiveness of the treating. This temperature will vary with different oils and chemicals. High treating temperatures tend to drive off the light ends and lower the gravity of the oil. Gravity increases are possible when excessive heat is eliminated by the use of chemical. On an average, every degree increase in gravity results in a saving of 2 1/2 percent in volume. When conditions require, a good emulsion compound used along with the paraffin treating chemical can aid in more complete water separation.

Although recovery may seem small in some instances, totals of all leases over a year's period will amount to several hundred barrels. The greatest single recoveries have been made by pipeline companies as a result of their larger tank capacities. The following reports are given as examples.

1. Problem:
   A 1,000 bbl. tank in the Midland Farms field of West Texas had a bottom build up of 6 inches during a 60 day period. Temperature of oil at 66° F. Gravity of oil 43° API. 6 inches of fresh oil.

Procedure:

Gas rolling lines were hooked up. Started bottom rolling, and 5 gallons of paraffin treating chemical were added. No other chemical was used. Bottom was rolled for a 24 hour period, was not circulated through heater treater.

Results:

Amount of bottom before treating	6 inches	32.4 bbl.
Amount of bottom after treating	2 inches	10.8 bbl.
Recovery		21.6 bbl.
Recovery in dollars		$59.48
Cost of Chemical		12.00
Recovery above cost		$47.48

2. Problem:

An 80,000 bbl. cone roof storage tank with an average bottom of 32 inches @ 160 bbl. to the inch. Bottom very heavy in spots with water pockets in the first foot of bottom.

Equipment Used:

A 60 hp electric booster pump. 2 and 3 inch aluminum pipe. 2 and 3 inch rubber hose sections and various connections used for circulating hook up.

Procedure:

The rolling system was tied into the tank fill and discharge line on the discharge side of the booster pump. This line was run to the base of the tank where it was tied into an aluminum riser up the side of the tank. 2 inch aluminum down lines, with tees on the bottom, were run in each of 5 hatches. These down lines were hooked up to the riser with sections of rubber hose and aluminum pipe. The chemical was injected into the rolling line by use of a gear pump mounted on the utility tracter. The tank was treated in two stages. On the first stage 440 gallons of chemical was added and tank circulated approximately 62 hours. About 11,000 bbl. of fresh oil was added for absorption. The tank was allowed to set but no water could be drawn off. The tank was run, then circulation started for second stage. On the second stage 275 gallons of chemical was added and bottom circulated for approximately 77 hours. Fresh oil was added as needed during both stages for additional absorption and agitation. The tank was allowed to set after second stage and approximately 70 bbl. of water was drawn off.

Results:

Amount of bottom before treating	32 inches	5120 bbl.
Amount of bottom after treating	9 inches	1440 bbl.
		3680 bbl.
Amount of water drawn off		70 bbl.
Total recovery		3610 bbl.
Total amount of chemical		715 gallons

Recovery in Dollars:

3610 bbl. @ $3.00 per bbl.		$10,830.00
Cost: Chemical	$1,664.16	
Labor	184.77	
Equipment & Supplies	99.31	
	$1,943.24	1,948.24
Net Profit:		$8,881.76

Note: The above profit does not include saving on a tank cleaning job. The cost does not include operating booster pump nor dismantling rolling hook up.

TREATING DOWN HOLE PROBLEMS

Paraffin content of crude oils vary, but oils with the higher content do not always present the most severe problem. A particular oil in natural form will hold its paraffin in solution under certain temperature and pressure. It only becomes a problem when the conditions change and a drop out occurs. It would hardly be possible to produce the oil without changes in these conditions. One solution to the problem is to increase the crude oil's capacity to hold more paraffin in solution.

By introducing the chemical into the stream ahead of the drop out point, the chemical will help keep the paraffin in suspension in the oil and eliminate or retard deposition throughout the entire system (see Fig. 3). Where multiple treating problems exist, combinations and mixtures of corrosion inhibitors, water emulsion compounds, and paraffin treating chemicals can be used.

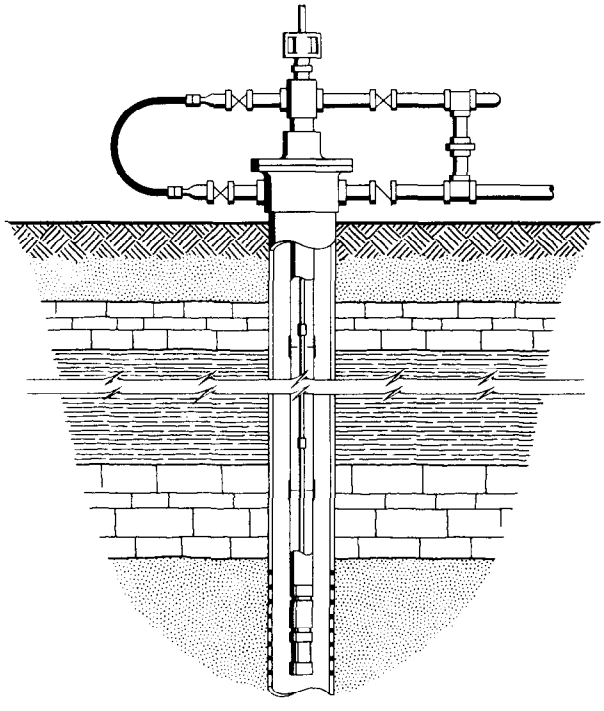

Fig. 3 CIRCULATING HOOK-UP FOR PUMPING WELL

The Prevention Or Control Of Paraffin

The most important advantage preventive treating holds over batch treating is the prevention or control of the paraffin before it becomes a problem. Paraffin deposits that are allowed to build up cause a decrease in the efficiency of practically all equipment used to produce the well, including dump valves, treaters, separators, meters, automatic controls, etc. In many cases, by the use of a paraffin treating chemical, treating temperatures can be lowered, thus increasing gravity and volume. Paraffin deposition is of concern to the equipment manufacturer as well as to the producer. In preventive treating, no loss of production is experienced as a result of downtime, nor is there loss caused by periods of restriction before critical plugging occurs. Case histories of preventive treating follow.

3. Problem:

Paraffin accumulation in a hydraulic subsurface pump system located in the Holliday field, Archer County, Texas. Producing 20 wells, at 150 bopd, using triplex pressure from 2000 to 2100 psi. A 1000

bbl. power oil tank with 33 inches of bottom in back and 12 inches in the front. B.S. & W. content ran .5 of 1%. Flow lines contained considerable build up of paraffin.

Procedure:

The power oil tank was batch treated with 15 gallons of paraffin treating chemical. Chemical was introduced into the system at the suction side of the triplex by use of a chemical injector at a rate of 2 quarts per day. After 25 days, 10 gallons more of chemical was added to the power oil tank to expedite the absorption of the paraffin in the tank.

Results:

	Before Treating	After Treating
B.S. & W. content in P.O.T.	.5 of 1%	Trace
Inches of bottom in P.O.T.	33" in back 12" in front	5" in back 0" in front
Rate of bottom buildup in P.O.T.	Fast	None
Temperature on treater	145°	130°
Temperature of oil in P.O.T.	100°	90°
Triplex pressure	2000 to 2100 psi	1750 to 1800 psi

As indicated above, the power oil tank is being kept clean. The temperature on the treater has been reduced 15°. The flow lines have been inspected and found to be clean. As can be expected, there has been a small build up of bottom in the storage tanks due to paraffin being cleaned from the system. This is gradually decreasing and the build up has been handled by agitating the oil. The triplex operating pressure has been reduced by 250 to 300 psi. Report covers 6 month period. There was also a decrease in electrical consumption from $500 to $300 per month.

4. Problem:

Paraffin build up in the tubing of a flowing well located in the Jal Mattie field of New Mexico. Well depth is 3000 feet, 24 bopd, and no packer. Paraffin build up down to 800 feet. Had to be cut for paraffin every 2 weeks. The flow line had to be burned on an average of once a week using 3 bbl. of crude.

Procedure:

The well was batch treated down the casing with 10 gallons of crude oil followed by 5 gallons of paraffin treating chemical. A chemical injector was then set at the well head with an injection rate of 3 pints per day.

Results:

Report covers a 6 month period. Well had to be cut at end of first 3 months.

Cutting tubing	month	$35.00
Crude oil	month	33.60
Labor	month	6.00
Cost before treating	month	$74.60
Treating cost	month	31.50
Monthly saving		$43.10

APPLICATIONS ON SPECIAL PROBLEMS

In general, batch or slug treating has its application under conditions of slow rates of build up. In some cases because of methods of producing the well, such as one with a packer set in the casing, one is unable to inject the chemical ahead of the drop out point. In cases where a severe condition exists in the tubing of flowing wells, application of treating chemical has been made by use of high pressure pumps. This has been used quite successfully on wells in the Gulf Coast area. Bottom hole injection valves can be used in preventive treating or circulating in wells where packers prevent regular down hole treating (Fig. 4). Slug treating by means of volume tank lubricator or pouring directly into the tubing, casing, or flow line has its place in conditions as mentioned. Contact time for chemicals will vary as to the type of chemical used and the consistency and amount of deposit. Better results have been obtained by increasing the frequency of treating, using the same total amount of chemical. This also has to be set up according to the rate of build up and consistency of the deposit.

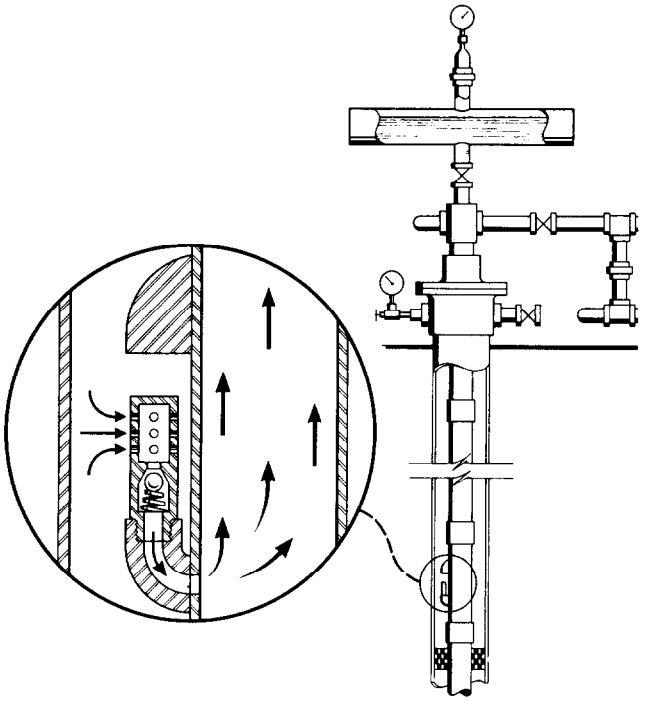

Fig. 4 VOLUME TANK LUBRICATOR AND BOTTOM-HOLE INJECTION VALVE

Formation Treating

Another application for paraffin treating chemicals, that has been used more in the last two years, is formation treating. The treating procedures used vary from spotting the chemical in the bottom of the hole and allowing it to set, to the use of pump trucks to force the treating fluid back into the formation. In wells where the restriction of flow into the well bore is caused by paraffin deposition, this application has paid off in good production increases.

In instances of special problems that occur infrequently, such as pulling and running bottom hole pumps, the presence of paraffin in the tubing can cause much delay and expense. Additional pulling unit time and loss of production through down time can be saved by a treating routine for such jobs. If the well is still pumping, it can be treated before pulling by introducing chemical down the casing, tying the bleeder back into the casing and circulating (see Fig. 3). If the well is completely off, the only application is down the tubing. Stripping jobs can be prevented by treating as soon as the pump is unseated and working out each tight spot on the way up. The chemical will dissolve and soften the deposit allowing more paraffin to be pulled out

with the pump. The following are given as examples of the foregoing.

5. Problem:

Production decline was caused by paraffin restrictions in the tubing and formation. The wells are located in the Caprock Queen field of New Mexico. This is a problem common to nearly all wells in the field. Wells were not making their allowable and were having to be hot oiled or pulled and tubing steamed, at intervals of from two to three months.

Procedure:

The initial application was a batch treatment of 10 gallons of paraffin treating chemical down the casing, by use of a volume tank lubricator. The flow line valve was closed and the bleeder tied in to the casing. The well was then circulated for a period of 24 hours. After the initial treatment, the well was put on a program of repeating the preceding method twice a month, using 2 1/2 gal. of chemical and circulating 24 hours.

Results:

The program has been in effect 7 months. The well is now making its allowable of 44 bbl. of oil per day as compared to 28 bbl. of oil per day previously. It has not been necessary to hot oil or steam out the tubing since the program started. As a result of keeping the rods free, there has been a decrease in electric consumption. The program has been expanded to include a large percentage of the wells in this field. The treating procedure and results have varied very little.

By use of hollow rods or macaroni strings down the tubing, it is possible to make the point of injection just below the drop out point. This is one method of application when the well cannot be treated down the casing for reasons of circulation problems or where packers are used. This is effective both on pumping and flowing wells. Installations of hollow sucker rods in flowing wells can be utilized when the well is put on a pump. There is available a crossover plunger that will allow the application of chemical below the pump by the use of hollow sucker rods (see Fig. 5).

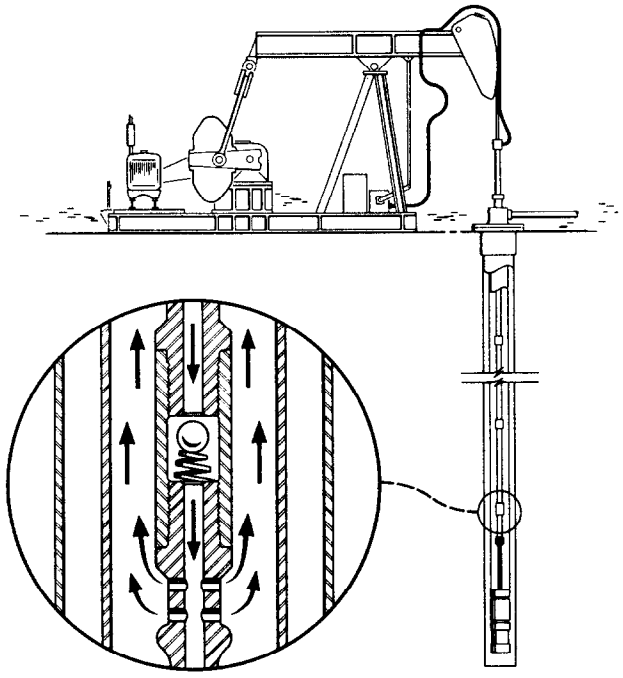

Fig. 5 HOLLOW SUCKER-ROD HOOK-UP FOR CHEMICAL INJECTION

Automation of leases where paraffin conditions exist, necessitates a preventive treating program. Paraffin build up on automatic equipment causes improper function and errors in metering and measuring.

TREATING FLOW-LINES AND PIPE-LINES

When conditions require treating only the flow lines and pipe lines, it is recommended that a preventive program be used, if at all possible. Best results can be expected if a chemical injector is used to apply chemical at the well head. Advantages of use of chemical injectors were mentioned earlier in the paper.

6. Problem:

Paraffin accumulation in a hydraulic subsurface pump system located in the South Eunice field of New Mexico. In a 4 month period before the treating program was set up, there was an average of 10 days downtime per month caused by pulling jobs and plug-ups. Soluble plugs were run once every 2 days in the power oil lines at an average pressure of 1,000 psi and 20 minutes run time. Costs were running $1,500 and higher per month of operation, and allowables were not being made.

Procedure:

The power oil tank was charged with 5 gallons of chemical a day, for the first 5 days of the program. Chemical was also injected, by use of a chemical pump, into the suction side of the triplex at a rate of 2 gallons per day for continuous treating.

Results:

The program has been in effect for 11 months with no major pulling problem. Soluble plugs were run twice monthly at an average pressure of 500 psi and 15 minutes run time. Downtime has been cut to a minimum and the allowable is being produced. The injection rate used is above average but is very economical compared to previous cost. The treating temperature was cut 10°F.

7. Problem:

Bottom build up of 8 inches in a 500 bbl. tank located in the Drickie Queen field of New Mexico. Bottom consisted mostly of paraffin and salt. A build up of the same combination was found in the flow lines of wells #1, #2, and #3. Wells pumping. Temperature on treater 115°F.

Procedure:

A small amount of chemical was introduced into each of the three flow lines, followed by a slug of fresh water, followed by another slug of chemical and allowed to set 18 hours. Approximately 4 gallons of chemical per well was used in each line. The wells were produced into the tank and the contents circulated through the heater-treater.

Results:

The tank was put on the line with a 1 inch bottom and 3/10% grind out. Total recovery was 7 inches of bottom and pressure was back to normal on the 3 flow lines.

8. Problem:

Pressure build up resulting from paraffin deposition in a 12 inch transmission line located in the southern part of the state of Veracruz, Mexico. The line is approximately 98 miles long and would plug off in 90 days if the oil were not heated or treated.

Procedure:

Two gas operated chemical injectors were set at the field gathering point. The injection rates used are 1 quart paraffin treating chemical per 178 bbl. of crude oil. The same injection rate is used for the water emulsion chemical.

Results:

The program has been in effect for a two year period, and no excessive pressures or plugging have occurred. The oil was heated, prior to treating program, to shorten settling time for sand fall out. This has not been necessary since treating.

POINTS TO REMEMBER

At the start of any program, not only the paraffin content in the daily production is being treated, but also that which has built up prior to the start of treatment. To compensate for this, it is recommended that the system be slug treated before constant injection is started and, also, that a higher injection rate be used during the first days of the program.

In any type of paraffin treating program, it must be kept in mind that the program must be carried on for a sufficient length of time to be effective before a definite evaluation can be made. In order to get a true evaluation it is necessary to include all loss of production, pulling jobs, repair and replacement of equipment caused by paraffin, along with cost of other methods of paraffin removal, as a comparison to the treating program.