ECOPUMP
A NEW CHEMICAL DELIVERY SYSTEM

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The ECOPUMP was designed to apply production chemicals continuously down the annulus of rod pumped wells. Chemical products suited especially well for injection by the ECOPUMP include corrosion inhibitors, paraffin control products, scale preventers, and demulsifiers.

The ECOPUMP has been in service for about 2 years. Corrosion inhibition was the objective in the first wells selected for test. Most of the data compiled during the last two years pertains to corrosion inhibitor applications. During that period corrosion rates were reduced by an average of 50% compared to batch treatment applications. Failure frequency was reduced by over 90%.

The ECOPUMP is a simple plunger type pump which is driven by the oscillating vertical movement of the walking beam of rod pumps. The ECOPUMP is normally mounted to the front cross- member of the base of beam type pumping units and, on top, to the walking beam near pivot point. As the beam pump strokes upward, the plunger retracts and draws fluid into the pump, then expels fluid as the beam pump strokes downward driving the plunger down into the pump barrel. Discharged fluid is routed down the annulus. The fluid volume pumped by the ECOPUMP is fully adjustable by moving the point of attachment on the walking beam either toward or away from the pivot point. Attachment further away from the pivot point increases the length of the plunger stroke and therefore the amount of volume pumped.

A suction hose is connected from a fluid pot mounted to the underside of the flowline to the inlet valve of the ECOPUMP. The fluid pot maintains a reservoir of fluid and prevents dry stroking in wells with intermittent flow. Fluid drawn from the flowline becomes the carrier fluid for chemical down the annulus. Chemical is injected directly into the ECOPUMP chamber by a separate chemical pump designed for and mounted on the ECOPUMP. The chemical rate is fully adjustable and is also driven by movement of the walking beam.

The amount of fluid pumped by the ECOPUMP is a function of plunger diameter, stroke length, and the number of strokes per minute. If a rod pump is set to stroke 10 times per minute, then approximately one barrel of fluid will be pumped for each inch of stroke the plunger is adjusted to move. The average volume of fluid pumped on the wells tested was about 10 barrels per day.

Results presented today were compiled from four wells in Mississippi and five wells in east Texas. Prior to treatment with the ECOPUMP, each well was either batch treated with corrosion inhibitor or continuously treated into side-streamed fluids diverted down the annulus – neither method was successful. Water production from the test wells ranged between 100 and 1000 barrels per day. Corrosion in both areas was caused primarily by carbon dioxide.

The ECOPUMP has been in service on these wells for at least 12 months with most over 18 months. Performance was monitored using one or more methods including iron counts, corrosion coupons, amine residuals, and most importantly failures.

Corrosion Coupon Results

Corrosion coupons were evaluated every 60 to 90 days depending on the particular well. Untreated wells in Mississippi showed an average corrosion rate of over 16 mpy. With batch treatments applied twice weekly, corrosion rates dropped to about 2 mpy, but actual failures remained high. Continuous injection with the ECOPUMP, at a rate of 20 to 30 ppm based on water volume, reduced the average corrosion rate to less than 1 mpy. The exception to this was a sand producing well which continues to have fluctuating corrosion rates between 4 and 16 mpy. Analysis of coupons from that well consistently shows a significant erosional component. On two occasions injection was interrupted when sand filled the chamber in the ECOPUMP causing the push rod to break away.

Untreated corrosion rates in the Texas wells averaged over 20 mpy with one well over 40 mpy. Batch treatments with corrosion inhibitor applied with a treater truck reduced corrosion rates to between 2 an 4 mpy, but again failure frequency remained high. Side-stream treatments down the annulus yielded similar results. Continuous treatment using the ECOPUMP reduced corrosion rates to less than one mpy in each of the east Texas wells.

Iron Counts

Iron counts were unreliable indicators in the Mississippi wells since hydrogen sulfide is present at low levels. Dissolved iron readily reacts to form iron sulfide.

Iron counts were monitored quite extensively in east Texas. Iron counts ranged between 20 and 60 mg/l in untreated wells. Batch treatments applied twice weekly reduced iron counts to between 12 and 16 mg/l.. Continuous injection of corrosion inhibitor using the ECOPUMP reduced iron counts to between 4 and 8 mg/l.

Amine Residuals

Chemical residuals were monitored only during the initial weeks of treatment to determine if chemical was getting down and into the tubing. A highly water dispersible filming amine was selected for each of the wells. Chemical selection was made based on historical performance, water dispersibility, wheel test results, and Copper Ion Displacement tests performed in the field.

The corrosion inhibitor was applied quite heavily (100 ppm) during the first week of treatment to charge annular fluids with chemical and to speed the filming process. Thereafter, 20 to 30 ppm of chemical was injected continuously.

Samples of water were collected before treatment was started, and amine residuals were determined to establish a zero point or background. Additional samples were collected 7 days and 21 days after injection was started. As expected amine residuals were over 70 ppm at 7 days and between 12 and 18 ppm after 21 days. This confirmed dispersion of chemical into the production string and residual analysis was discontinued.

Failure Frequency

The most significant measure of effectiveness was failure rate. In the year prior to treatment with the ECOPUMP, the 5 east Texas wells experienced 10 corrosion related failures. These failures occurred while being batch treated. The cost of each failure averaged over $6,000. During the 12 months after the ECOPUMP was installed, there were no failures reported.

In the four Mississippi wells, nine failures were recorded during the 12 months prior to treatment with the ECOPUMP. The average cost per failure was about $7,500. These wells were being treated with corrosion inhibitor either by batch treatment or by continuous injection into fluid side-streamed down the annulus. During the next 12 months with injection by the ECOPUMP, one failure was recorded in the well producing sand.

It should be noted that most of the wells tested had fluid levels of less than 300 feet above the downhole pump. The most corrosive well in east Texas had a fluid level of 2000 feet above the downhole pump. Corrosion inhibitor was still able to get around and protect the tubing. An initial batch treatment is recommended for wells with fluid levels greater than 500 feet above the pump.

Conclusion

Continuous treatment with corrosion inhibitor has long been preferred because it is more effective and more economical than batch treatments. In most cases, failure rates can be reduced when continuous protection is possible. The ECOPUMP tests do not reveal any new information; rather, they reinforces this precept.

Proper chemical selection is critical as with all corrosion inhibitor applications. The ECOPUMP provides only a means for continuous delivery in certain wells where it was not previously possible.

Chemical dispersion into the main flow is obviously required to facilitate filming and protection. Dispersion is a function of relative solubility in the produced fluids and mechanical factors affecting chemical distribution. Suitability of the ECOPUMP on problematic wells must be evaluated individually.

Chemical application with the ECOPUMP is not limited to corrosion inhibitors. Installations are now being completed on wells with severe downhole asphaltene and paraffin deposition. Performance data regarding these applications will be forthcoming in the next three or four months.