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Extreme Temperature ESP Development

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Abstract

Efforts to develop electrical submersible pumping (ESP) system technology for harsh environment applications has resulted in equipment designed and developed specifically for applications in higher temperature wells. This paper will discuss the development evolution of this equipment through Centrilift's state-of-the-art high temperature test facility "hot loop" and continuing development by field operations in Canadian SAGD applications.

Internal Development:
The utilization of a state-of-the-art test facility that can be entered and exited at strictly planned / controlled intervals where temperature, system cycling and system monitoring can be controlled in a safe environment, has been instrumental in advancing the ESP equipment technology to a satisfactory operational level at 200° C – 220° C (392° F – 428° F) environments. This facility allows the equipment component design and materials evaluation to proceed quickly and under controlled procedures, with the end result being a fully tested and evaluated system for field applications. Several equipment modifications based on the test results will be discussed.

Field Testing/ Development:
The utilization of customer owned producing wellsites for initial application of the extreme temperature equipment is critical for the final 'live' well test of the design and tweaking of minor issues that would be difficult to detect under cleaner and controlled lab type environments. Further equipment design focus beyond 250°C will be dependent upon SAGD operators' targets and requirements.

INTRODUCTION:

For years the gap between theory and practice has been the fodder for field testing and iterative field development carried out in producing wells throughout the oil and gas industry. It is industry's quest for a panacea that has made component level testing insufficient. Component supplier claims are easily evaluated under laboratory conditions, both in-house and through the use of outside laboratories.

The testing of new system(s) designs is another issue altogether. In-house development and testing of all phases of Centrilift's new extreme temperature ESP product offering would have been impossible without the construction and availability of the hot loop test facility located at headquarters in Claremore, Oklahoma. Field testing alone would have extended the development process and delayed product availability.

OIL SANDS EXPLOITATION

Alberta's oil sands have now attained global recognition as an important reserve base **(Fig. 1).** Technology has allowed these reserves to be recognized as proven reserves and to be developed. With approximately 90% of the reserves too deep to mine, Steam Assisted Gravity Drainage (SAGD) is a proven method to is develop the deeper resources. EnCana, one of the largest landholders of this resource, is consistently optimizing its processes. One of the most significant well enhancements has been ESPs, which allow the optimizing the steam oil ratio (SOR) with greater well control and ease of operation. ESPs can run at lower pressures than steam lift or gas lift, which improves economics of the project by lowering the SOR. The high fluid temperatures of up to 218ºC (456ºF) are greater than the elastomers in traditional ESPs can handle. With extensive lab testing and innovative solutions, the high-temperature ESPs are now the preferred lifting method in the majority of SAGD projects.

SAGD
SAGD was first tested at Alberta Oil Sands Technology and Research Authority (AOSTRA) in the 1980's **(Fig. 2)**. Multiple pilots have been done since that time and in 2000 EnCana started the first commercial SAGD operation. SAGD consists of two parallel horizontal well pairs, approximately 400 to 1,000m in length, located at the bottom of the reservoir with approximately 5m of vertical separation. The upper well is used to inject steam into the formation, which comes into contact with the oil, condenses and lowers the viscosity of the oil. The resulting oil/water emulsion drains by gravity to the lower well, which produces the emulsion.