Don’t Count Your Chickens…
The Importance of Planning When Making Heavy Oil Decisions

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Introduction

One of the most frequently quoted English sayings is, “Don’t count your chickens before they’re hatched.” In other words, do not assume that you will get the things that you want until you have them. Certainly this old idiom can be applied to a range of situations, including heavy oil production. When making decisions about heavy oil, testing, evaluation and planning are essential.

Pilot studies provide an insight into reservoir behaviour enabling oil and gas companies to characterize a reservoir and manage it more effectively. For example, crucial knowledge can be gained, such as the depletion profile and by-passed oil zones, oil and water zonal contribution, reservoir pressures, cross-flow, well integrity (cement and casing) and potential issues with commingled flow. When the time comes to make key decisions, such as well placement or completion design, operators with the most accurate picture of their reservoir will make the best choices for their wells and surface facilities.

By knowing more about a reservoir, a more accurate timeline can be drawn up and the correct follow-up production method can be decided, thereby, enhancing overall recovery. The improved ability to predict how a reservoir will behave benefits every decision-maker on the project team, from the geologist and production engineers to the asset manager. The time and money operators invest in the beginning to learn about the reservoir will pay off many times in the end. This is especially important in today’s economic climate.

Further efficiencies are evident when the pilot study is integrated into the heavy oil production process. By conducting a pilot study, an existing model can be built, tested and improved accordingly. Making continuous improvements and constantly learning about the reservoir will ultimately decrease the time that it takes to get to full production capacity. This will lead to a more efficient way of planning production facilities in the long-term.

Testing, Testing, Testing…

Heavy oil extraction presents a number of challenges. It is vital to understand the mobility of reservoir fluids to calculate the recovery rate, decide upon the potential recovery method and the artificial lift method. However, determining the true viscosity and composition of heavy oil is a complex process involving both in situ testing with wireline tools, and the laboratory analysis of samples taken from the well. Additionally, it is important to test for potentially foaming oil as heavy oil containing gas can be both beneficial and problematic. The key is to understand enough about the fluid properties to know under what conditions the foaming is likely to occur. After all, it will not be beneficial if the foaming does not begin until the fluids reach the production separator.

Heavy oil composition also represents unique challenges to flow assurance. Flow assurance is the ability to transport produced fluids from the reservoir through the wellbore, flow lines and facilities in a predictable manner over the life of the project. Heavy oil exhibits large compositional variations between different reservoirs and compartments of the same reservoir. Often, there are compositional gradients within a compartment. Compositional variations can lead to significant variations in fluid physics, such as viscosity, which have a major impact on hydrocarbon production. In general, shallower oil is heavier than the oil found in deeper, hotter reservoirs. Similar to refineries, the hydrocarbons remain heavier if temperatures are lower. In contrast, at elevated temperatures, there is extensive cracking leading to lighter hydrocarbons. In addition, microbes can live in formation water if the formation water is not too hot (<80°C). The microbes preferentially consume alkanes at oil/water interfaces, thereby increasing the asphaltene concentration, which greatly increases viscosity. In general, this biodegradation process leads to large compositional, thus viscosity, variations. Efficient production of heavy oil necessitates understanding these variations. Every new heavy oil development eventually requires some form of enhanced oil recovery, such as steam injection, solvents or a combination of both. Flow assurance is especially challenging in deep water and remote environments.

Heavy oil is often associated with soft, unconsolidated near-surface reservoirs in which wellbore stability can be a key issue, both while drilling and while producing. Consideration of the geomaterial properties of these low strength rocks, especially with viscous fluids they contain, is particularly important. For example, while steam injection will reduce viscosity, it may lead to stress induced formation failure leading to well breakage and/or collapse, perhaps extending to subsidence at the surface. Conversely, expansion due to heating a reservoir or the injection of large volumes of fluids may lead to heave or uplift at the surface, with associated HSE implications. By knowing the geomaterial properties, such obstacles can be avoided.

Surface facilities form a major part of steam injection-based production. They can include the design and optimization of piping systems, oil/water separation, oil dehydration, vapour recovery and...
The Business Model

An Early Production Facility (EPF) is a flexible solution to the need for new surface facilities, whether they are for producing heavy oil, or conventional oil and gas. The need can include a complete grassroots development to meet license requirements for online production, or simply a few extra steam generators or a water treatment plant to expand a field’s capacity. The key to EPF being efficient is working economically without compromising safety.

Various levels of early production systems are available on the market today. In the last 30 years, for example, Schlumberger has built more than 60 major EPFs ranging in size from 300 to 120,000 BOPD. Typically, they are installed in remote regions, where newly-formed national oil companies or small to mid-size operators have a difficult time assembling the resources to design and build their own production facilities. Business models vary from one service provider to the next. Schlumberger builds and operates production facilities on a lease basis. At the end of the contract, a customer typically has the option to end the lease, renew it or purchase the facility outright. Typical contracts run one to five years.

Testing Saves Time

An important aspect of EPFs is that they allow operators to quickly test their reservoirs. With leases as short as one year, asset managers have the option, with relatively little expense, to see what a field can do. The nature of an EPF – with modular units that are easy to transport and install – allows the operator to add capacity as and when needed. This means that pilot studies can be fully integrated into the production process in a ‘test as you go’ fashion (Figure 1). Consequently, early production facilities are able to bring production – and cash flow – on stream two to three months ahead of schedule. This is imperative in today’s economic climate where flexibility and cost-effective measures are more important than ever before, due to the highly volatile oil price.

Pilot studies are necessary to decide what equipment is needed for production. If excessive amounts of sand are not planned for, for example, the EPF will not have the capacity to handle it. Even if you can add the equipment later, it will almost certainly cause delays and add to the cost. Ordering new equipment can eat up all of the time that would have been gained if the EPF was installed as planned. By testing and gaining knowledge in advance, valuable time can be saved in the long-run.

The standard engineering, procurement and installation track may take 24 to 36 months, but the same equipment leased under a build-operate-lease contract is often up and running in just 9 to 15 months. The instability of today’s energy prices only magnifies the potential gain. Additionally, early production facilities are a way of making the best use of an operating company’s available staff. With many operators facing a shortage of experienced hands, a turnkey solution for new projects is very appealing. One less obvious benefit of leasing an EPF is the flexibility it offers in developing a field. If the asset does not perform to expectations, more measurements and changes can be made without high capital expenditure. At the end of the lease, the service provider simply takes the equipment away.

Look to the Bottom Line

In the present day economic climate, carefully planned, efficient spending is essential. Before a company commits to capital expenditure, proof is needed that a project is viable and return-on-investment is high. Now, more than ever before, companies can not afford to “count their chickens before they hatch.” By testing, planning and making adjustments, heavy oil decisions will be more accurate and, consequently, more cost effective in the long-term.

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