Decarbonise case study Total Flow

Flow diagnostics cut gas–oil ratio, maximise oil production, and reduce carbon-per-barrel

Location: Asia-Pacific
Customer: PETRONAS
Well type: Oil producer

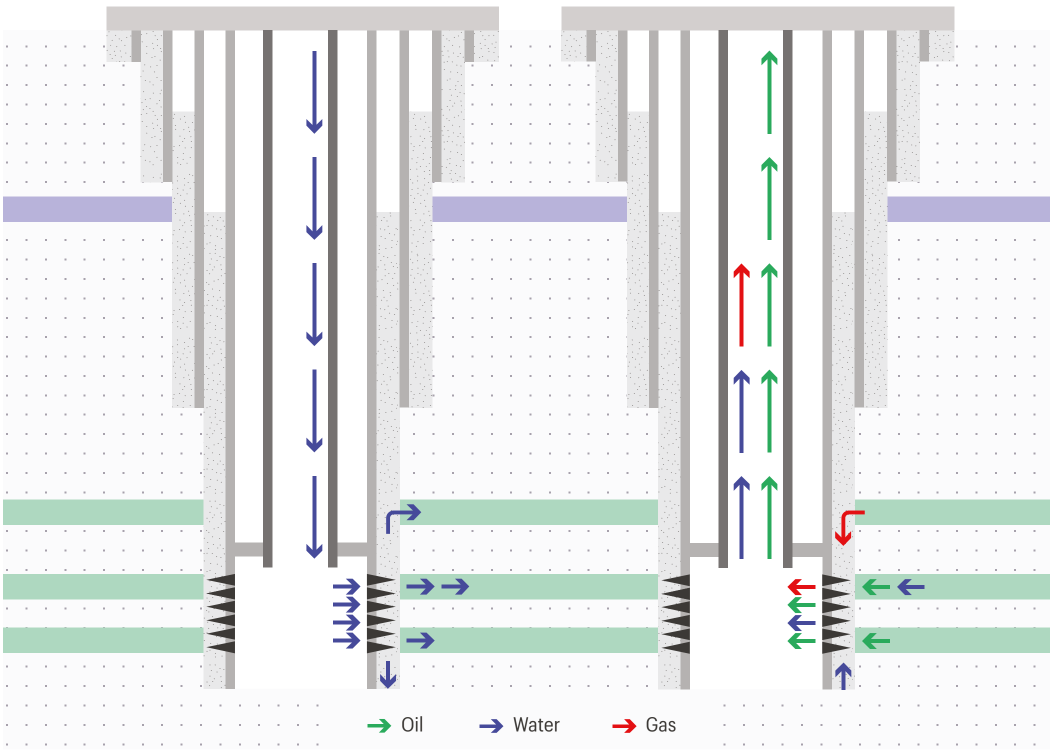
Case benefits
— Identified reservoir intervals contributing to high gas–oil ratio
— Reduced gas-oil ratio leading to increased oil production
— Reduced energy requirement for disposal of excessive produced gas
— Post-workover diagnostics validated effectiveness of the isolation job
— Enabled targeted remediation treatment to increase production and recovery from the well by ensuring that it operates at maximum potential
— Reduced emissions and carbon-per-barrel over the life of the field

Challenge

A high gas–oil ratio leads to unnecessarily high carbon emissions, lower oil production and increased carbon-per-barrel rates. Managing and processing excess gas requires substantial energy and capital expenditure for surface infrastructure and facilities. In this case, the aim was to identify zones for gas shut-off that would enable the operator to optimise surface infrastructure capacity, maximise oil production and minimise carbon footprint.

Well A-1 features a 7 in. x 4-1/2 in. cemented liner across several commingled oil and gas-bearing zones. Developing compartmentalised multi-stacked reservoirs using simplified well completions makes it challenging for diagnostics to determine production allocation, reveal flow assurance issues, understand reservoir connectivity, monitor individual well performance, and forecast total field production.

Gas production had already exceeded the limit of surface processing facilities for well operation with existing production rates, which meant the operator had to choke back production. In addition, the unwanted gas was taking up part of the operator's pipeline quota and creating other transportation and flow assurance issues. The well contains at least five clastic reservoir zones, each with multiple layers, that are perforated across an interval of more than 1,500 ft. This level of complexity meant that conventional production logging tools were unable to adequately characterise flow or confidently distinguish the main gas-contributing layers.



Total Flow example well sketch.

Total Flow locates and quantifies wellbore and reservoir flow, and reveals the relationship between the two.

Delivered by our True Flow system with Chorus and Cascade technology, Total Flow provides the clarity and insight needed to manage well system performance more effectively.

Total Flow is commonly used to diagnose unexpected or undesirable well system behaviour, but it can also be used proactively to ensure the well system is working properly.

Solution

The operator selected TGT's Total Flow product, with Cascade, Chorus and Indigo as the main technology platforms chosen to perform the well system diagnostic survey. This would reveal which zones were contributing to the production of oil and gas, diagnose wellbore and reservoir flows, and help identify potential well integrity issues such as annulus sealing problems due to poor cement. The solution combines the sensitive, fast-response temperature sensor of the Indigo platform with high-definition acoustic sensing from Chorus that reveals active flow in the well system.

Comprehensive temperature and flow modelling with Cascade enabled TGT analysts to assess and allocate production distribution and provide accurate oil and gas flow profiles across the reservoir zones. The survey also identified active flow layers and recorded characteristic acoustic signals generated by liquid and gas flowing through reservoir media and the wellbore.

Result

Total Flow diagnostics quantified the contribution of reservoir layers from five different zones and identified the main gas producing layers, providing a comprehensive flow profile. The operator was able to define active flow units and differentiate between flows through the reservoir matrix, the behind-casing channels and the wellbore completion components.

This enabled the operator to target and conduct an effective remediation plan. The workover involved a 200-ft-long 2-⅞-in. straddle installed to isolate the zone with the highest gas contribution. A post-workover Total Flow survey was conducted to evaluate the effectiveness of the isolation job. The straddle had isolated 83% of the gas production. This delivered a reduction of 7.9 MMscf per day at surface (equivalent to 2.8 Bscf per year).

Overall, the isolation job was considered highly successful. Identifying the main gas shut-off zones played a crucial role in optimising surface infrastructure, maximising oil production, and minimising carbon footprint for this well.

Pre- and post-workover survey results illustrate the effectiveness of the gas zone isolation programme and resulting decrease of gas production, which enabled surface infrastructure to stay within its operating envelope.