CHALLENGE
Control gas inflow and maximize oil production by optimizing inflow control valve (ICV) configuration and accurately measuring flow rates.

SOLUTION
Use PhaseTester* portable multiphase well testing equipment with Vx* multiphase well testing technology to measure flow rates and acquire surface samples during flow to characterize effluents and confirm production after performing auto gas lifting processes.

RESULTS
Brought wells back on production, increasing total field production by 40% and minimizing well interventions.

Seeking production enhancement solution for underperforming wells
An operator in the Middle East was producing from mature oil wells drilled in fields with clastic reservoirs. Over time, substantial amounts of gas and water production had choked back the oil, impairing production from the wells to the point that they were unable to maintain natural production for long periods of time. Because of substantial reductions in oil production, the operator was considering various artificial lift methodologies to revitalize these underperforming wells.

Conventionally, gas lift would be the optimal method because of the field’s GOR and flow rate fluctuations as well as early water breakthrough. This method, however, requires developing and building an extensive pipeline network at a higher cost and a two-year lead time.

Reliably measuring multiple phases with portable test equipment
To decrease time and associated costs, the operator collaborated with Schlumberger and decided to use auto gas lifting (AGL), an artificial lift system that uses existing gas from an associated or nonassociated gas reservoir to enable or improve production from an oil reservoir. AGL is an attractive alternative to conventional gas lifting because the method

- reduces capex by eliminating the need for a compressor and gas lift piping
- reduces opex by minimizing well interventions, compressor power, and maintenance
- has simple installation and superior well integrity
- sustains stabilized production
- reduces footprint and starts up the well faster after any plant shutdowns.

The operator saw AGL as an innovative solution to its production challenges, and Schlumberger asked to test the methodology on a pilot well by using PhaseTester equipment with Vx technology as well as fluid sampling and production logging tools.

The well test procedure was to flow the oil and gas zones by using various downhole inflow control valve settings while monitoring downhole flow with production logging tools and collecting surface fluid samples for fluid characterization. The well was first flowed with both oil and gas zones commingled. Then, the oil zone was isolated and the gas zone opened, and both zones were commingled. To meet the accuracy criteria of the operator, oil- and gas-mode calculations were concurrently implemented while continuously flowing both oil and gas streams.
Recompleting wells with 40% increase in total field production

The dynamic response of PhaseTester equipment with Vx technology made it possible to quickly estimate well performance, even during the ICV slot changes. Well performance analysis of the multirate tests was conducted to quantify well performance and deliverability. Using PhaseTester equipment with Vx technology introduced a number of advantages for the operator, such as optimizing the oil inflow by controlling the gas inflow with an ICV and dynamically measuring the flow rates, building a choke–ICV correlation to be used as a baseline, and accurately back-allocating the surface production to two reservoirs.

The successful application of the AGL method was proven at the full-field scale by the operator. All wells were recompleted and put back on sustained production, and total field production increased by 40%. Further, the operator required fewer well interventions and accrued significant capex savings.

<table>
<thead>
<tr>
<th>Flow Period</th>
<th>CGR, m³/MMm³</th>
<th>C7+, Mole %</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>369</td>
<td>3.989</td>
</tr>
<tr>
<td>4</td>
<td>365</td>
<td>3.917</td>
</tr>
<tr>
<td>5</td>
<td>324</td>
<td>3.517</td>
</tr>
<tr>
<td>6</td>
<td>240</td>
<td>2.682</td>
</tr>
<tr>
<td>7</td>
<td>250</td>
<td>2.740</td>
</tr>
<tr>
<td>8</td>
<td>892</td>
<td>7.024</td>
</tr>
<tr>
<td>9</td>
<td>670</td>
<td>5.585</td>
</tr>
<tr>
<td>10</td>
<td>553</td>
<td>4.571</td>
</tr>
</tbody>
</table>

Measured condensate/gas ratios (CGRs) and mole percentages (C7) of the recombined fluid. Flow periods 3–7 are at a fixed surface choke at various ICV slot settings while flowing only the gas zone to the surface. Flow periods 8–10 are at a fixed surface choke at various ICV slot settings while flowing oil and gas zones commingled.

Oil vs. gas flow rates as measured on a fixed surface choke at various ICV slot settings.

Optimal oil production 74 m³/d at 55 ksm³/d gas rate at 60 degF and 14.7 psi

Commingled flow of oil and gas

Oil zone is isolated

slb.com/Vx