SUMMARY

These days, an increasing number of completion devices are activated by pumping balls downhole to engage a nipple or sleeve with a slightly smaller ID than the ball. The technique is safe and effective. Unfortunately, it is not without problems. Many operators have noticed that their completions fail to produce as expected from log analysis or offset well performance. Root cause analysis pegs ball failure as the most likely cause. Differential pressure across a seated ball can cause it to deform and jam in its seat. Normal flow-back will not dislodge a jammed ball and as a result all zones below the blockage are prevented from producing. The only solution is to mobilize a Coiled Tubing unit and attempt to drill out the ball. Operators are forced to take the added cost and risk of milling out the balls and seats, often blindly as the obstruction problem created may be hiding by other well production conditions.

The ELEMENTAL* degradable technology alloy ball from Schlumberger does its primary activation job perfectly. Moreover, it typically returns to surface during cleanup, but if it doesn’t, it will completely degrade to a harmless powder within a few days. Other degradable balls can fail to degrade in wells with low bottomhole temperatures. The ELEMENTAL reaction is controlled and exothermic, so it generates it’s the right amount of heat to speed up degradation in a consistent manner. ELEMENTAL balls are tough. They can withstand 10,000 psi differential pressure without deforming, fracturing or jamming in their nipples. The new degradable activating balls have all the properties necessary to perform their designed purpose with none of the drawbacks of conventional balls. Any water-based fluid triggers the reaction. ELEMENTAL activation balls work in any ball-actuated completion module.
Many operators using ball drop systems for multistage stimulation have noted that their completions fail to produce as expected from logs or offset wells. After root cause analysis, they conclude that ball failure is the likely reason. Differential pressure across the ball seat can cause the balls to deform and get jammed in their seats; as a result, they are unable to be dislodged during flowback. Deformed and jammed balls are serious conditions that can plug all production from beneath. The only solution is to trip into the well with coiled tubing and mill out the balls and seats. Aside from the added cost and risk, this process can create additional damage from fluids and debris to the recently created fractures.

The ELEMENTAL* degradable alloy fracture ball eliminates problems related to deformed and jammed balls.

The key to such innovative technology is its twofold degradation process. The first part involves a series of micro-galvanic cells built within the structure of the material. Similar to a car battery, crystallographic phases electrochemically interact in the presence of an electrolyte (water), degrading the material. The second part is the engineered inability of the material to passivate, or form a protective layer on the outer-most surface. In hours to days, this dual effect leads to full degradation of the ELEMENTAL alloy fracture balls in the presence of water-based fluids.

The product of the degradation process is a fine powder that does not impede production and is easily circulated out during cleanup. Furthermore, the self-heat-generating nature of the degradation process makes this technology especially applicable for low temperatures, where degradation becomes a difficult challenge. Even in this environment, ELEMENTAL alloy fracture balls perform within the same time operating window.

The high-strength, impact-resistant degradable balls are stronger than conventional materials. They are capable of sustaining differential pressures up to 10,000 psi without deforming or fracturing, so there is no risk of jamming or plugging the well. The new degradable fracture balls have the properties necessary to accomplish their designed purpose without the drawbacks found in conventional balls.

With the advent of the new degradable technology, operators can be sure that they are getting what they have paid for. By eliminating the risk of balls breaking or jamming in the nipple, considerable time and money are saved because the clean-out trip with a mill is unnecessary. With the confidence that each well is performing to its limit, operators can rest assured that production will reach its full potential.

**Case Studies**

Since their introduction, the new ELEMENTAL degradable alloy fracture balls have been run in more than 1000 stimulation stages in the US, Canada, and other international locations. A wide variety of well depths, temperatures, pressures, and well fluids were encountered. No problems were experienced with the balls. One operator wanted proof that the balls could be milled out if they had to be. They were milled out successfully with no special operational requirements.

Job completed in five hours—no ball residue found

Degradable balls were run in a six-stage well scheduled to be fractured using the Schlumberger HiWAY* flow-channel fracturing technique. The pressure log showed a clear ball signature for all stages. Different fracturing profiles for the stages confirmed that each was fully isolated from the others. After treatment, the well did not flow back naturally to surface. This was expected, and coiled tubing was brought in to lift the well and recover any debris or ball residue. The coiled tubing passed...
through all six nipples, indicating that there was no ball residue impeding flow. The entire job was completed in just five hours.

Well with 16 stages treated—balls from the deepest 11 fully disintegrated

Another well with 16 stages was treated using low-temperature foam at 50 degC (122 degF). After treatment, five balls were caught in the ball catcher 53 hours after completion of the 16th stage. After 72 hours, the ball catcher was rechecked and found to be empty. A comparison of this well’s production with that of a nearby offset well indicated that all stages were open. Five partially degraded balls were recovered from the last five stages pumped. The balls from the deeper 11 stages fully disintegrated, as production demonstrated.

References