Geothermal in the Oilfield: Using Hot Produced Water for Power Generation

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At the Rocky Mountain Oilfield Testing Center (RMOTC) near Casper Wyoming, a demonstration project has been completed using what was a common waste product from oil production - large volumes of “hot” water - to generate electricity. The Teapot Dome oilfield produces 40,000 barrels of water per day at near 200°F from the Tensleep oil reservoir, about 5500 ft below the surface. This water is relatively fresh (<2400 TDS), and is discharged into Little Teapot Creek after three cooling ponds. Working with ORMAT Nevada Inc., RMOTC installed into this flowstream a binary “Organic Rankine Cycle” geothermal power generation unit, which uses isopentane as a closed system working fluid (boiling point of 85°F). The unit has been operational since September 2008. It averages 180 KW output, which helps to offset the power requirements of the oil field, saving substantial operating costs for electricity to power the pumps. This is the first application of geothermal power generation in an oilfield in the U.S.

The Teapot Dome region has an anomalously high heat flow - the gradient is about twice the average for the region. Published geothermal-assessment maps indicate east-central Wyoming not to be a promising area for geothermal energy. But there is something unusual about the geo-hydrologic system in the area that heats up the groundwater to this degree, and investigations are underway to identify the causes.

There are many other locations in the U.S. where conditions are favorable to apply this technology. RMOTC produces the water from relatively shallow depths, but many other “stripper” oilfields that pro-duce water along with the oil from deeper depths, and are currently re-injecting the water, may be candidates as well. The binary system allows lower temperature fluids to (indirectly) run the turbine. Often the economic limiting factor for ongoing oil production is the cost of electricity. Geothermal has the potential to extend the economic life of the oil field, as well as increase the oil reserves and ultimate recov-ery. Also, oil fields by nature have existing infrastructure in the form of wells, flowlines, and gathering systems, reducing the up-front cost of geothermal installations.

Other innovations being tested at RMOTC include the improvement of drilling technology to reduce costs for drilling geothermal wells. In addition, advanced geophysical methods are being investigated to identify and characterize geothermal potential not only in the oil reservoirs, but also in the granite basement rocks at depth, for future EGS development.