Scientists at NASA Ames Research Center have developed a system for evaluating status and response of a mineral-producing field (e.g., oil and/or gas) by monitoring selected chemical and physical properties in or adjacent to a wellsite headspace. Nanotechnology sensors and other sensors are provided for one or more underground (fluid) mineral-producing wellsites to determine presence or absence of each of two or more target molecules in the fluid, relative humidity, temperature and/or fluid pressure adjacent to the wellsite and flow direction and flow velocity for the fluid. A nanosensor measures an electrical parameter value and estimates a corresponding environmental parameter value, such as water content or hydrocarbon content. The system is small enough to be located down-hole in each mineral-producing horizon for the wellsite.

Benefits

• Improves the quality and production of the oil by monitoring the chemical composition in wells
• Allows data to be relayed back to decision makers for possible modification to production methods
• Increases oil production
• Has minimal impact on reservoirs

Applications

• Measuring hydrocarbon content in oil drilling
• Methane detection in mining industry
• Environmental monitoring
• Chemical and gas sensing
• Medical and food industry
Technology In Detail

Current mechanical, electromagnetic or optical sensor technologies are relatively low-tech and passive, and do not acquire data at sufficient distances to permit reservoir managers to fully comprehend the chemical composition, volume and dynamics of the petroleum in a given reservoir. The most advanced tool for monitoring the wells is a multiphase flow meter. It monitors the flow rate of oil, water and gas. There is no tool or methodology that can provide the information about the quality of the oil such as hydrocarbon content and the oil to water ratio, which relate to the volume and production enhancement methods (i.e. steam injection).

In large part, the future of the oil and gas industry depends on the ability to better understand the volume and dynamics of a reservoir to optimize production and avoid damaging the reservoir or interrupting flow through over-production or other production enhancement methods such as steam injection. The disclosed chemical nanosensor network, combined with the physical (micro)sensors such as humidity, temperature and pressure, acoustic or electromagnetic wave, form a monitoring system can substantially improve the quality and production of the oil by monitoring the chemical composition in wells and then relay the information to the decision maker to modify and fine tune the production enhancement methods in real time to improve the oil quality and control the quantity. Without adequate and reasonably complete data for a candidate wellsite, the success rate is presently 20-25 percent and has not increased much in the last 20 years.

The geographic market for this technology is global. Large and small U.S. and North American reservoirs are applicable, as well as reservoirs worldwide. The potential of this new technology to dramatically increase oil production will have a significant downward impact on world prices. Even a marginal enhancement of the sensor capability of oil and gas monitoring will produce exponential benefits. The potential of heavy oil is entirely technology driven. In situ production methods (as opposed to open pit mining methods) require steam injection that causes the liquefaction of tar sand deposits. But without solid data regarding the dynamics of the geological system, production techniques result in only a 20-25% recovery rate. The future ability of conventional oil and gas production to meet world energy demand while also reducing political tensions depends almost entirely on increasing the productivity of known reserves through new technology significantly upward from the current average of approximately 33%. There currently is no active monitoring system on the market capable of meeting that requirement.

Patents
This technology has been patented (U.S. Patent 7,875,455).

Licensing and Partnering Opportunities
This technology is part of NASA’s Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about licensing possibilities for this technology for commercial applications.

For More Information
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