

## Feasibility Study on Treatment & Utilization of Oilfield Produced Water in Oman

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Oilfield wastewater (produced water) is one of the biggest environmental problems facing Oman today. Produced water is the greatest waste product generated in the production of crude oil in Oman. The volume of produced water is currently estimated at more than 6.5 times greater than that of oil production. In a single southern oilfield, Nimr, the quantity of produced water is roughly 250,000 m<sup>3</sup> per day.

Disposal to shallow aquifers, or shallow well disposal, risks the possibility of pollution of precious groundwater resources. For disposal to deep aquifers, or deep well disposal, operational costs are significant, as the high pressure pumps that must be used for such disposal, have high energy requirements, i.e., high electrical power consumption.

Treatment and subsequent utilization of water for agriculture is one alternative to disposal to aquifers. Although salt concentration in produced water of southern oil fields in Oman is somewhat high in terms of irrigation, 3000-6000 ppm, such water can be utilized for irrigation of certain salt-tolerant plants if the oil is removed and the volume of water for irrigation is properly controlled.

A process whereby produced water can be effectively treated for use in irrigation was developed through a joint study, between Sultan Qaboos University (SQU), Oman, and Shimizu Corporation. This initial study was supported by Petroleum Energy Center (PEC), Japan/Japan Cooperation Center Petroleum (JCCP) and conducted during 1997-2001. The study included both laboratory-scale experiments, and the operation of a 2 m<sup>3</sup> per day capacity pilot plant, treating oilfield produced water using an air-flotation/filtration/adsorption combined process.

Based on the technical success of the pilot-scale test, a commercial-scale facility was then designed and its economics were assessed through a second joint study between SQU and Shimizu. This study was supported by Ministry of Economy, Trade and Industry (METI), Japan, and conducted during 2002-2003.

Based on the results of pilot scale tests, a produced water treatment facility of 40,000 m<sup>3</sup> per day capacity was designed for Nimr Oilfield. For this study, rhodesgrass was selected for irrigation calculations, due to its salt tolerance and its market demand. At an irrigation rate of 12.5 mm per day, more than 300 ha of land area can be irrigated with the water treated by the facility. Assuming a rhodesgrass yield of at least 30 tons per ha per year, more than 9,000 tons of rhodesgrass can be harvested per year, using water treated by this facility.

Cost was estimated for the construction and operation/maintenance (O&M) of the 40,000 m<sup>3</sup> per day water treatment facility for Nimr Oilfield. Initial cost was estimated to be around US\$19 million, and O&M cost was estimated to be around US\$4,700 per day, if the rate of US\$1 is JPY111.

Present value (PV) of this system is estimated. PV for water treatment was calculated at US\$0.125 per m<sup>3</sup> of produced water treated. PV of recovered oil was calculated at US\$0.022 per m<sup>3</sup> of produced water treated. If the value of recovered oil is subtracted from the PV for water treatment, net PV would be calculated at US\$0.103 per m<sup>3</sup> of produced water treated. Such a unit cost would be significantly lower than that of deep well disposal (US\$0.4-0.5). If proceeds from sale of agricultural products are considered the net PV unit cost would be even lower. As such, this indicates that such a facility would be economically feasible.