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Please fill in your abstract title.	Effective and Sustained Cone Control Essential to Accelerate and Maximise Reserves Recovery in Water Drive Reservoirs - North Kuwait

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Abstract

Objectives/Scope:
An effective Cone Control Completion (CCC) has been developed at Kuwait Oil Company, where significantly higher oil production rates were achieved with much less water production at surface. The Inverted (bottom-discharge) ESP is the key component that facilitates the high fluid disposal rates thereby creating the required drawdown for effective water cone management. Ensuring sustained operation of this system, however, is key to accelerating and maximizing the recovery of reserves from this age-old challenging environment.

Methods, Procedures, Process:
The objective of this technology is not to reverse the water cone, but to control it. The upper segment of the oil column is partially perforated no more than 30% of the total column length. The cone control perforations are made at, or just below, the oil/water contact. The disposal interval is perforated within a pressure-depleted reservoir in need of pressure support, or within a non-producing aquifer. Oil production is increased gradually until the water cone is conclusively established. The inverted ESP is then energized to create a drawdown that effectively retards the progression of the water cone into the oil perforations. Management of the established water cone is achieved by adjusting the ESP rate to balance the drawdown below the oil/water contact to be equal to the drawdown in the oil perforations.

Results, Observations, Conclusions:
In the one well that was completed with the CCC initially, the vertical permability was so high that the water cone was established within hours, and an immediate reduction in watercut in the produced fluid was observed when the ESP was subsequently energized. Subsequent ESP discharge pressures, however, indicated that the disposal injectivity was exponentially less than the productivity of the control perforated interval, despite similarity in log-derived permeability. A second candidate produced for several months, developing a watercut >90% before CCC installation. The very high log-derived permeability of the disposal aquifer was similar to the permability of the interval below the oil/water contact. Disposal injectivity was estimated to be equal to, if not higher than, the oil perforation productivity. Disposal injectivity was found to be significantly less, thereby severely limiting the drawdown achieved below the oil/water contact. A third candidate also showed that the disposal aquifer had very favorable log-derived permability. Again, the actual injectivity was significantly below expectation. The delta-P across the ESP was so high that the ESP packer penetrator was compromised. Disposal Injectivity has proven to be key to the inverted ESP run life, and effective cone management.

Novel/Additive Information:
As fully oil-saturated water drive reservoirs are now extremely rare, this effective Cone Control system is an excellent technology for improved oil recovery from the remaining oil rims in water drive reservoirs.