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Research of Modelling and Controlling for Groundwater Flow System around Oil Storage Caverns

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Water-sealed underground oil storage caverns are generally artificially excavated in rock by choosing a suitable area. To prevent gas and oil leakage from damaging the ecological environment while the oil storage caverns are excavated or operated, they should stay below a certain groundwater level, ensuring that the water pressure in the fractured rock around oil storage caverns is greater than the oil pressure at the same position. Modelling and controlling of groundwater flow system are the technical difficulties before running the underground oil storage caverns. The slug test system of estimating parameter developed by Hohai University was used to estimate the hydrogeological parameters of wall rock around oil storage caverns, and the combination of tracer test in drill hole and fracture statistics in wall rock was utilized to analyze the flow characteristics of water in fracture controlled by fault fractured zone. To analyze the seepage characteristics of water-sealed underground oil storage caverns, a calculation software was programmed based on the Signorini type variational inequality formulation. The most effective controlling method of groundwater system during operation period of oil storage caverns was proposed by the influence weight sequence of controlling factors to seepage and inflow including the key design parameters of water curtain system, pressure of injecting noble gases (nitrogen) above storage oil, height of storage oil in caverns, which was estimated by combining analytical hierarchy process in operations research and numerical simulation program of oil storage caverns, and it was changing the injecting water pressure of water curtain boreholes. The seepage simulation model was applied to estimate the seepage field and water inflow of an underground oil storage caverns during the future operation period.