Seepage Investigation of Al-Fulaij Recharge Dam Using a Numerical Model

Salim Majed Al Hashmi

Abstract

It is well known and established by many researchers that, Gypsum dissolves on contact with circulating water leading to volume reduction and Anhydrite expands on contact with water leading to volume increase. Al-Fulaij recharge dam (3.3 km long, 7.7 m high and 3.7 million m³ storage capacity) which is located in Barka-Rumays area of Al Batinah coast, about 40 km west of Muscat has the problem of excessive seepage (estimated approximately between 5,000 and 12,500 m³/day). Some remedial measures have been carried out which included mainly construction of upstream blankets and cutoff walls. Unfortunately these measures did not stop the seepage due to many reasons and almost the same amount of seepage was noticed again during impoundment. The objective of this study was to investigate possible causes for excessive seepage at Al-Fulaij recharge dam and to suggest remedial measures. A finite element program (SEEP W 2007) was used to simulate the dam with the most possible causes and with the suggested remedial measures. It was found that the most possible cause of the excessive seepage is the presence of permeable soil layer underneath the dam due to the dissolution of the gypsum material. As a result of this cause the seepage quantities increased tremendously than the expected amounts between 70% and 104%. There is also a sign of settlement that has taken place because of gypsum leaching from foundation. Two methods were proposed to control the seepage and they have been modelled by the program to validate their efficiency. The first method is the installation of geomembrane at the upstream face of the dam. The second method is performing grouting at the foundation of the dam. It is expected that, using geomembrane will reduce the current seepage by about 57% while conducting grouting at the dam foundation will reduce the seepage by about 45%. It was concluded that performing grouting is the best option although geomembrane gave better results. This is the case because the total process of installation is costly and needs special care as well as it needs protection from sunlight and vandalism. Grouting is more suitable and has also the advantage of enhancing the dam stability by filling the voids and cavities which were created by gypsum leaching.