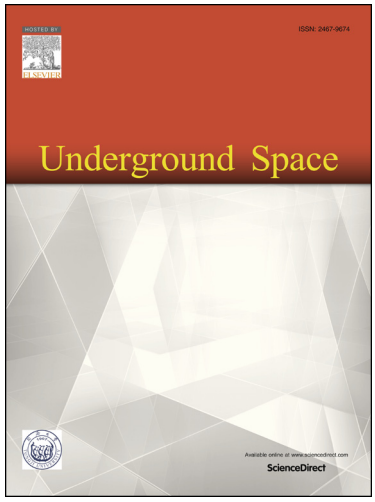
Accepted Manuscript



Transient electromagnetic detection method in water-sealed underground storage caverns

Fang Lin, Shougen Chen, Guowei Ma

PII: S2467-9674(16)30008-3
DOI: http://dx.doi.org/10.1016/j.undsp.2016.07.001
Reference: UNDSP 3

To appear in: *Underground Space*

Received Date: 5 June 2016
Revised Date: 1 July 2016
Accepted Date: 6 July 2016

Please cite this article as: F. Lin, S. Chen, G. Ma, Transient electromagnetic detection method in water-sealed underground storage caverns, *Underground Space* (2016), doi: http://dx.doi.org/10.1016/j.undsp.2016.07.001

Transient electromagnetic detection method in water-sealed underground storage caverns

Fang Lin • Shougen Chen • Guowei Ma[1]

Full contact details of corresponding author

Name: Guowei Ma, Professor
E-mail: guowei.ma@uwa.edu.au

Abstract: Taking advantage of the water sensitivity of the transient electromagnetic method (TEM), this study assesses the effectiveness of the water curtain system for underground LPG storage caverns during the excavation period. It also detects fracture water flow during the excavation process in light of the practice of two pilot large underground LPG storage caverns in China. Comparative maps of apparent resistivity derived from TEM measurements before and after water-filling during the excavation process have been discussed to improve the quality of the water curtain system. This is the first case to apply TEM to detect the quality of the water curtain system during the construction of underground LPG storage cavern projects, and it is found to be practical, more visualized and worth popularizing.

Key word: LPG storage; Transient electromagnetic method; Underground caverns; Water curtain system; Fracture flow

Introduction

Underground caverns are the safest means of storing hydrocarbons, and China claims an increasing oil demand with its rapid economic development (Lee et al., 1996, Lee & Song, 2003, Lin et al., 2016). Most previous researchers have focused on the overall performance of the storage facility, but few studies have addressed the quality of water curtain systems. The water curtain system plays an important role in water-sealed underground rock caverns. The storage facility must be located at a sufficient depth below the groundwater table and in the vicinity of a permanent source of groundwater recharge so that the natural hydrostatic head cannot be depleted by drainage into the cavern. In other words, the groundwater pressure around the caverns should be strong enough to prevent any petroleum leakage (Lin et al., 2015). Therefore, reliable estimation of groundwater inflow into underground openings is of critical importance for the design and construction of an underground facility in rock mass. Among them, Rehbinder et al. (1988) developed an experimental setup to investigate the criterion of no outflow from a cavity using water curtain holes around it. Li et al. (2013) built up an experimental physical modelling system to evaluate the performance of water curtain systems with different geometrical parameters. Wang et al. (2015) investigated several issues pertaining to the design of the water curtain system and the arrangement of boreholes for a pilot underground oil storage cavern in DEM & FEM and field testing. However, owing to the complexities

F. Lin · Shougen Chen
MOE Key Laboratory of Transportation Tunnel Engineering, Southwest Jiaotong University, Chengdu 610031, Sichuan, China
e-mail: felyo@foxmail.com
F. Lin · GW Ma
School of Civil, Environmental and Mining Engineering, The University of Western Australia, Perth 6009, Western Australia, Australia