Safety Monitoring of Underground Oil Storage Facilities using AE and MS Technique

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Abstract

Acoustic emission (AE) and microseismicity (MS) are the phenomena of radiation of elastic waves in material that undergoes irreversible changes such as crack occurrences, propagations or coalescences etc. These are occurred due to the external changes. The amounts and rate of these tend to rapidly increase before the macro-scale or large-scale failure of the material. The monitoring method using this characteristic of AE and MS is known to be useful in detecting the failure warning of the material and structure compared to the conventional methods to monitor displacements, stresses, groundwater and etc. This method also has an advantage to cover a wider area because of the volume measurement unlike the conventional spot measurements. This study introduces the self-developed AE/MS monitoring system and its application to underground structures, and looks into how to apply the system for monitoring the safety of underground oil storage structures during construction and operation stages. The self-developed system consists of a separated local device in a field and a server computer in the office for a stable field application. It has the own operating program with seven individual modules. The main functions of the program are stable measurement, alarm, analysis of the amount/rate of events and source location, etc. The self-developed system was applied to the underground oil storage facility and deep tunnel under construction for the safety monitoring. In addition, the effectiveness and compatibility of the system were tested through the utilization on a rock slope and an underground research facility. In case of large caverns such as underground oil storage, a safety monitoring is one of the important issues during construction and a risk management is required for response the internal and external changes during operation. External forces such as earthquakes can induce the changes or problems of fault zone, clogging and plug etc. surrounding oil cavern. Therefore the multi-criteria monitoring method combined with AE/MS technique to detect micro & early damages and groundwater survey to monitor the performance of the water curtain system, should be considered for insuring the safety during construction and operation.