In-situ testing and data applications for upstream-constructed coal refuse impoundments

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Abstract

Upstream-Constructed Coal Refuse Impoundments have unique characteristics as compared to the other engineering structures as the hydraulically-deposited fine coal refuse (FCR) is used as the foundation material. Key design aspects for such structures include developing and implementing risk-appropriate in-situ field and laboratory testing, characterizing embankment and foundation materials, and the FCR material. FCR requires comprehensive evaluation of the physical properties, undrained shear strength, seepage and settlement parameters. These parameters are then used to analyse the stability during construction and determine the rate of placement/loading Coarse Coal Refuse (CCR) material on top of the FCR without compromising the stability of the system.

Information to develop the site exploration program for upstream-constructed coal refuse impoundments, and key elements required for site characterization. Cone penetration testing (CPT), and CPT data variations for different materials (depending on their behaviour) and the use of seismic CPT with pore pressure measurement (SCPTu) for upstream construction are key. The pore pressure dissipation data obtained from SCPTu can be interpreted to obtain the estimates of groundwater conditions, and seepage properties, particularly permeability and consolidation characteristics. How CPT data can be incorporated into the analyses will be discussed.

A case study is presented in which the required strength of the FCR is determined using the stability analysis to achieve the short-term factor of safety of 1.3. This strength is then compared with the strength gained by the FCR material for different construction/loading rates. Once the loading rate is established, and placement of the fill starts, the next step is monitoring the response of the FCR material to ensure consistency with the assumptions made in the analyses. This is achieved by installing rapid response piezometers at strategic locations and monitoring the excess pore pressures developed during construction. Action levels are developed for monitoring of the piezometers, which indicate the system will remain stable (having factor of safety of 1.3 or greater) as long as the excess pore pressure readings from installed piezometers are below the action levels. The monitoring of the pore pressures from the same case study as discussed above will also be presented and compared to the action levels.

In conclusion, this paper presents the details of upstream-constructed coal refuse impoundments, developing the investigation plan for site characterization for such impoundments including effective use of SCPTu data for loading rate analyses, and effective monitoring of the performance of the system.

Keywords: Fine coal refuse, characterization, stability, pore pressure, monitoring