Performance of soil mix technology low permeability reactive in-ground barrier walls for contaminated land applications

The current work was undertaken to advance the use of soil mix technology (SMT) in the construction of in-ground low permeability barrier walls (i.e. cut-off walls) and formed part of the Soil Mix Remediation Technology (SMiRT) project. The work involved the SMT installation of six low permeability barrier walls at a contaminated site, each with a different grout mixture used. The grout mixtures incorporated various ratios of Portland Cement (PC), bentonite, Ground Granulated Blast-furnace Slag (GGBS), and Pulverised Fuel Ash (PFA) as well as novel reactive additives zeolite and organoclay. The main focus of the research was an assessment of the barrier walls ~3 years after construction by a combination of laboratory and *in situ* tests. In addition, a comparison study to laboratory mixed specimens was undertaken, as well as an investigation into shrinkage of SMT barrier wall materials and its compensation by reactive magnesia addition. It was found that generally the SMiRT barrier walls performed well, however, issues were identified relating to construction and on-site conditions. There was an apparent lack of grout in two of the barriers resulting in low strength, which was attributed to poor mixing in the field due to plastic sheeting present in the site made ground. Core tests found general unconfined compressive strength (UCS) values of ~2.5 MPa, permeability values of 10^{-7} m/s to 10^{-9} m/s, and leachable heavy metals of ~0.3 mg/l and organics of ~100 mg/l. Of the six barrier walls, those that incorporated GGBS and zeolite were found to have the highest strength and lowest permeability and contaminant leaching. The results showed that the SMT barrier walls were able to withstand significant contamination present at the site and compared well to other previously completed SMT projects. An assessment of laboratory mixed specimens discovered a strong correlation between the permeability of the laboratory mixed specimens and results of *in situ* permeability tests undertaken at the SMiRT site. The laboratory study also demonstrated that those specimens containing GGBS and zeolite had the greatest strength and lowest permeability and contaminant leaching. However, the effect of organoclay addition on the sorption of the contaminants was found to be limited due to the unsuitability of the quaternary ammonium compound (QAC) used to modify the organoclay. Shrinkage of SMT barrier wall materials was discovered to be exacerbated by the bentonite component, however, it was found that shrinkage of these materials can be fully mitigated by the addition of reactive magnesia.