First Ever Heavy Metal Stabilization Project in Korea

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Background/Objectives. Since the Soil Environment Conservation Act (SECA) was enacted in 1996, the site remediation business in Korea has grown to a $0.6 billion/year scale today. SECA, however, allows only mass removal technologies for soil remediation; consequently, heavy metals contaminated soil in Korea has typically been treated with costly soil washing. Upcoming amendments to SECA are expected to allow risk assessment and risk reduction based technologies. Janghang Smelter has been operated since 1936. The area surrounding Janghang smelter had been contaminated by flue dust and resulted in soil contamination by various heavy metals including As and Pb. The government purchased this land and initiated a comprehensive remediation plan in 2009. The first stage of the plan was carried out from 2012 to 2016 and involved excavation of contaminated soil for treatment with a soil washing process. The second stage was designed with soil washing again. There is, however, a natural park with two pine forests in the Janghang site and, due to local government and citizens' strong desire to preserve the natural park, the government decided to apply a risk reduction based remedy (i.e., heavy metal stabilization), which has never before used in Korea.

Approach/Activities. Commercial heavy metal stabilization products from several vendors were compared in a laboratory treatability study followed by a pilot study, in the spring and summer of 2017. Multiple evaluation methods, including SPLP, a modified sequential extraction procedure (SEP) to differentiate the five As fractions: (1) non-specifically sorbed; (2) specifically-sorbed; (3) amorphous and poorly-crystalline hydrous oxides of Fe and Al; (4) well-crystallized hydrous oxides of Fe and Al; and (5) residual phases, plus a Solubility/Bioavailability Research Consortium (SBRC) protocol were applied to provide a comprehensive evaluation of stabilization performance and risk reduction. The results were used to select the best reagent for the full-scale application which is scheduled for November 2017 to spring 2018.

Results/Lessons Learned. Two MetaFix® recipes (H-1E and I-6A) and another product (AC-5) showed good results in lab test in terms of SPLP leaching concentration reduction. H-1E reduced up to 97% of As SPLP concentration in sandy soil while I-6A reduced up to 94% of As SPLP concentration in silty clay soil. AC-5 showed poorer SPLP performance for sandy soil but better for silty clay soil than MetaFix®. MetaFix® showed a clearer trend of converting relatively mobile fractions (1) and (2) to more stabilized fraction (3), and converting fraction (4) to (5) in SEP results. In addition, MetaFix® performed better than AC-5 in the SBRC protocol. MetaFix® I-6A and AC-5 were further tested through a pilot at the site. A 10m^2 plot was assigned to each of the 2 products in the pilot scale testing. The targeted treatment zone was ~ 15 cm deep. The AC-5 reagent showed more reduction of SPLP As than I-6A (54% vs. 13%). The SEP and SBRC results of I-6A were consistent with the laboratory test results, while AC-5's SEP results were inconclusive and its SBRC protocol risk value was even higher than the untreated control. Based on these findings, I-6A was selected for the upcoming full-scale application.
Site background, laboratory test, pilot study, and full-scale data, implementation process, long term monitoring protocol (at least 2 years after implementation), feedback from Korean Ministry of Environment, milestone significance to the Korean remediation market will be presented.