Innovative Steam Auger Mixing and ISS Combined Remedy Bench-Scale Simulations

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Background/Objectives. Historically, traditional single technologies have been an ineffective remedy on a complex waste material at a confidential chemical manufacturing site in the eastern United States. The engineering firm wanted to investigate the effectiveness of a combined remedy of in situ steam mixing and in situ solidification/stabilization (ISS) using laboratory treatability simulations. The objectives of the treatability study were to characterize the physical and chemical properties of the mixed waste material sampled from the site, evaluate the reduction in contaminants of concern (COCs) through the use of in situ steam injection during auger mixing, and evaluate potential solidification reagents and reagent addition rates capable of improving the physical properties, primarily workability and strength of the steam treated wastes.

Approach/Activities. KEMRON designed, fabricated and utilized a proprietary laboratory scale steam auger mixing apparatus specifically designed to simulate full scale steam auger mixing technology and in-situ reagent injection. The waste material was characterized as a very low pH thick tar heavily impacted with gasoline range organics and polycyclic aromatic hydrocarbons. KEMRON performed two initial ("trial run") steam injection simulations on the tar material. These trial runs were to evaluate the effectiveness of prototype apparatus to simulate steam treatment. The trial runs allowed KEMRON to modify to the system to provide an effective steam simulation. KEMRON performed additional steam injection simulations on composite waste material, neutralized composite material, and individual materials. The steam injection simulations were performed at a duration of approximately 3 hours. During the steam treatment, off gas samples were collected to monitor mass removal. KEMRON extracted material periodically through the specially designed sampling port as well as extracting air samples for flame ionization detection (FID) screening. The steam treated material was used to evaluate the effectiveness of common stabilization reagents such as Portland cement, corn cob grit, cement kiln dust (CKD), blast furnace slag, and lime kiln dust (LKD).

Results/Lessons Learned. The results of the combined remedy study revealed significant mass removal through steam treatment allowing for surprisingly effective stabilization of the material using very feasible addition rates of common reagents. Many reagents quickly transformed the steam treated tar like material into a workable soil like matrix. The most promising reagent to create a workable soil like matrix appears to be LKD. The use of 10% LKD created a soil like matrix immediately after introducing and mixing the reagent either by slurry or dry to the treated material.