Long-Term Challenges for EVO Biobarrier Performance

Vitthal Hosangadi (Vitthal.hosangadi@noreasinc.com) (NOREAS, Inc., Irvine, California, USA)
Pamela Chang (Battelle, Columbus, Ohio, USA)
Michael Pound (NAVFAC SW, San Diego, California, USA)

Background/Objectives. Hexavalent chromium [Cr(VI)] and volatile organic compounds (VOCs) have been detected at elevated concentrations in groundwater (over 100 milligrams per liter) proximal to the Bay in Operable Unit 20 (OU 20) at Naval Air Station North Island (NASNI) in Coronado, California. The VOC plume is ½ miles long, and the Cr(VI) is at the leading edge of the VOC plume. Enhanced in situ bioremediation (EISB) technology was implemented in 2012 by injection of emulsified vegetable oil (EVO) for microbial reduction of Cr(VI) to Cr(III) and to support reductive dechlorination of VOCs. EVO had been tested (along with other donors) on bench-scale prior to field-scale injections. Commercially available microbial cultures were also injected. The injection wells form a 700-foot biobarrier (PRZ). This PRZ is referred to as the upgradient PRZ or UGPRZ and consists of 38-dual screened injection wells, some of which are located inside a building. During routine monitoring a waxy soap/grease material (termed “crud”) was observed in most of the injection wells. Preliminary tests indicate that the material is comprised of fatty acids and salts. A second round of injections was initiated in late 2018 after a well redevelopment process, but injection flow rates were a fraction of those observed in 2012 (with some not accepting any injectate). Some of the wells without crud also did not accept any injection, which suggests that this occluding material extends into the formation (termed “scum”). It is hypothesized that the crud/scum (collectively termed “scrud”) is caused by interaction of the EVO with naturally occurring minerals in groundwater. At the same site there is a second PRZ called the DGPRZ. The DGPRZ has over 400 wells that were injected in 2015, replenishment planned in 2020. Crud has been observed in some of these wells. There is anecdotal evidence that this problem has been encountered at other sites. A cost-effective solution to address the scrud is desired, given the number of wells in the DGPRZ and the potential impact on remedy performance.

Approach/Activities. ***Step 1–Bench Tests:*** A number of materials were tested on a bench scale to evaluate their effect on the crud; including acids, bases, surfactants (such as Biosolve and Ivey-Sol), and chelating agents with and without heat. In a number of cases, the crud dissolved after being mixed with heated material, but reformed when it cooled down, which suggests that it was heat (and not necessarily the material itself) that caused the crud to dissolve. From an implementation standpoint, adding heat presents a logistical challenge (due to need for heating equipment). Consideration was also given to the possibility that if a material is added to the well and is successful at dissolving the crud in the well, it may cause a larger problem in the aquifer matrix by causing the scum to reform at a further distance from the well. After extensive testing a multicomponent “Scrud Remover” consisting of a number of innocuous ingredients (alcohols, mineral salts, and buffer) was formulated for cleaning the wells. ***Step 2–Field Tests:*** The Scrud Remover was incorporated into a robust well development process for clogged wells. Injectability tests were performed before and after the Scrud Remover-enhanced well development process. The after tests were completed 5 days, 25 days, and 45 days after development. Rhodamine tracer was incorporated into selected injection wells that are in close proximity to test wells to evaluate transport of injected fluids. Levels of Rhodamine were measured in proximal wells to evaluate transport of injected fluids.

Result/Lessons Learned. It is anticipated that the results will allow for evaluating long term efficacy of the Scrud Remover in terms of injectability, as well as prevention of scum formation

within the aquifer matrix. The results will be used to optimize a much larger replenishment effort that is expected to occur in 2020. If successful, the Scrud Remover will be available commercially.