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EMAIL REGARDING U S EPA REGION VI COMMENTS ON SITE 16 PRECIPITATION ISSUES NAS CECIL FIELD FL
11/15/2011
U S EPA REGION IV

NAS Cecil Field
OU 7, Site 16
EPA Environmental Engineer review of the Site 16 Precipitation Issues in ISCO Wells

From: Vaughn-Wright.Debbie@epamail.epa.gov [mailto:Vaughn-Wright.Debbie@epamail.epa.gov]
Sent: Tuesday, November 15, 2011 4:28 PM
To: Sanford, Art F CTR OASN (EI&E), BRAC PMO SE; Vaughn-Wright.Debbie@epamail.epa.gov; Grabka, David; Jonnet, Mark; Michael.Halil@CH2M.com; Jessica Keener; Simcik, Robert; mark.e.davidson@navy.mil; Boerio, Megan; stacin.martin@navy.mil
Cc: mark.e.davidson@navy.mil; Osteen.Bill@epamail.epa.gov
Subject: Fw: Cecil Field Naval Air Station, Site 16 (12-R04-001)

Everyone:

During our meeting last week I mentioned that I had our ADA OK lab take a look at the pilot study to see if they had any ideas regarding the poor results. Please take a look at Scott's review notes. If you would like to explore further and discuss with Scott just let me know.

Deborah Vaughn-Wright
U.S. Environmental Protection Agency
Superfund Division
404/562-8539 (Direct)
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----- Forwarded by Debbie Vaughn-Wright/R4/USEPA/US on 11/15/2011 04:24 PM -----

From: Scott Huling/ADA/USEPA/US
To: Debbie Vaughn-Wright/R4/USEPA/US@EPA
Cc: Felicia Barnett/R4/USEPA/US@EPA
Date: 11/15/2011 04:04 PM
Subject:Cecil Field Naval Air Station, Site 16 (12-R04-001)

Dear Debbie,

Greetings from OK. I have reviewed the e-mail and the power point document. There was limited information included in these documents but nevertheless, there were a couple technical issues to think about. I do not have any significant recommendations to provide, but I do have a few comments on the well clogging issue, ISCO, and natural attenuation mechanisms at the site. Attached is a document summarizing these comments. A hard copy will be mailed to you later today. Call me anytime if you want to discuss any of these issues. Scott (See attached file: ISCO Technical Review_1.docx)

Scott G. Huling, Ph.D., P.E.
Environmental Engineer

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November 15, 2011

OFFICE OF

RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Cecil Field Naval Air Station, Site 16 (12-R04-001)

FROM: Scott G. Huling, Environmental Engineer
Applied Research and Technical Support Branch

TO: Debbie Vaughn-Wright, Remedial Project Manager
EPA Region 4, Atlanta, GA

General comments are provided below regarding the precipitation issues in the chemical oxidant injection wells at Cecil Field Naval Air Station, Site 16. If you have any questions or would like to discuss any of the comments, call me at your convenience (580) 436-8610.

cc: Linda Fiedler (5203P)
Kay Wischkaemper, Region 4
Felicia Barnett, Region 4
Dave Jenkins, Region 4
Bill O'Steen, Region 4

Technical Review Comments

General Comments

Based on a review of the power point file that presented a summary of the precipitation problems at site 16, and information provided by David Grabka (Florida Department of Environmental Protection, 11/3/11) several general comments are provided.

1. The "concentrated carbon source" appears to be the cause of the highly reduced ground water conditions and therefore the high concentrations of dissolved iron (Fe). The co-existence of Fe and sulfur (S) suggest that pyrite, ferrihydrite, and possibly other forms of Fe are present. Under reduced and acidic conditions, the solubility of Fe increases and these minerals dissolve resulting in an increase in Fe and S concentrations. Generally, ferrous iron (Fe^{+2}) is ideal for Fenton treatment systems because of the role Fe^{+2} plays in the Fenton reaction. However, excessive quantities of Fe^{+2} also represent additional challenges such as excessive precipitation, H_2O_2 transport limitations, etc.

2. It is unclear how the jar tests were to be used to identify alternative methods to minimize precipitation. Increasing the pH ($\geq$ pH 3) or raising the redox by increasing the oxidative conditions will result in precipitating the Fe under all conditions tested.

3. The method used to assess permeability reduction is unclear. The reports indicated that the injection well was "clogged". Permeability reduction could have resulted from Fe precipitation, but it could also be attributed to the formation of O_2(g) resulting from H_2O_2 decomposition. O_2(g) is retained in the porous media and blocks the flow of ground water. Additionally, O_2(g) formation during the H_2O_2 reaction also results in significant backpressure in the injection well. Either of these O_2(g) results could be misinterpreted as well clogging by Fe precipitation. In summary, there are several points to note, (1) introducing an oxidant into reduced ground water containing high levels of reduced inorganics will result in significant changes in redox and solubility. Consequently, precipitation is expected for Fe and other species and may be responsible for well clogging (as proposed); (2) permeability reduction may also be attributed to O_2(g) formation as described above, and (3) the impact of either O_2(g) or Fe precipitation on permeability reduction can be remedied either through conventional well completion methods, or naturally through the re-establishment of geochemical redox conditions.

4. The presence of high levels of organic carbon and highly reduced conditions suggest that reductive dehalogenation of chlorinated VOCs (CVOCs) may be playing a significant role in the fate of CVOCs at the site (i.e. natural attenuation). The very low redox conditions and elevated concentrations of Fe and S suggest that the subsurface biotic system can be described as methanogenic. An influx of any oxidant into the subsurface will increase the terminal electron acceptor content in the aquifer (i.e., dissolved oxygen, ferric iron, sulfate, etc). Typically, this would shift the terminal electron accepting process from the inefficient methanogenic condition, to more efficient biotic conditions including iron and sulfur reducing conditions. The main point is that injecting oxidant into the subsurface can chemically oxidize the target compound, but also helps to sustain reductive dehalogenation natural attenuation processes.

5. The steps and injection activities involving Fenton-driven ISCO at the site is unclear. In general, H_2O_2 injection should be rapid and performed under high pressure to deliver the oxidant into the subsurface as quickly as possible. H_2O_2 undergoes "reactive transport" and due to the fast reaction rate of H_2O_2, H_2O_2 must be rapidly delivered to the targeted zones to overcome reaction in transit. On 4/28/08, H_2O_2 was injected at 1.33 gpm until there was a "well clogging" issue, and subsequently injected at 0.015 gpm on 5/28/08. No specific information on the conditions associated with the clogged wells was provided, however, the oxidant delivery at 0.015 gpm even for long durations would be ineffective due to rapid H_2O_2 reaction.

6. In general, it is unclear whether appropriate steps were performed to give ISCO a reasonable chance of success, and whether ISCO could be successful given site specific conditions (i.e., injection of H_2O_2 into a highly reduced aquifer containing high levels of dissolved iron would be problematic resulting in dramatic changes in geochemistry, including precipitation). Permanganate (MnO_4^-) may be a better candidate for ISCO since it is highly soluble, less reactive, and will not result in significant production of O_2(g). Greater rates and quantities of the MnO_4^- oxidant could probably be injected and have a greater radius of influence around the injection wells. This could be tested at the site assuming there was still interest in an ISCO remedy. It should be noted that highly reduced conditions and elevated concentrations of organic matter are generally difficult conditions to overcome for an ISCO remedy due to the high oxidant demand expected for any oxidant that is used. Additional testing and analysis is needed.