UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
61 Forsyth Street
Atlanta, Georgia 30303-3104

August 12, 2014
Mr. Wayne Reiber, P.E.
Manager
Environmental Assessment and Remediation
Corporate Safety, Health and Environmental Affairs
Cabot Corporation
Two Seaport Lane, Suite 1300
Boston, MA 02210

Dear Mr. Reiber:

Thank you for the July 3, 2014, Summary of ISCO Bench Test
Phase I Results, Cabot/Koppers Superfund Site, Gainesville, Florida.

After review of this submittal, we have come to the conclusion that the submittal is insufficient in its present form for purposes of evaluating in-situ chemical oxidation (ISCO) treatment for the Cabot Carbon portion of the Site. We require that this submittal be revised and resubmitted within 60 days of the date of this letter to address the comments included as an enclosure to this letter from J.M. Waller.

We look forward to working with you on implementing remedial action at the Cabot Carbon portion of the Koppers Site.

Sincerely,

Scott Miller
Remedial Project Manager
U.S. Environmental Protection Agency

Enclosure

J. M. WALLER® ASSOCIATES, INC.

A SERVICE DISABLED VETERAN OWNED SMALL BUSINESS

RACII Lite 0491

Contract No. EP-S4-08-03

August 11, 2014

Mr. Scott Miller
US Environmental Protection Agency Region 4
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Subject: Comments on the ISCO Bench-Scale Summary Report – July 2014

Dear Mr. Miller:

The attached comments are part of the J. M. Waller Associates, Inc. (J. M. Waller) review of the ISCO Bench-Scale Summary Report – July 2014 prepared by Geosyntec, Inc. for Cabot Corporation (Cabot). The comments largely address the conflicting recommendations of the report cover letter (pgs. 1 – 3) and the conclusions and recommendations section of the report. Additionally, the recommendations made during the July 9th Technical Meeting with Cabot and Gradient, Inc. (Gradient) representatives also appear to be in conflict with some of the conclusions and recommendations of the report.

The ISCO Bench-Scale Summary Report found that three of the five oxidants (PAP, MAP, and Ozone) investigated during the Phase I comparative screening tests show promise in their ability to oxidize site contaminants of concern (COCs) and recommended that further investigation may be warranted in the proposed Phase II detailed oxidant investigations. J. M. Waller review of pertinent literature regarding the use and effectiveness of In-situ Chemical Oxidation (ISCO) treatment at similar sites and found that literature supports the conclusions of the report. However, the report cover letter and Cabot and Gradient representatives have suggested that ISCO is not a viable treatment option. Proceeding to the Phase II investigations was not recommended for any of the oxidants. During the July 9, 2014 Technical Meeting, the Cabot and Gradient representatives stated that the oxidant volume needed for treatment of site COCs would be prohibitively large due to formation of reaction by-products and the high COCs concentrations and ISCO is therefore infeasible. However, it is unclear if this means that ISCO treatment as a whole is infeasible or if ISCO is not a practical technology to treat the highly concentrated source areas. Could ISCO be used to treat other portions of the plume such as the dissolved phase or be used in conjunction with another technology?

There is also no detail into how the volume of oxidant and number of wells needed for full-scale implementation were determined. If the data needed to determine these parameters exists, it should be provided and calculations of oxidant volume and number of wells should be outlined in detail. Observations made during Phase I reactor experiments are utilized to make judgments on field-scale applicability; however, it is not clear how laboratory observations were extrapolated to field-scale. For example, how was the conclusion made that off-gassing will be a significant issue in field-scale implementation of ozone injections based on the results from

the batch reactors. Also, should the formation of reaction by-products be included in the percent reduction of initial Total VOCs calculations? The percent reduction of Total VOCs is a parameter used to judge the effectiveness of site COC degradation by ISCO oxidants and should be clearly defined.

In summary, J. M. Waller believes that serious consideration should be made for proceeding with the Phase II investigations with the three oxidants (PAP, CHP, and Ozone) as outlined in the report recommendations. The Phase II study will provide the "data required to select oxidant doses for field-scale application", as outlined in the bench-scale work plan. Additionally, the Phase II investigations will determine the effectiveness of aerobic bioremediation of reaction by-products after ISCO treatment and natural attenuation. It is the reviewer's opinion that there is insufficient data at this time to determine the oxidant volume required for treatment and the overall viability of ISCO as a treatment option.

If you have any questions or comments on this matter please contact me.

Sincerely,

Joshua Hayes, EIT
Environmental Engineer

Attachments

C: A. Ostrofsky (J. M. Waller Program Manager)
T. Turner (J. M. Waller Project Manager)
File: RACIILite-3401

Comments on ISCO Bench-Scale Summary Report – July 2014
Cabot-Koppers Site

Specific Comments:

1. The report cover letter states “The presence of high COC concentrations and resulting high oxidant demand, combined with generation of reaction by-products, including ketones and VOC TICs during treatment, point to the need for multiple oxidant applications at field scale. The volume of oxidant required for treatment of the source zone could be prohibitively large (e.g., on the order of 300,000 to 1,000,000 gallons of liquid oxidant and activator).”

   This conclusion seems to imply that the remediation goal of the ISCO treatment was complete degradation of Contaminants of Concern (COCs) to compounds with no health based criteria, e.g., Groundwater Cleanup Target Levels (GCTLs). A United States Environmental Protection Agency (EPA) report reviewing current trends in Insitu Chemical Oxidation (ISCO) treatment at sites states that the primary objective of ISCO is "transforming groundwater or soil contaminants into less harmful chemical species” (Huling, S. and Pivetz, B., 2006). Additionally, one report (Krembs, F. et al., 2010) reviewing ISCO field applications concluded that 80% of sites attempting to reduce contaminant mass and time to cleanup were successful. However, the same report stated that only 15% of sites attempting to utilize ISCO to meet MCL for COCs met this goal. Therefore, it is important to define clearly the remediation goals of ISCO implementation.

   It is unclear from the report contents how the volume of oxidant required, i.e. 300,000 – 1,000,000 gallons, was derived. Please specify how these calculations were made. Furthermore, it is unclear what dosage of oxidant was utilized in the calculation of oxidant volume required. The Interstate Technology Research Center (ITRC), for example, states that peroxide concentrations typically vary from 3% to 35%, with 3% being used to simply initiate reactions and concentrations closer to 35% being used for treating sites potentially impacted with DNAPL (ITRC, 2005). Similarly, Stroo and Ward 2010, state that hydrogen peroxide concentrations in modified Fenton’s (a form of CHP) applications typically range from 5 to 20%. Siegrist et al 2011, summarizing the implementation 37 CHP projects and 8 persulfate projects, reported that the median injected oxidant concentration was 190 g/L (19%) for CHP projects and 160 g/L (16%) for persulfate projects. The doses used for CHP and PAP in the soil slurry tests (20 g/L and 40 g/L, which are effectively 2% and 4% by weight) appear to be low, relative to standard industry practices. By these measures, were the oxidants, namely CHP, PAP and MAP, investigated at a full range of typical dosages in field applications? In addition, is it possible that the low doses used in the study have contributed to the large amount of ketone produced due to incomplete oxidation?
   It should also be noted that current practice for applying CHP also incorporates the use of stabilizers, such as citrate and phytate, to significantly extend the oxidant longevity in CHP systems (Watts, 2007). Such stabilizers could also potentially reduce byproduct formation by maintaining the oxidant activity long enough to achieve more complete oxidation of the target chemical. Where stabilizers investigated during bench-scale studies or are they planned?

Based on the successful CHP and PAP results achieved for oxidation of many target chemicals (VOCs up to 61% and SVOCs at 67 – 100% destruction) and in considering the factors mentioned above, it appears premature to eliminate CHP or PAP as a potentially effective ISCO treatment for some portions of the site. Further testing of CHP and PAP at higher concentrations and with stabilizers may show significantly better performance than the Phase I study.

Based on J. M. Waller's review of the ISCO Bench-Scale Summary Report, it appears that some of the oxidants studied are viable candidates for the transformation of phenols and BTEX to less harmful and more readily treatable or degradable compounds, e.g., ketones, and merit further consideration.

Additionally, since the Phase II investigations have not been completed, there cannot be an evaluation of bioremediation or Monitored Natural Attenuation (MNA) of reaction by-products. The report specifically addresses treatment of reaction by-products stating that reaction by-products "can be readily treated or removed by supplemental treatment or natural attenuation" and would be investigated if Phase II studies were initiated.

2. The report cover letter states "Implementation of an ISCO remedy in the Upper Hawthorn Group Formation (UHG) would require installation of a large number of injection wells (e.g., up to 400 multi-level well clusters) through source material in the Surficial Aquifer and into the UHG, which may lead to contaminant mobilization and potential cross-contamination."

   It is unclear how the number of wells (up to 400 multi-level well clusters) needed for implementation of an ISCO remedy was determined. Sufficient data is not provided or how the data was derived to perform the calculation of the number of well or analysis of the feasibility of implementation of ISCO. If sufficient data exists to make this determination it should be provided and the calculation should be outlined in detail.

3. The report cover letter states "Gas-phase ozone injections caused volatilization of COCs into off-gas and caused foaming in laboratory tests. The need to capture large volumes of off-gas for treatment along with management of foam would make implementation of ozone treatment in the UHG Formation infeasible at field-scale."

   Bench-scale experiments did show significant off-gassing of Volatile Organic Compounds (VOCs) during treatment; however, without conducting further investigations (Phase II or pilot-scale studies) it seems difficult to draw the conclusion that ozone would not be effective in treating COCs or that excessive VOCs will need to be treated from off-gassing during field-scale implementation based on the bench-scale test using an artificial slurry of site material in small glass bottles (reactors). Phase I bench-scale tests were initiated and intended to be a comparative screening of various oxidants and their ability to degrade site

COCs. Is it the intent of the report to use the slurry reactors in the studies as surrogates for field conditions outside of this comparative oxidant screening?

It is recommended, as discussed in the report conclusions, that ozone as an ISCO oxidant merits consideration for further investigation.

4. Page 8 of the report states “The total VOC concentration in both the CHP and PAP reactors was greater than the unamended control due to the formation of ketones (primarily acetone) as reaction by-products.”

   The formation of reaction by-products, i.e., ketones, should not be figured into the calculation for Total VOCs concentration post-treatment. Is it typical to present the reaction by-products in a sum calculation of all VOCs? It would seem that this would artificially lower the percent of initial VOCs degraded by treatment. The ketones should be accounted for separately since the formation of ketones as reaction by-products can obscure the degree of degradation of initially present VOCs, e.g., Benzene, Toluene, Ethylene and Xylene (BTEX).

   The confounding of the results for degradation of VOCs can be illustrated in the presentation of percent reduction of Total Ketones and Total VOCs in Table 3 of the report. As shown in Table 3 of the report, both the Total Ketones % reduction and Total VOCs % reduction are very similar. This seems to indicate that VOC degradation, as a whole, was ineffective and in fact counter-productive. However, it is not completely clear from the data present how the % reduction of Total VOCs, and more importantly BTEX, was calculated. Please specify how these calculations were made.

   In the cover letter, it is stated that the mass destruction was up to 38% for VOCs; however, it is not clear if this value includes reaction by-products. Mass reduction for BTEX was up to 61% for all oxidants. A full representative data set including all identified VOC species and their mass reduction is needed to determine the effectiveness of oxidants ability to reduce VOC concentrations and the degree of incomplete oxidation.

5. Page 17 of the report states “PAP is recommended for further consideration because it performed best among liquid oxidants at destroying COCs (particularly phenols) while producing relatively small quantities of reaction by-products.”

   This statement seems to be in conflict with the conclusions made in the reports cover letter that suggests that ISCO is not a feasible technology for the Cabot site and that no oxidants should be considered for further evaluation. The conclusions of the ISCO Bench-Scale Summary Report also recomends MAP and Ozone for further investigations in Phase II of the bench-scale experiments.