

**EPA Comments on the
Bench-Scale Solidification Treatability Study Work Plan
Red Devil Mine, Red Devil, Alaska**

General Comments:

1. The work plan lacks the specificity to be implemented as it is currently written. The details necessary to perform the work should be included. The specific comments provide examples of some of the necessary details. Note that the specific comments do not represent an all inclusive list.

Response to Comment 1: There will be a more thorough explanation of work performed presented in the summary of results report.

2. It is not clear how many tests are planned to run for this bench scale test. Four samples were collected and in the text there is mention of four different ratios of water/cement mixes. Does this imply that there will be sixteen tests? Will all the tests be run simultaneously? Also the text notes a possible range for the cement mix ratio. Will all various cement mix ratios be tested as well?

Response to Comment 2: The test mixes will be prepared in a single day. A maximum of ten samples will be submitted for laboratory analysis. Volume of cement added as well as ferrous sulfate will vary in each sample.

3. The text states that ferrous sulfate will be used as an additive that may enhance the solidification process. Will tests be run with and without this additive to the ordinary Portland cement? If the tests using ferrous sulfate are unsuccessful will other additives be tried?

Response to Comment 3: Tests will be run with and without ferrous sulfate. Portland cement and ferrous sulfate were selected based on their availability and ability to be transported to the site. Should all the tests prove unsuccessful, it is doubtful that an additional study will be performed.

4. There should be a discussion of test objectives. The reader assumes the purpose of this study is to address RCRA ARARs associated with the RCRA characteristic waste. That objective should be stated in the work plan. Any other test objectives, such as structural strength, should also be clearly stated.

Response to Comment 4: The objective of the tests is to reduce the leachability of arsenic so that it passes the TCLP hazardous waste criteria. Compression strength will be tested using a pocket penetrometer and the consistency of the mix will be visually documented. These last two points of data are being documented and are not considered to be primary objectives of the pilot study.

5. The work plan seems to focus on evaluating the treated soils with respect to the toxicity characteristic criteria, i.e. the treatment goal is to remove the toxicity characteristic from treated soils. If the soils start out exhibiting the toxicity characteristic and are excavated for disposal in an on-site repository (landfill), then placement in the landfill would require that the treated soils meet applicable LDR treatment standards. Therefore, data from sampling of treated soils should be compared to applicable Universal Treatment Standard (UTS) values for the principle constituent (the constituent for which the soils exhibit a characteristic) and any underlying hazardous constituents. In this case, the LDR treatment standard for arsenic is the same as the toxicity characteristic level (5.0 mg/l). However, the work plan should state that the treated soils shall be analyzed using the TCLP extraction method (EPA SW-846 Method 1311, with the leachate analyzed for arsenic and any underlying hazardous constituents (e.g., mercury). The decision criteria should be applicable treatment standards, which are either “traditional” standards of 40 CFR 268.40, or the alternate treatment standards at 40 CFR 268.49.

Response to Comment 5: EPA protocols associated TCLP analysis will be followed. Additionally, TCLP analysis for both arsenic and mercury will be run.

6. While the proposed testing (using EPA SW-846 Method 1311 for extraction) is appropriate from a regulatory perspective, testing at conditions more representative of site conditions than the weak organic acid (acetic acid) conditions associated with the TCLP extraction method should be considered as well. The reason for this recommendation is that the leachability of arsenic is affected by the redox conditions and pH of the environment in which the material in question finds itself. If soils are treated with OPC, then the treated wastes will tend to be fairly alkaline. Note that the solubility of arsenic increases at higher pH values, unlike some of the other hazardous metals. Thus, the evaluation of the treated soils using a leachate medium that is a weak organic acid may not appropriately reflect what may be a reducing or alkaline environment that the treated soils will actually be exposed to when disposed of on-site. Use of the TCLP weak organic acid extraction fluid would tend to underestimate the leachability of arsenic in actual field conditions. Even though the treated soils might technically meet LDR treatment standards, the performance of the treated soil in the disposal unit might not be protective of HH&E.

Response to Comment 6. While meeting TCLP requirements is an objective of the pilot test, it should be noted that the treated material will be placed in a repository designed to limit surface water infiltration and provide protection from weather elements. Therefore, the use of TCLP results should be sufficient.

7. Since the proposed treatment also involves use of ferrous sulfate, the previous concerns may be at least partially mitigated. Never the less, EPA has seen issues of protectiveness arise when the actual field conditions that treated wastes are exposed to were not considered. To ensure the proposed treatment will perform in an acceptable matter in the field, not just under TCLP conditions, such an evaluation should be performed.

Response to Comment 7: See previous response.

Specific Comments:

1. P. 1, Introduction 1st parag. The last sentence of this paragraph notes that sample may be separated to reduce the amount of soil requiring treatment. Some size range should be included in this text. Later in the work plan there is discussion of a < 1 inch size fraction. Is this the range that BLM is considering?

Response to Comment 1: Approximately 5 gallons of soil were collected from each sampling location. In order to run multiple tests, the sample size will not be 5 gallons. At a minimum, 500 grams of soil from the most contaminated location (based on analytical data) will be used for each solidification tests. If practical, the weight of soil for each test will be increased to 1000 grams. It should be noted that the laboratory requires a minimal amount of soil to analyze for TCLP. Increasing the volume of material that is to be solidified does not alter the amount of soil that will be submitted to the laboratory.

Finally, the <1-inch size is indicative of being able to thoroughly provide contact between the soil and the solidification reagents.

2. P. 3, Solidification Mixes, last parag. More details should be provided in this text, such as how will the soil moisture content be determined, what are the required handling characteristics and how are these characteristics visually determined?

Response to Comment 2: Initial soil moisture content will be determined by laboratory analysis. With regards to handling characteristics, the intent is to have a material that can be readily handled/moved by common construction equipment that would be at the site during implementation of the final remedy.

3. P. 3, Sample Preparation, 4th step. Is “MR” an acronym for mix ratio in both equations or does MR represent molar ratio in the second the equation? It the latter, it is recommended that two different acronyms used.

Response to Comment 3: In the final report, two different acronyms will be used.

4. P. 3, Sample Preparation, 5th step. The desired percent moisture of the sample(s) should be stated in this step. Also, how will the percent soil moisture of the sample be determined?

Response to Comment 4. The percent moisture for each sample will be stated in the summary report. Also, laboratory analysis will determine the initial soil moisture content.

5. P. 4, Sample Preparation, 6th step. More details should be included in this step. For example, the text should clearly state if the mixing is being done manually or mechanically using a powered mixer.

Response to Comment 5. Mixing will be done manually, and sample preparation will be clearly summarized in the summary report.

6. P. 4, Sample Preparation, 7th step. The text states that the pH and temperature will be recorded to the nearest whole unit and nearest degree respectively. This reviewer disagrees with truncating the data. The reading of the instrument should be recorded. If, during the analysis of the data, it makes sense to truncate the data then that can be done at such time. However, if the complete readings are recorded, such information will be available if there is a need for such information at a later date.

Response to Comment 6. Given that a wet solidified mass is going to be tested, pH paper will be used. Additionally, an infrared meter will be used to measure temperature. These methods do not require laboratory grade equipment and recording to nearest whole unit and nearest degree is acceptable.

7. P. 4, Sample Preparation, last paragraph. The text notes that the sample will be stored under ambient conditions prior to being submitted to the lab for analysis. How do the ambient conditions of the lab compare to field conditions? Are there any major differences, such as temperature, which would affect the prepared samples?

Response to Comment 7: Storing of the samples will not be at the laboratory, but at a warehouse in Chicago, IL. Given the typical November temperatures in Chicago, this should not differ greatly when compared to the temperatures in Red Devil Alaska during construction season.

8. P. 4, Evaluation, 2nd para. This paragraph should specify what minimum TCLP value the test must meet to be successful. If that value is a concentration of <5.0 mg/L arsenic it should be stated.

Response to Comment 8: Successful solidification results will be if at least one generated leachate concentration for arsenic is less than its TCLP hazardous waste threshold. This will be reiterated in the summary report.