CHAPTER 5
SOLIDIFICATION/STABILIZATION

CHAPTER 5 SOLIDIFICATION/STABILIZATION

5-1. GENERAL. Solidification/stabilization (S/S) refers to treatment processes that are designed to accomplish one or more of the following:

- improve the handling and physical characteristics of the waste;
- decrease the surface area of the waste mass across which leaching of contaminants can occur; and
- reduce the solubility of hazardous constituents in the waste.

S/S is performed by mixing contaminated materials with one or more reagents such as cement, lime, or fly ash. S/S is applicable for the treatment of contaminated liquids, soils, and sludges. The final product of an S/S process may vary from a granular, soil-like material to a cohesive solid depending on the amount of reagents added and the type of waste being treated. S/S can be performed as an in-situ process or the contaminated material can be excavated and treated above ground in some type of mixing unit.

a. Preconstruction Submittals. The contractor should provide preconstruction submittals as required by the specifications. The following is a list of typical submittal requirements.

(1) Solidification/Stabilization Work Plan. Review the work plan to ensure the following items are adequately addressed.

(a) Information to demonstrate the S/S contractor meets the qualification requirements specified.

(b) The proposed mix design to be used in treating the contaminated material.

(c) Bench scale treatability study test results (if required).

(d) Equipment proposed for mixing, batching, and process control. Process flow diagrams, mixing times, and processing rates. Any anticipated pretreatment of the contaminated material should also be identified.

(e) Drawings indicating dimensions and layout of the S/S system.

(f) Air emissions, dust, and noise from the system should be identified and estimated. Control systems proposed for use should be described.

(g) QC procedures which covers control of batch proportions, control of mixing time, and post-treatment testing.

(h) Proposed stockpile design. Ensure the stockpile design meets the criteria outlined in the specifications.

b. Construction Submittals. The contractor should provide construction submittals as required by the specifications. The following is a list of typical submittal requirements.

(1) Qualifications of key personnel. Do not allow individuals identified in the specifications as key personnel to start work until their qualifications have been submitted and approved.

(2) A field demonstration report including pre-treatment and post-treatment test results, batch proportions, mixing time, and mixing speed.

(3) Reagent certificates of analysis should accompany each shipping unit.

(4) QC test results.

(5) Mixing time, mixing speed, and mix proportions for each batch of material treated.

5-2. PRODUCTS.

a. Materials.

(1) Water. Require chemical testing of the proposed water source when the water is of questionable quality.

(2) Reagents. Verify the reagents meet the specified requirements. Reagents should be shipped in properly labeled containers with instructions for handling and storage.

b. Equipment. Verify that mixing equipment has a positive means for controlling the mix proportions, maintaining the time of mixing constant, and maintaining the appropriate speed of rotation of the mixing unit.

(a) Check the reagent silos and feeders during operation to ensure caking of the reagents is not occurring which could cause variations in the reagent feed rate.

(b) Verify that scales, meters, and volumetric measuring devices used for measuring contaminated material, reagents, and water for S/S processing are accurate to within the specified limits.

(c) Verify measuring devices are being calibrated at the specified frequency.

5-3. EXECUTION.

a. Utility Clearances. Check that all utility clearances have been received for any subsurface work and that there are no overhead hazards that will interfere with the S/S unit.

b. Stockpiles. Verify stockpiles are constructed in accordance with the specifications. Typically, stockpiles for storing contaminated material include the items listed in the following paragraphs.

(1) A chemically resistant impermeable geomembrane liner. Make sure the ground surface on which the geomembrane is placed is free of objects which could damage the membrane.

(2) An impermeable geomembrane cover with a minimum thickness of 10 mils.

(3) Berms surrounding the stockpile to prevent run on and runoff of liquids.

(4) Check to see if leachate is collecting within the stockpile liner. Ensure leachate collected from the stockpile is handled in accordance with the specifications. Typically it will be analyzed (and treated, if necessary) prior to disposal or it may be reused in the S/S process.

c. Field Demonstration.

(1) Prior to full-scale S/S operations, a field demonstration is often performed on a representative amount of the contaminated material.

(2) Verify the full-scale processing equipment is being used for the field demonstration. Reagents (including water source), mix ratios, and mixing procedures used during the field demonstration should be the same as those used for the remainder of the S/S work.

(3) Verify contaminated material used for the field demonstration is obtained from locations outlined in the specifications.

(4) Prior to performing the field demonstration, contaminated material to be used for the field demonstration is usually tested to verify it contains representative levels of contamination.

(5) Verify the treated material from the field demonstration meets the physical and chemical criteria listed in the specifications.

(6) Require additional test runs if the treated material does not meet the specified requirements.

(7) The estimated increase in volume resulting from S/S treatment is often determined during the field demonstration. Volume increase is determined by comparison of the volume of contaminated material to be treated to the volume of treated material.

(8) Determine if the specifications allow the contractor to continue to process contaminated material while waiting for test results from the test run.

d. Operation.

(1) Weather Conditions.

(a) Check the specifications to see if there is a minimum temperature below which solidification/stabilization should not be performed.

(b) Do not allow contaminated material to be treated if it contains any frozen material.

(c) Do not allow S/S to be performed during periods of heavy rainfall if this will result in the addition of excess water to the mixture.

(2) Ensure that dissimilar materials which testing has indicated will require the use of different S/S mix ratios are not mixed together.

(3) Visually monitor the physical appearance of the material being treated. If there is an obvious change in color, odor, or texture of the material, consideration should be given to requiring additional QA testing.

(4) Oversize Material. Verify oversize material that cannot be handled by the S/S unit is removed, treated and disposed of in accordance with the specifications.

(5) Verify the contractor is not diluting the soil to be treated by excavating and treating materials which are outside the specified area of treatment.

(6) Verify confirmation samples are taken at the specified frequency for the side walls and bottoms of excavations to verify all contaminated material has been removed. Excavations should generally not be backfilled until confirmation tests confirm that all contaminated material has been removed.

e. Tests.

(1) Verify mixing time, mixing speed, and the amounts of contaminated material, reagents, and water added to each batch are recorded by the contractor and maintained within the limits specified in the approved S/S Work Plan.

(2) Verify treated material is segregated into stockpiles for post-treatment testing so that material can be retreated if it does not meet the post-treatment testing criteria. Stockpile size should be equal to or less than the volume at which the most frequent QC test is run. Each stockpile should have a visible number to aid in the tracking process. The numbers should be correlated to the QA/QC samples which have been collected.

(3) If the treated material will be placed directly into an on-site landfill, verify the contractor is segregating and tracking the location of each batch of material so that it can be located if reprocessing is necessary.

(4) Post-treatment testing specified should be performed on representative samples of treated material. Require the contractor to perform additional testing on treated material that appears to be poorly mixed or have improper mix proportions.

(5) Verify QC specimens are allowed to cure as described in the specifications.

(6) Typically up to 6, 2-4 inch diameter samples are made for each round of QC testing. The samples are allowed to cure (typically 1 to 7 days) and then tested for leachability of contaminants. Physical tests such as unconfined compressive strength and hydraulic conductivity are also sometimes required.

(7) For in situ S/S jobs, verify the specifications indicate the depth below ground surface at which QA/QC samples are to be collected. Ensure the contractors method of sample collection can obtain a sample which is representative of the specified depths.

(8) Require reprocessing and/or retesting to be performed on treated material that does not meet the physical and chemical requirements listed in the specifications. The specifications should address how retesting and reprocessing will be handled QC or QA tests

fail. Contact the designer if retesting and reprocessing is not addressed.

(9) The S/S mix design may be changed by the contractor based on the characteristics of the material being treated. Require additional test runs if there is a question about the new mix design proposed.

(10) Check the specifications or QA Plan to see if samples need to be submitted for QA testing. Typically, samples for QA testing should be collected at the same time as QC samples, however, at a reduced frequency. This allows comparison of the QA and QC test results. Ensure QA and QC sample numbers are correlated so that test results can be easily compared.

(11) Ensure the treated material from the S/S process, upon meeting the physical and chemical testing criteria, is disposed of as required by the specifications.

f. In Situ Solidification/Stabilization. In situ S/S is typically performed using large diameter augers which inject reagents into the soil and mix the reagents and soil together. The following are inspection items which are specific to in situ S/S.

(1) Verify the auger is drilling vertically into the contaminated material. This is especially critical where the contaminated soil is deep.

(2) Typically, the rate of entry and withdrawal of the auger is controlled and synchronized with the rate of injection. Verify reagents are being injected uniformly and in the right proportion throughout the zone of contamination.

(3) Closely monitor the depth of penetration of the auger to ensure the entire depth of contaminated soil is treated.

(4) Samples are usually collected from the treated soil at specific depths within the treated soil column. Verify the method of sample collection can retrieve an isolated sample from the specified depth.