Stabilisation/Solidification of Manufactured Gas Plant Wastes: Pilot Test Study – Part 2

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A Compass Environmental, Inc. Company
Deep Soil Mixing (DSM) has been practiced for many years, primarily in the geotechnical and deep foundations arenas.

In the late 1980s and early 1990s, DSM crossed over into the environmental arena.

Since that time, DSM has gained wide acceptance in the environmental remediation market, and in particular, the MGP sector.

To date, approximately 46 sites have been remediated via DSM, of which Williams has completed 9.
DSM Remediation Phases

Remediation Phases:
- Bench-scale treatability testing
- Pilot-scale (field) testing
- Full-scale implementation
Pilot-scale Testing

- Following selection of the design mixes during the treatability study, the pilot study is developed
- Principal purpose is to scale-up the design mixes developed during treatability testing for application under actual field conditions
- Pilot study also used to determine the operational parameters under which the DSM drill platform will be operating
Pilot tests are integral to the success of DSM projects

- Principal benefits:
  - Used to confirm the results of treatability testing
  - Used to optimise selected mix designs
  - Gives the contractor experience with the proposed full-scale equipment
Operational parameters determined during a typical pilot test include:

- Diameter of the mixing tool (1.8, 2.4, 3.0, or 3.7 metres)
- Cycle time
- Rotational speed
- Penetration and withdrawal rates
- Optimisation of delivery mix viscosity based on soil moisture content
Operational Parameters (continued)

- Adjustments to grout density to accommodate existing conditions
- Exposure of pilot test columns for visual inspections to determine:
  - Lateral stability
  - Voids
  - Inclusions
  - Homogeneity of mix
- Development of the work platform
- Consideration of column sampling
- Finalisation of the mix design
Pilot Study Design

- The pilot study begins with development of the work plans. The plans identify the approved additives, the type of drill platform, and the type and quantity of data to be collected.

- Batch plant, utility, and drill platform locations are finalised in the field.

- Data collected from the study is organised on spreadsheets and ultimately populated into a GIS database.
The diameter of the mixing tool is critical in determining the volume of each column and the number of columns to be drilled for the project.
The most economical and efficient column geometry is one in which the overlap of each column is minimised, thus reducing the areas receiving additional additive and mixing time.
Mixing Parameters

Cycle time and rotational speed of the auger are important in determining the costs for full-scale work.

- Cycle time dictates the total amount of time the platform has to drill one column. A typical column 4.6 metres in depth requires approximately 45 minutes of cycle time.

- Rotational speeds range from 6 to 8 rpm. As torque increases with column depth, the rotational speed and advance rate are slowed.
Mixing Parameters (continued)

- An indirect measure of cycle time and rotational speed is the homogeneity of the unexcavated mixed column.

- Penetration and withdrawal rates are also used as indirect measures of how well a column is mixed. Typically, 2 to 4 passes must occur for the column to be completely mixed.
• The selected mix design is optimised during the pilot test based on the collection of additional data for in-place moisture content and density.

• The design is also altered based on field data, drilling performance, and quantity of fluff (swell) produced.

• Slurry can be thinned or thickened based on the soil moisture content and additional grout can be pumped as required.
• The batch plant is set up with a grout flow meter to determine the overall volume of material injected.

• Grout density is measured by a simple mud balance.

• The greater the column strength required, the greater the amount of additive required, and thus the more fluff produced. The pilot study is an excellent means of quantifying the amount of fluff generated by actual drilling conditions.
Grout Mixing

• Grout is mixed in batches to maximise and simplify quality control.

• Grout batches developed based on dimensions of the column and the soil density.

• A batch tank with high-shear lightning mixer maintains a homogeneous grout mix which is subsequently pumped to mixing tanks and then to the DSM rig.
Grout Mixing (continued)

Typical batch plant flow diagram for grout mixing
Soil Mixing Equipment

- The pilot study is implemented with full-scale soil mixing equipment.
- The DSM rig assembly primarily consists of a rotating mixing tool attached to a hollow Kelly bar. The Kelly bar and mixing tool are supported by a high-torque transmission attached to a crawler-mounted lift crane.
- If necessary, the drill platform can be equipped with a hood to minimise emissions.
Sampling

• After column installation, analytical samples are collected via an in situ sampling device and analysed for the various performance criteria.

• Based on the analytical results, mix designs are selected for full-scale implementation of various soil types, taking into consideration the quantities required, availability, and costs.
Conclusions

• The pilot study confirms the results of the treatability study and allows the selected mix designs to be further refined.

• Operational information gained from implementing the pilot study with full-scale equipment is invaluable when preparing to commence full-scale remediation.
Thank You

Questions