Full Spectrum of Small-Scale Cleaning Characterization:
From Cleaning Agent Selection to Cycle Optimization to Worst-Case Soil Matrix Creation

Small-Scale Cleaning Study

Confidential Client

PROJECT DESCRIPTION

Small-scale cleaning studies should be performed to characterize the cleaning behavior of process soils. The results can aid full-scale cleaning by providing an understanding of full-scale cleaning observations, providing a starting point for full-scale cycle parameter development, identifying cost-saving options for the full-scale cycle, and reducing full-scale cleaning activities which saves time and costs.

The Hyde Analytical Laboratory was contracted to perform small-scale cleaning characterization of multiple soils. This was accomplished by first simulating the full-scale cleaning cycle to evaluate its effectiveness in removing the soil residues.

Additionally, alternative feasible cleaning cycles were simulated to identify a set of parameters optimized for soil removal and cost savings.

Cleaning times were gathered at small scale and used to rank the soils to generate a matrix and identify the worst-case soil from a cleanability perspective. The soils were also confirmed to be effectively cleaned from multiple MOCs present in the full-scale equipment train.

STUDY OVERVIEW

The laboratory conducted a small-scale study to evaluate the effectiveness of the current full-scale cleaning cycle in removing soil residues.

The cycle was also optimized by evaluating additional feasible cleaning agents and parameters to determine if cost savings could be implemented at full scale (e.g., by using lower concentrations or temperatures).

Once a cycle was identified and optimized at small scale, the simulated cycle was used to assess the cleanability of multiple soils so they could be ranked from a cleanability perspective.

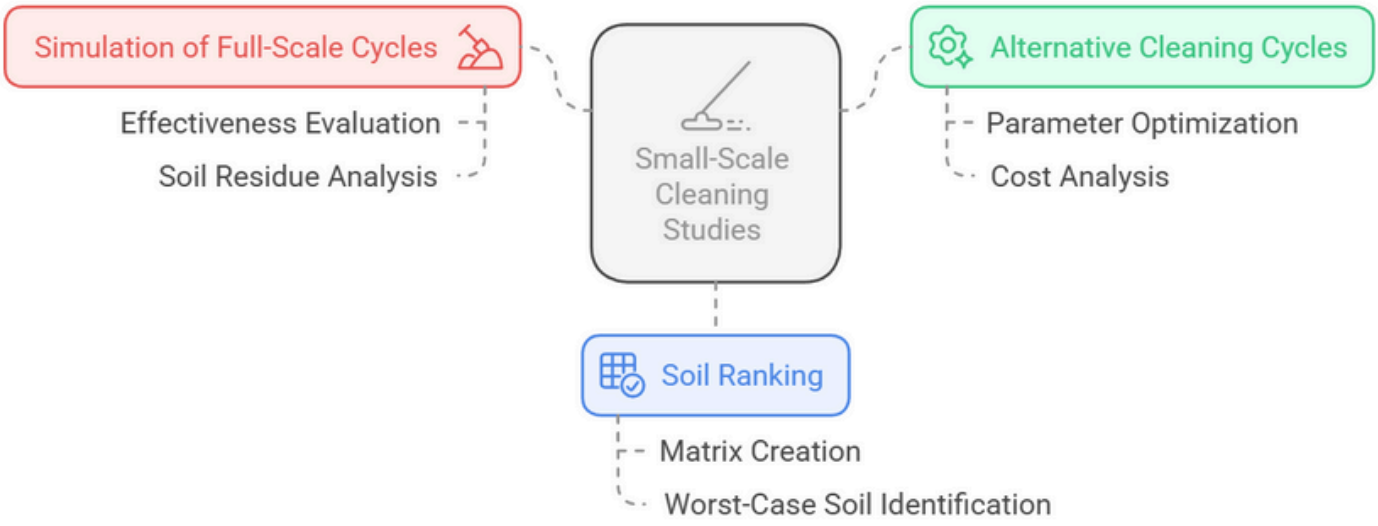
The rankings were used to generate a worst-case matrix for cleaning validation, which reduces the full-scale validation burden and saves costs.

It was also confirmed that all soils could be effectively cleaned from all MOCs present in the full-scale equipment train.

SCOPE AND DELIVERABLES

- **Current Cycle Evaluation:**
  Determine the effectiveness of the current cleaning cycle in removing the process soil residues.
- **Cleaning Agent Identification:**
  Evaluate multiple alternative cleaning agents that can effectively remove the soil residues.
- **Cycle Parameter Optimization:**
  Evaluate multiple cycle parameters to identify the set of inputs that is capable of effective removal of the residues while also providing cost savings options (e.g., cheaper cleaning agent, lower concentration/temperature).
- **Cleanability Rankings:**
  Using the identified and optimized cleaning cycle, assess the cleanability of all soils and rank them from easiest to hardest cleaning challenge. The rankings aid cost savings during full-scale cleaning validation activities.
- **Evaluation of Additional Materials of Construction (MOCs):**
  Assess the effectiveness of the identified and optimized cleaning cycle in removing the soil residues from additional MOCs that are present in the full-scale equipment. The cleaning behavior of soil residues may vary across MOCs, and it should be confirmed that residue is removed from all applicable MOCs in the equipment train.

SMALL-SCALE CLEANING STUDIES PROCESS OPTIMIZATION



SOLUTIONS, RESULTS AND ACCOMPLISHMENTS

1 **The current cleaning cycle was not effective in fully removing the process soil residues.**
Cleaning the soil in hot caustic alone did not remove the soil and instead made it harder to clean by "baking" the soil onto the surface.

2 **Adding a pre-rinse to the cleaning cycle significantly aided cleaning.**
Evaluation of alternative cleaning agents determined the use of an ambient water pre-rinse led to the full removal of the process soil.

3 **Optimization of the cleaning cycle led to possible cost savings.**
As it was determined that the lowest concentration and temperature of the cleaning agent was capable of effectively removing the soil residue.

4 **A cleanability ranking matrix was generated.**
The matrix identified the soil found to be the hardest to clean, which can be leveraged to reduce full-scale validation activities.

5 **A cleanability ranking matrix was generated.**
The matrix identified the soil found to be the hardest to clean, which can be leveraged to reduce full-scale validation activities.

lab@hyde-ec.com
www.hyde-ec.com
Louisville, Colorado, USA

Hyde ENGINEERING +CONSULTING