

Evaluation and Testing of Field Screening Technologies for Detection of Soil Sterilants

Technology Report Proposal

Submitted By: [REDACTED]

OACETT Membership #: [REDACTED]

Submitted to: OACETT

10 Four Seasons Place, Suite 404

Toronto, ON M9B 6H7

Date Submitted: [REDACTED]

Discipline/Division: Environmental

1.0 Introduction

Soil sterilants were commonly used from the 1960s to late 1990s for non-selective vegetation control on industrial sites in Alberta. Soils treated with sterilants often become a source of contamination to adjacent lands and waterbodies. Currently, environmental delineation of soil sterilants relies on soil and groundwater samples collected in the field and submitted to analytical laboratories for analysis via Gas Chromatography/Mass Spectrometry (GC/MS) or High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS). However, analysis by these approaches are expensive, time-consuming and not practical for use in the field. Currently there are no field-ready technologies that are available to achieve the goal of on-site detection, identification, quantification and delineation, as there are for other contaminants such as petroleum hydrocarbons (PHCs) or salinity, for example. This report reviews detection/field screening or proxy laboratory analytical methods to minimize the costs associated with identification, quantification and delineation of soil sterilants in soil and/or water at impacted sites. Additionally, the author tests commercially available field screening technologies in accurately and consistently detecting soil sterilants in soil and/or groundwater.

2.0 Body

Problem Statement:

- Currently there are no field-ready technologies available to achieve the on-site detection, identification, quantification, and delineation of soil sterilants. Current approaches to identify and delineate soil sterilant impacts in and soil and/or groundwater are laborious, time-consuming, expensive, and not practical for use in the field. This report aims to address the problem of the lack of field-screening technologies for said soil sterilants

Methodology:

- Firstly, the author will complete a literature review of existing field-screening technologies and evaluate their potential ability to detect soil sterilants in soil and/or groundwater. Further discussions with instrumentation manufacturers and suppliers will be completed to assess the likelihood of these technologies detecting the target soil sterilants as well as confirmation they are suitable for field use (ruggedness, weather resistance, portability etc.). Based on the results of the literature review, the author will choose several technologies that show potential for use a field screening device for the target soil sterilants and conduct preliminary testing on soil and/or groundwater samples. Preliminary testing will include screening of samples of commercially available soil sterilant containing products using the chosen field screening technologies. If it is confirmed that the chosen field screening technologies are able to detect the soil sterilants in pure form, these technologies will continue on in testing. Following preliminary testing, the following test products will be prepared:

- 100% pure liquid or solid sterilant
- A slurry containing 50% by weight of each solid sterilant mixed with distilled water.
- A sample of the dry silica sand (no water or sterilant added).
- Spiked samples of silica sand containing the following concentrations of each sterilant (subject to the amount of the different sterilant products obtained):
 - 1,000 mg/kg
 - 100 mg/kg
 - 10 mg/kg
 - 1 mg/kg
 - 0 mg/kg (sand only)
- Each of these spiked sand samples will be saturated (i.e., approximate water content of 25%) using distilled water.
- Spiked samples of distilled water containing the following concentrations of each sterilant (subject to the amount of the different sterilant products obtained):
 - 1,000 mg/L
 - 100 mg/L
 - 10 mg/L
 - 1 mg/L
 - 0 mg/L (distilled water only)
- Readings/measurements/outputs from each of the instruments will then be examined and evaluated in an attempt to identify whether:
 - The sterilant of focus appears to have been detected in one or more of the samples.
 - Whether the pattern of detection appears to be unique.
 - Whether the response appears to vary in relation to sample concentration.

It is possible that the results may need to be provided to the instrument manufacturers and suppliers, or some other third party to assist in this interpretation.

Hypothesis:

- Currently existing field screening technologies that detect and identify common chemical elements within soil sterilants, such as bromine and sulfur respectively, will be able to detect the target soil sterilants in field samples, with the caveat that detection limits will be above environmental standards for the specific soil sterilant.