BPSS – 12E – Bioventing Pilot Test Guidance

This document provides general guidelines for designing bioventing systems. Bioventing is an in-situ technology primarily used for the remediation of aerobically biodegradable organic contaminants of concern (COCs) in the vadose zone (i.e., unsaturated soil). Note that COCs present in the capillary fringe and saturated zone are not significantly affected by this technology. In bioventing, bioremediation is enhanced by inducing air (or oxygen) flow (using injection or extraction wells). A bioventing system (using extraction wells) is similar to a soil vapor extraction (SVE) system, except that a lower air flow rate and pressure/vacuum is used. The lower air flow rate enhances the bioremediation process (the primary mechanism of bioventing), while minimizing volatilization (the primary mechanism of SVE).

A bioventing permeability and respiratory pilot test is required to evaluate the feasibility and effectiveness of the technology and to provide data for the design of the final treatment system. Prior to implementation of the pilot test, a pilot test plan must be submitted to the FDEP or local program for approval. The pilot test plan must include, at a minimum, the following information:

1. A site diagram (indicating the North direction, drawn to scale, and including a graphical representation of the scale) depicting the following:

    a. The horizontal and vertical delineation of the plumes in each impacted medium and other pertinent information such as utilities, surface seals, and potential receptors (e.g., workers, air intake systems, buildings, etc.); and

    b. The test well network, consisting of dedicated air injection well(s) (AIWs)/extraction wells and observation wells.

2. Dedicated AIWs/extraction wells are required to effectively implement the pilot test. Consider the following during AIW/extraction well design:

    a. A minimum of one AIW/extraction well located within the most contaminated area and a minimum of one AIW/extraction well of similar construction located within an area with no documented contamination (i.e., background well) are required. The lithology and surface seal of the background well location must be representative of the contaminated area;

    b. The AIW/extraction well screen length must be in accordance with the contaminant concentration profile; and

    c. The AIWs/extraction wells must be properly grouted immediately above the screened interval to eliminate short-circuiting of the injected air to the atmosphere.

3. Dedicated observation wells are required to accurately monitor the system throughout the test. Consider the following during the observation well design:

    a. The number of observation wells must be sufficient to properly evaluate the operational conditions;

    b. The screened intervals of the observation wells must be similar to the screened intervals of the AIWs/extraction wells;

    c. Separate observation wells are necessary for each of the air injection/ extraction wells located in the area of contamination and outside of the area of contamination;

    d. The observation wells must be located in a radial pattern, to evaluate the influence of the system in all directions, and must be located at appropriate distances (e.g., 5 ft., 10 ft., 20 ft., etc.) from the AIWs/extraction wells; and

    e. The observation wells must be appropriately located to evaluate the following: 1) anisotropic conditions (e.g., backfill, tank farms, drainage structures, etc.), 2) possible migration of COCs, based upon vapor monitoring results during the pressure/vacuum testing, and 3) areas of potential preferential pathways (e.g., grassy areas, dispenser islands, etc.) resulting from varying surface seals.

4. Construction details of all AIWs/extraction wells and observation wells.

5. A description of the baseline monitoring (i.e., prior to the initiation of any testing) of the AIWs/extraction wells and observation wells, including oxygen (O_2), carbon dioxide (CO_2), COCs, and methane (CH_4). Note that appropriate precautions must be taken to minimize aeration during the gas sampling procedures. These precautions must be described in detail. The feasibility of the bioventing technology should be evaluated based upon the baseline results.

6. A description of the permeability and respiratory testing, which must include, at a minimum, the following:

    a. Injection of air and an inert tracer gas (typically 1 to 2% of the final air mixture) and monitoring at the AIW for applied pressure and flow rate throughout the test;

    b. Monitoring at the observation points for concentrations of O_2, CO_2, CH_4, tracer gas and COCs and for observed pressure/vacuum at specific intervals until O_2 and CO_2 concentrations in all observation wells approach 20% and 2%, respectively. Injection should be terminated when these conditions are met. Injections must be terminated prior to these conditions if any evidence of contaminant migration or concentrations of COC in the vapor is observed.

The monitoring frequency during injection must be determined by the rate of the O_2 and CO_2 percent increase and decrease, respectively; and

c. Upon completion of the permeability testing (injection), respiratory monitoring at all AIW and observation wells. Parameters must include O_2, CO_2, COCs, CH_4, and tracer gas. Frequency must be hourly for the initial six (6) hours. Frequency of monitoring thereafter must be determined by the rate of oxygen utilization (approximately 12 hr. intervals). Monitoring must be terminated when oxygen levels approach 5% or after five (5) days.

7. Description of all specific goals and objectives of the pilot test (e.g., minimum radial influence, maximum rate of diffusion of the tracer gas, minimum rate of reduction of oxygen concentrations, etc.).

8. Because of the variability of time that may be necessary for bioventing pilot tests, the standard template pilot study scopes are not appropriate. A site-specific cost estimate for the pilot study based on the projected duration should be developed and then reduced later by VCO if the actual duration necessary to reach stable state is less than the duration used for the cost estimate.