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SOIL VAPOR EXTRACTION VOC CONTROL TECHNOLOGY ASSESSMENT

The Soil Vapor Extraction (SVE) Process

Typically, a SVE system consists of extraction wells, inlet wells (optional), piping headers, vacuum pumps, flow meters, vacuum gauges, sampling ports, an air/water separator (optional), a volatile organic compound (VOC) control system (optional), and a cap (optional). Extraction wells are usually designed to fully penetrate the contaminated soil. These wells are normally constructed of slotted, plastic pipe placed in permeable packing to allow vapor flow into the pipe. The VOC in the contaminated area migrate through the soil into the pipe where it is either released to the atmosphere or vented to an air pollution control device. The decision to employ an air pollution control device is usually dependent upon the expected VOC concentration and applicable regulations. The VOC compounds migrating to the extraction wells will typically be the lighter and middle fraction compounds with molecular weights up to approximately 200 g/mol or organic compounds containing up to 12 to 15 carbon atoms. Heavier compounds have more of a tendency to remain in the soil unless the vacuum is increased.

SVE Operation

The operation of an SVE system is relatively simple. The blower (vacuum pump) and other necessary equipment are turned on and the flow comes to equilibrium. The steady state flow rate reached for a given system is usually a function of the equipment, flow control devices, system geometry, soil permeability, and site characteristics.

The blower provides reduced pressure in the extraction wells and induces airflow into any inlet wells present. If injection wells are employed, the discharge pressure from the vacuum pump (or after the VOC treatment device if present) is used to inject air into the wells. The reduced pressure in the extraction wells (combined with net airflow from inlet or injection wells if present) is sufficient to volatilize a large number of organic compounds and induce VOC migration to the extraction wells. At the extraction wells, compounds pass through the permeable membrane within the pipe and into the well itself where the VOCs are drawn out of the soil, and towards the vacuum pump.

In some cases, an air/water separator is employed prior to the vacuum pump, to prolong the system life and increase the efficiency of any VOC treatment system present. In addition, a nonpermeable cap is often placed over the contaminated area to prevent fugitive VOC migration out of the soil, and promote movement towards the extraction wells.

The exhaust air from the vacuum pump is sampled on a routine basis and used in conjunction with flow rate measurements to determine the VOC extraction rate and total amount of VOC extracted from the site. Typically, the extraction rate is initially high and gradually decreases over time. In the latter stages of an extraction operation, the blower is often cycled to conserve energy. This is typically done as follows: the blower is turned on, flows come to equilibrium and the extraction rate is measured. After a period of time has elapsed, the extraction rate is again measured. If the rate has decreased appreciably, the blower is turned off and the site is allowed to settle. After settling, the process is repeated. This procedure is employed because in the latter stages of operation (i.e., after the initial extraction rate has decreased appreciably), the VOC extraction rate becomes diffusion limited by soil moisture, and is not a function of the vacuum applied to the extraction well.

EMISSION CONTROLS

- carbon adsorbers
- thermal incinerators
- catalytic incinerators
- condensers

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