



Ground Remediation Systems Limited

Vacuum Extraction (SVE/Dual-Phase-HVE/MPE-Bioslurping)

Soil and Groundwater Remediation

Water Treatment

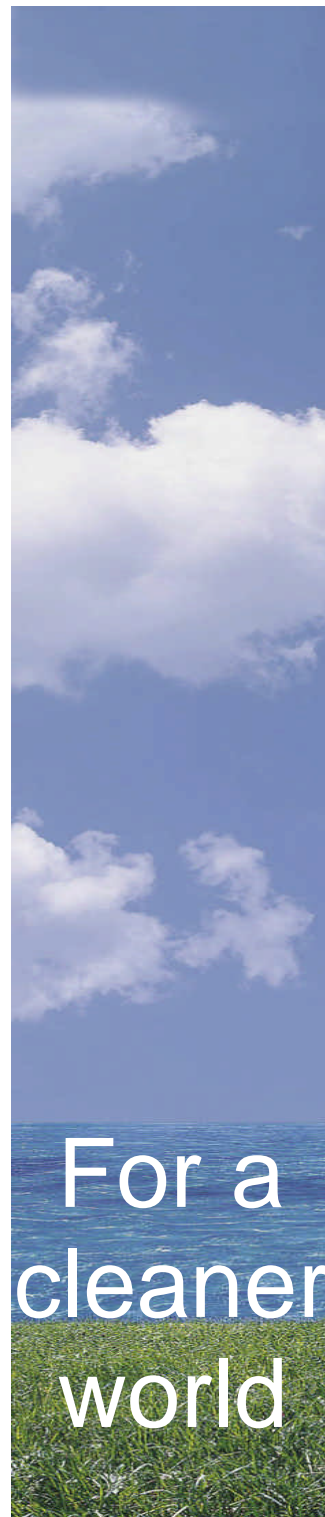
Vapour Treatment

Design & Supply

Installation & Commissioning

Operation and Control

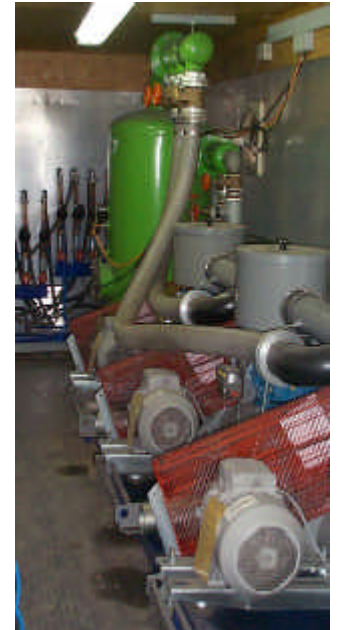
Project Management



For a
cleaner
world



Soil Vapour Extraction/Bioventing



Soil vapour extraction is an established technology for the in-situ and ex-situ remediation of volatile organic compounds (VOCs) in soils. The process removes soil vapour contaminated with VOCs and generates a mass transfer of VOCs from the soil pores to the vapour phase.

A high percentage of petroleum hydrocarbon contaminant reduction in SVE schemes is achieved by enhanced biodegradation. The introduction of oxygen to the formation can replace the depleted oxygen used by indigenous aerobic bacteria and encourage a population growth.

Optimisation of a soil vapour

extraction scheme for bioventing can result in effective remediation of less volatile compounds such as those associated with diesel, kerosene or heavier oils.

Different site conditions and contaminants will require different applications of the process. Such variables may include:

- Well spacing;
- Well construction;
- Extraction rate; and
- Applied vacuum.

GRS offers a wide range of systems for different applied vacuums and extraction rates including Zone 1 rated Explosion Proof systems for potentially explosive gases.

Such systems are typically equipped with flame arrestors, bursting discs and in-line and ambient LEL detection systems.

Any of the systems can be constructed on skids or, more commonly, within Steel ISO shipping containers.

GRS also has a range of vapour treatment technologies including:

- Catalytic Oxidation;
- Activated carbon; and
- Solvent recovery systems

All vapour treatment systems are designed to be simply connected to the extraction system and integrated into the control logic.

SVE can be enhanced by a range of optimisation techniques including:

- Groundwater abstraction to lower the water table and expose the capillary fringe or smear zone to SVE;
- Air Sparging - the simultaneous injection of fresh air into the groundwater to volatilise and transfer to the vapour phase any dissolved phase VOC contaminants. In the right formation this can be considerably more effective than simultaneous groundwater abstraction.

SVE can also be used with Product recovery programmes to enhance (Vacuum Enhance) the recovery rate.



Dual-Phase (High Vacuum) Extraction



Dual-phase extraction is an established technique for the simultaneous extraction of contaminated groundwater and soil vapour. More commonly used in silty or clayey soils, where a higher vacuum is required, the technique obviates the need for submersible pumps. High vacuum soil vapour extraction improves the feasibility of soil vapour extraction in lower permeability soils. The deeper vacuum increases the radius of influence and the mass transfer of volatile contaminants. The technique offers the following advantages over other conventional remediation techniques:

1. Simultaneous abstraction of soil vapour and groundwater;
2. Development of a cone of depression (and associated minor cone of ascension) and exposure of the capillary fringe (smear zone) to Vacuum Extraction;
3. Mass transfer of VOCs from the liquid to the gaseous phase, particularly those with a high vapour pressure. In excess of 90% of the dissolved-phase VOCs is often air stripped (depending on the compounds) within the riser and pipe-work. In some cases, above ground treatment of the abstracted groundwater will not be necessary;

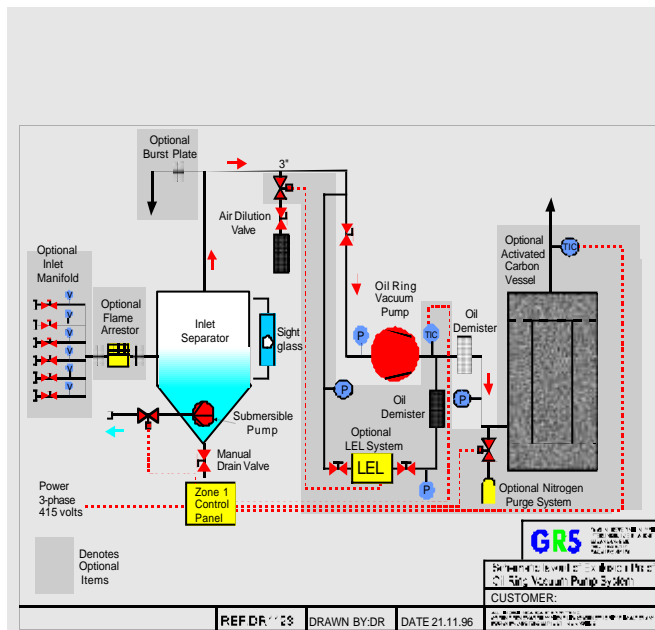
4. Enhanced in-situ bio-degradation through oxygenation;
5. Potentially significantly accelerated remediation of the soil and groundwater.

It is frequently believed that dual-phase or multi-phase extraction is limited by depth. This is because a vacuum can inherently not exceed -1 bar (equivalent of circa 10m). In other words, a vacuum cannot lift the water-table in a well by more than 10 metres. However, Dual/multi-phase extraction can in fact remove liquids from depths far exceeding 10 metres by air entrainment of the liquids. GRS has installed and operated such systems at numerous sites and we would be pleased to explain the techniques in detail.

A Dual-phase High Vacuum Extraction System typically entails the use of a water ring vacuum pump (WRVP) or oil ring vacuum pumps (ORVP).

GRS Typically supplies integrated containerised plant inclusive of off-gas treatment technologies such as catalytic oxidation or activated carbon and aqueous phase treatment for abstracted liquids such as oil/water separation, air stripping, activated carbon etc.

Multi-Phase Extraction/Bio-Slurping



This technique uses the same principal as dual-phase extraction typically employing **explosion proof** water ring vacuum pumps.

However, through control of the depth of the extraction lance, the MPE technique allows the controlled extraction of free-phase NAPL/DNAPL, even lubricant or crude oils along with groundwater and soil vapour.

Extraction lances of various sizes can be utilised. The smaller the diameter of the extraction lance, the less air flow is required to entrain liquids from the borehole. Therefore an advantage of small lances is that more lances can be employed in

more wells from a single MPE system. Particularly small extraction nozzles can limit the soil vapour extracted substantially. This leads to an inherent vacuum within the extraction pipework and lance network such that even if only 1 out of 10 lances is submerged, it can still extract liquids. This may be particularly helpful in more permeable soils where large diameter lances in the same scenario may produce substantial quantities of soil vapour, thus reducing applied vacuum and the potential to extract liquids from boreholes where the lances are still submerged.

GRS has specialised in constructing systems with a

multi-functional application. By installing two inlet separators, two vacuum headers and two or more high vacuum pumps, the operator can choose between the following applications:

- 1) High Vacuum on one branch of wells and low vacuum on another. This can overcome the problem of air flow following the path of least resistance and the failure to remediate less permeable parts of the site.
- 2) Dual-phase or multi-phase extraction on one header and lower vacuum SVE on another header. This enables a single system to extract liquids from numerous wells in very permeable soils while

simultaneously extracting soil vapours from the same wells using separate pumps. The operator has the ability to select the number of pumps connected to either header.

Advantages of MPE include:

1. Simultaneously extract soil vapour and liquids with the same pump if required;
2. Recovery of viscous/dense products eg lubricating oil;
3. No complex down-hole skimmer pump systems;
4. Simultaneously control the cone of depression, skim free-phase product and vapour extract if required

Ground Remediation Systems Limited
Sterling House, 2 Park Street, Wigan United Kingdom WN3 5HE.

Tel: +44 (0) 1942 493170. Fax: +44 (0) 1942 493171. Email: grs@remediation.com Website: www.remediation.com