VEG Technology
In-Situ & Ex-Situ Thermal Treatment of Soils
Enhanced Oil & NAPL Recovery

Summary
The Vapor Energy Generator (VEG) system is a patented, mobile in-situ and ex-situ technology used to remediate soils for unrestricted reuse, and for enhanced recovery of oil and non-aqueous phase liquids (NAPLs). Relying on a highly efficient, patented vapor generator, the ex-situ component of the technology thermally treats soils within a fully enclosed chamber, while eliminating emissions through the use of patented filters. The ex-situ technology is also fully sustainable, relying on vapors generated through thermal treatment of soils to serve as fuel for operation of the system; this significantly reduces operational costs relative to other thermal treatment options.

The in-situ component of the VEG technology relies on the highly efficient vapor generator to change the physical properties of soil contaminants, NAPLs, crude oil, and fuels in the subsurface, allowing for subsequent recovery/recycling.

Applications
- Full treatment of gasoline, diesel, jet fuel, motor oil, and manufactured gas plant (MGP) wastes in soils
- Treatment of VOCs (e.g., benzene, TCE, PCE, vinyl chloride), SVOCs and PAHs, TCE/PCE, PCBs, and pesticides in soils for unrestricted (i.e., residential) reuse
- Ongoing in-situ and ex-situ treatment of munitions constituents, including TNT and RDX
- Enhanced recovery and recycling of crude oil from oil wells, and from refinery and pipeline releases, and recovery of weathered NAPLs from UST releases to achieve site closure
- Enhancement of alkaline hydrolysis through combined use of VEG and lime
- Treatment of comingled wastes (metals and SVOCs/VOCs) through combined use of VEG and recyclable steel slag
- Successful application and federal and commercial facilities, including award-winning USACE project

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Pre-VEG Treatment Concentration (mg/kg)</th>
<th>Post-VEG Treatment Concentration (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline/Diesel</td>
<td>150,000</td>
<td>&lt;100</td>
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<tr>
<td>BTEX</td>
<td>2,500</td>
<td>&lt;0.5</td>
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<tr>
<td>PAHs</td>
<td>60</td>
<td>&lt;0.01</td>
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<tr>
<td>PCBs</td>
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<td>&lt;0.2</td>
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<tr>
<td>TCE/PCE/VC</td>
<td>50</td>
<td>&lt;0.001</td>
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<tr>
<td>Pesticides</td>
<td>250</td>
<td>&lt;0.001</td>
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</table>

VEG Mobile Ex-Situ Soil Remediation System
VEG Highly Efficient Vapor Generator
Enhanced Oil Recovery Using VEG Vapor Generator
Results of VEG Treatment Applications
VEG Technology
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Technology

At the core of the VEG soil remediation technology is a patented, compact, highly efficient vapor energy generator, which initially utilizes recycled water and propane to generate steam at 1300°F. The vapor generator provides the thermal energy for both in-situ and ex-situ applications of the VEG technology.

Featuring an enclosed rotational renewal/treatment chamber containing a 20-inch auger and a hollow 6-inch shaft, the VEG soil remediation system rotates via a variable speed hydraulic system, thermally treating soil moving down the auger. Soil contaminants are entirely desorbed at specified temperatures and residence times, and are passed as vapors into the box head space within the enclosed chamber. Induced vapors in the head space are then sent through patented filters for capture and/or treatment of NOx, SOx, HCl, and CO₂ components, with the remaining vapors subsequently sent back to the vapor generator to replace the propane as the fuel to operate the system.

Attributes and Benefits

- Successful implementation under USEPA oversight
- Typical soil treatment rates of 30 cubic yards/hour
- Eliminates offsite transport and landfill disposal of soils
- Results in unrestricted onsite reuse of soils
- Eliminates land use covenants and deed restrictions
- Eliminates need for import of clean backfill to the site
- Eliminates landfill waste generator liability
- Recycling of crude oil through enhanced oil recovery
- LNAPL recovery for plume stability and site closure
- Patented filters ensure negligible air emissions, thereby easing permitting process
- Entirely sustainable system relying on induced vapors for fuel to run system operations
- Transportation of VEG system via a single vehicle, significantly reducing mobilization and setup costs
- Typical cost savings > 50% relative to landfill disposal
- Typical carbon footprint reductions > 80%

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