

Don't Pay to Process Hot Air

*Let RSI's equipment Pay You with Process Savings,
Energy Cogeneration, and More!*

Technology Proven Worldwide Approved For Hot Work Zones No Open Flame

Historically, it has been the practice in the soil and groundwater remediation industry to specify oxidation equipment based upon maximized process flow rates and applied vacuum - but what are you really paying for?

Process Flow Rates vs. Mass Removal Rates

Most oxidation processes require influent dilution air to meet acceptable LEL process safety limits - sometimes reducing influent concentration down to 20% of LEL values. High process low rates, therefore, do not necessarily equate to high mass removal rates, especially when VOC abatement is required.

Stop paying for processing ambient air! RSI's Internal Combustion Engine (ICE) technology utilizes dilution air only as necessary to maintain stoichiometric combustion. Further, RSI's ICE systems can operate with VOC influent concentrations at or above LEL with minimal to no supplemental fuel usage.

Energy Recovery

- Condensing vapor back to liquid
- Recycle flare gas into renewable energy
- Converting waste energy to usable power

U.S. Patent: 4,846,134; 4,979,886

Canadian Patent: 1,287,805, Patents Pending



In the final analysis, when you compare the capital, installation, utility and O&M costs of thermal and catalytic oxidizers to ICE systems on a "cost per pound destroyed" basis, ICE technology is usually the clear, cost-effective choice.

In fact, according to a study conducted by the United States Air Force

(AFCEE):

"Based upon the cost estimate provided in Section 3.4, ICE technology is similar to that of thermal an catalytic oxidation when influent concentrations range between 3,000 to 5,000 ppmv TVH. Above these concentrations, ICE technology becomes more cost-effective."*

*Excerpt from:

Technology Transfer Division, July 1998
(The complete report is available from RSI upon request.)

Look at the real bottom line! Don't let others sell you hot air! Make your investment dollars count by purchasing mass removal efficiency. RSI systems are self-contained and portable. Trailer mounted units may be towed to your site, connected to a propane or natural gas source, and can be operating within minutes!

Let Our Equipment Pay You!

Generate Profits from Lost Product!

Why should you settle for equipment that doesn't pay for itself? Not only does RSI's equipment operate without requiring an external source of electricity, now our equipment can produce electricity for other uses.

RSI now offers generator modules that interface with our internal combustion engines. Our systems provide up to 80kW of electrical power, and produce this electricity by using extracted contaminants as fuel while remaining completely under computerized emissions control.

The RSI Phoenix S.A.V.E. controller monitors and adjusts process parameters to maintain stoichiometric combustion even while the generator module is producing electricity. The end user is assured of safe, clean and continuous electrical power without impacting the integrity of the site remediation in some instances, actually enhancing it.

Think of the convenience that this affords the user!

**Greatly reduce or eliminate the need to flare
Condense vapors into sellable products
Return electrical energy to the grid**

Electrical power is now available on your site for running lights, electric pumps, tools, blower motors, compressors, etc.

Systems have been delivered across the U.S.
and around the world.



But why stop there?

Produce and Sell Electricity Back to the Grid!

Properly equipped, RSI remediation equipment can turn unused energy in the form of hydrocarbon contaminants in the soil or groundwater into dollars in your pocket. Let RSI help you to realize a return on your investment while still remediating your property.

Our gen-set module will produce electricity that can be sold back to the local utility company, and, in some instances, reduce actual operating costs. The energy that is produced can be sold back to your local electrical utility company. RSI can assist you in the selection of switching equipment that will ensure effective power transmission.

Advances in our control technology and increases in energy costs now make energy cogeneration a reality, with payback cycles that have been drastically reduced.

Consult with RSI for advice on the feasibility of installing energy cogeneration features on your next order. Don't just let a great potential revenue source go up in smoke!

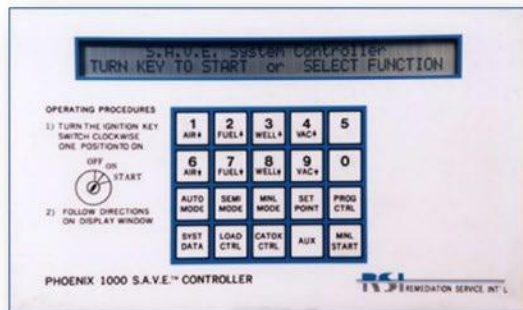
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Why RSI?

Technology For The Environment

Remediation Service International (RSI), a division of Innovative Environmental Solutions, LLC, is a leading manufacturer of self contained, portable systems for soil and groundwater remediation. RSI also manufactures systems for air pollution prevention treating vapors from tank degassing, and other industrial vapor emission sources. Systems have been delivered across the U.S. and around the world. RSI is an established, reliable manufacturer providing complete technical and service support, including pilot testing, and special engineered systems to meet our customers' needs.



Critical to our success has been the development of the patented Phoenix S.A.V.E.™ Controller. It continuously monitors system operation to optimize system performance. The controller records process information for future retrieval and the telemetry feature allows bidirectional communication and control of the S.A.V.E.™ systems. These features significantly reduce labor costs associated with the operation of conventional remediation systems.



Technology Proven Worldwide Approved For Hot Work Zones No Open Flame



Systems have been delivered across the U.S. and around the world.

Our patented S.A.V.E.™ portable remediation systems are versatile, with available modular components to meet the requirements of most projects. Our technology, for example, has been used successfully to remove Methyl tert Butyl Ether (MTBE) dissolved in groundwater and destruction of chlorinated hydrocarbons in vapor streams.



U.S. Patent: 4,846,34; 4,979,886

Canadian Patent: 1,287,805

Our Technology Meets EPA Demands

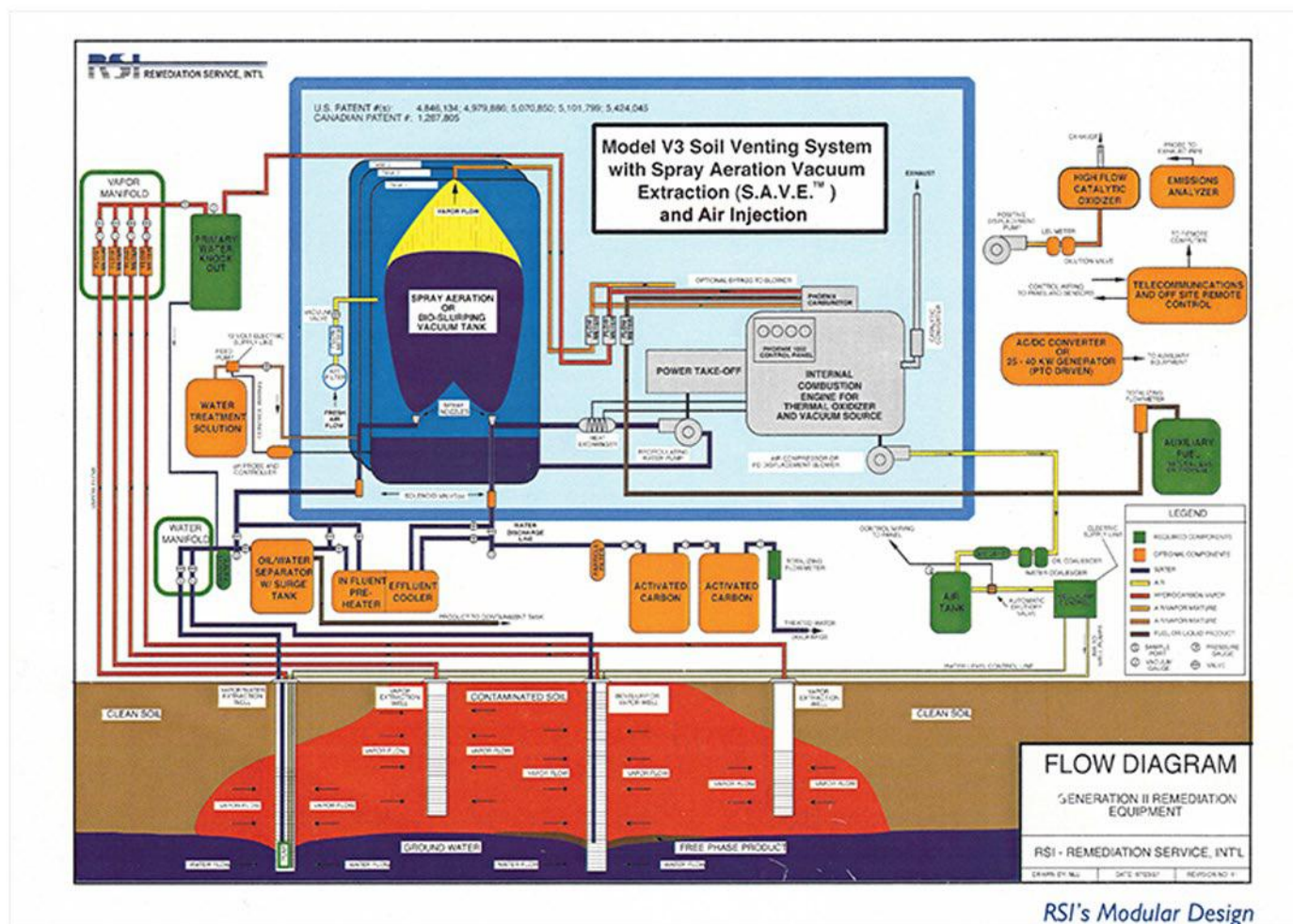
Why RSI?

Technology For The Environment

Stop paying for processing ambient air! RSI's Internal Combustion Engine (ICE) technology utilizes dilution air only as necessary to maintain stoichiometric combustion. Further, RSI's ICE systems can operate with VOC influent concentrations at or above LEL with minimal to no supplemental fuel usage.

In the final analysis, when you compare the capital, installation, utility and O&M costs of thermal and catalytic oxidizers to ICE systems on a "cost per pound destroyed" basis, ICE technology is usually the clear, cost-effective choice.

Look at the real bottom line! Don't let others sell you hot air! Make your investment dollars count by purchasing mass removal efficiency. RSI Patented Technology



RSI's Modular Design

U.S. Patent: 4,846,34; 4,979,886

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Our Technology Meets EPA Demands

Remote Monitoring & Control

Computerized System Control and Telemetry

To optimize system performance, including contaminant extraction and destruction efficiency, RSI has developed a fully automated, user-friendly, computer control system for its modular remediation systems. The Phoenix S.A.V.E.™ Controller maximizes vapor flow from the extraction wells and minimizes alternate fuel consumption simultaneously. The electronic controller senses any deviation from the stoichiometric air-to-fuel (A/F) ratio to optimize contaminant destruction and meet stringent air emissions standards. With the ability to optimize system operation to meet Air Quality Control standards, the patented computerized control system is cutting-edge technology.

Maintaining optimal A/F ratio is challenging with variations in site conditions, such as fluctuating hydrocarbon, oxygen or carbon dioxide concentrations. Competing systems require constant operator input to adjust to changing conditions. The Phoenix S.A.V.E.™ Controller can handle virtually any change in site conditions, from a slug of free product to a temporary loss of supplemental fuel. In the event of system shutdown based on the automatic detection of an incorrect operating condition, the computer can be preprogrammed to restart after verifying that all operating conditions are correct.

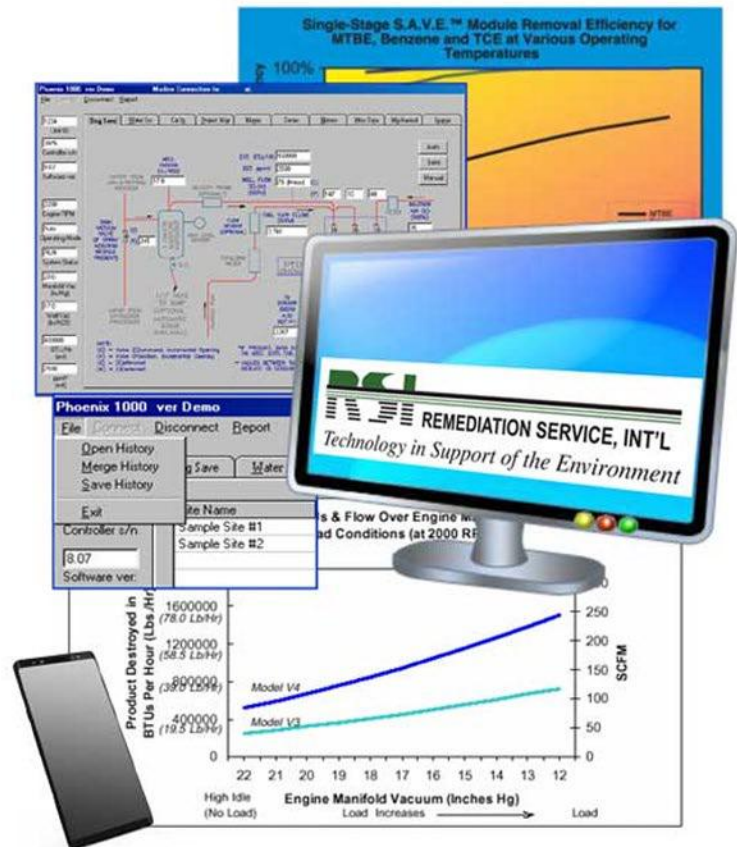


In the event of a system shut down, the optional telemetry system can report unit status to the technician on call.

The Phoenix S.A.V.E.™ Controller will not start the engine when a safety "kill" switch has been activated, for instance, due to high engine temperature, low oil pressure or high water level in the moisture knockout tank.

U.S. Patent: 4,846,34; 4,979,886

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Monitor and control any site anywhere from your desktop workstation

The Phoenix S.A.V.E.™ Controller has proven cost effective for our S.A.V.E.™ systems. Increased runtime, less-frequent maintenance visits, and reduced cleanup costs are achieved with this breakthrough technology. Truly innovative environmental solutions. "Patents



Remote Monitoring & Control

Landline or Cellular

Bidirectional communication and control

The Project Manager

The optional "Project Manager" software module allows for control of the "Smart Valve Manifold System".

This unique system optimizes BTUs extracted from the contamination source by rotating from well to well to determine the most efficient method of extraction. This reduces energy cost and increases contaminant removal rates. The system can be manually overridden for operator control, both on and off site.

Left - Site Controller; Right - Phoenix Host Software

The Phoenix Data-logger

Monitoring includes data reporting on engine vital signs and system operation. Reports are generated automatically or manually at the discretion of the operator. Data is stored at programmable intervals for future retrieval, and it can be downloaded via direct or modem connection to the PC.

Host Program Requirements

Any Pentium or higher computer running Microsoft Windows 95 or higher with a minimum of 8 megabytes of free disk space. U.S. Robotics (3COM) Sportster modem (internal or external).

U.S. Patent: 4,846,34; 4,979,886

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Tank Degassing



REMEDIATION SERVICE, INT'L

NEW air quality regulations have been enacted!

Pollution Prevention: Reduction of VOC Emissions From Tank Degassing and Loading Operations

In many regions, air quality regulations have been enacted to control emissions of volatile organic compounds (VOC) from facilities that load organic liquids.

Conditions include actual loading into tank trucks, trailers, railroad tank cars, above and below ground storage tank, marine barge and ship fuel tanks.



ICE technology Features:

- Flare Reduction
- Industrial Degassing
- Centrifuge Vapor Abatement
- Vacuum Truck Vapor Control
- Approved For Hot Work Zones
- Technology PROVEN Worldwide

This includes storage tank degassing regulations designed to reduce VOC emissions from above-ground and underground storage tanks.

Storage tank cleaning and repair operations are distinct steps in a “degassing” process and a source of VOC emissions. Maximum VOC emission allowances are typically quite stringent. In California, for example, VOC loading and storage facilities must be equipped with an approved vapor recovery and/or disposal system.

The emissions generated during the cleaning and repair operation come from the vacuum pump that extracts the sludge and rinsing liquid from the storage tank. Industries subject to these provisions include tank owners and operators, as well as companies involved in tank excavation, tank repair,

To control these emissions, two options are contemplated by the regulatory boards:

- (1) A vapor recovery system capable of collecting and returning discharged hydrocarbon vapors and gases during loading of organic liquids into transport vessels back to a stationary storage container, or into an enclosed process system.
- (2) A vapor disposal system designed and operated to destroy VOC emissions prior to discharge into the atmosphere.

Tank Degassing

The RSI S.A.V.E.™ Solution

RSI's specially designed pre-engineered remediation systems for tank degassing operations are already in full compliance with the regulatory boards requirements as a vapor disposal system. An engineered system can be specially designed to meet your particular VOC flow rates, concentrations and discharge emissions.

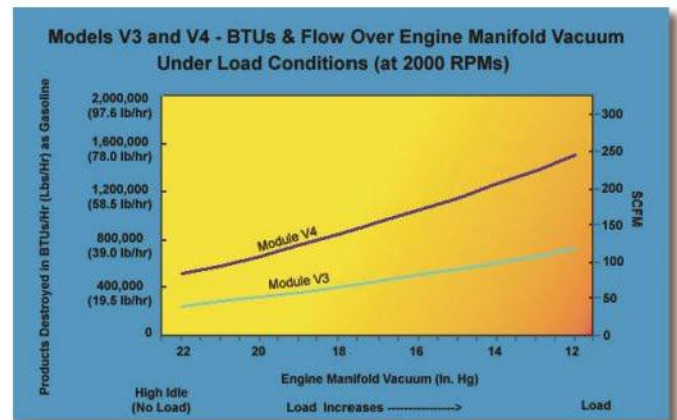
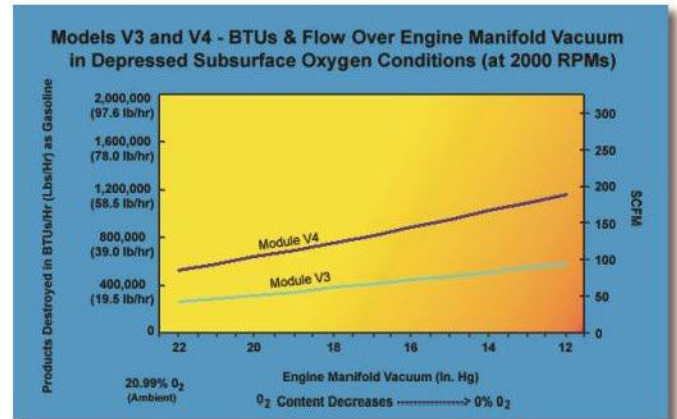
ProGreen® Chiller Installation



Specially engineered engine with air fuel controller.



RSI's S.A.V.E.™ systems are truly innovative environmental solutions ready to help you meet today's requirements, and those of tomorrow.



Note:

Total air throughput remains constant at set RPM and manifold vacuum. Engine manifold vacuum is a function of rpm, load, timing, and air-fuel ratio.

Typically, systems are operated at high RPM, minimal load, advanced timing, and at or near stoichiometric air-fuel ratio, which results in high engine manifold vacuum. "Patents Pending"



Ground Water Treatment

Clean up Ground Water with Pump & Treat, Bio-Slurping, & Air Injection Combined

The predominant treatment for removing high contaminant concentrations found in extracted groundwater has been a combination of air stripping followed by activated carbon polishing prior to discharge. Conventional air strippers require a large air-to-water flow ratio to achieve adequate groundwater treatment objectives. Although removal of the groundwater is an effective plume containment mechanism, this is hardly an efficient means for treating groundwater.



Skid unit in Grangemouth, Scotland

RSI's (S)pray(A)eration(V)acuum(E)xtraction(S.A.V.E.™) system incorporate the basic principles of air stripping with an innovative new twist.

Spray Aeration Vacuum Extraction
Most organic contaminants have a favorable Henry's law coefficient for air stripping, given their relatively low solubility in water and high vapor pressure. RSI's patented S.A.V.E.™ system uses the same principles as a conventional air stripper; however, it enhances the stripping process by:

- Maximizing the surface area between groundwater and air using a finely atomized spray.
- Waste heat, generated by the Internal Combustion Engine (ICE) increases the temperature of the contaminated groundwater increasing the vapor pressure of the organic contaminants and furthering their vaporization into the air phase.
- The vacuum generated by the ICE lowers the pressure, which further enhances the transfer of contaminants to the vapor phase.
- ▣ Water in the Spray Aeration tank is re-circulated, which maintains a high water-to-air transfer rate.

U.S. Patent: 4,846,134; 4,979,886

Canadian Patent: 1,287,805

The combination of these four improvements over most conventional air strippers significantly reduces the air/water ratio, which results in less vapor phase treatment. In the case of petroleum hydrocarbons and MTBE, the c o n t a m i n a t e becomes partial fuel for the ICE.



Bio-Slurping - Dual Phase Extraction (DPE)
The introduction of the DPE module to the Soil Venting Equipment (SVE) system allows us to perform dual-phase extraction, removing the petroleum hydrocarbons (NAPL phase) pooled above the groundwater, as well as hydrocarbon vapors and contaminated water at the water table, which considerably reduces site cleanup time and total project costs.



Ground Water Treatment

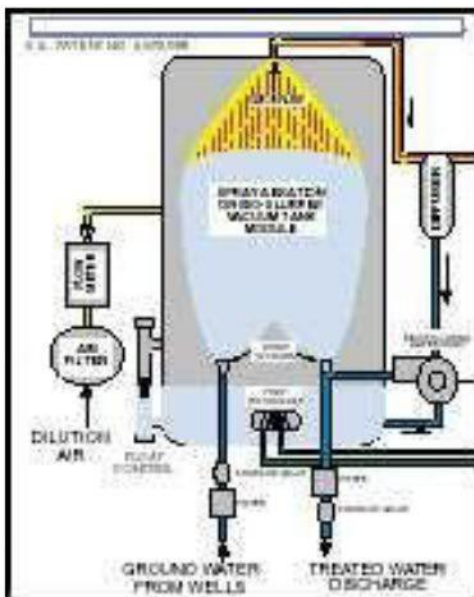
Air Injection

A blower or air compressor is attached to the ICE to generate a volume of air at a certain design pressure which is injected into the groundwater at the source of contamination. Injected air also promotes biodegradation in the aquifer and in the vadose zone

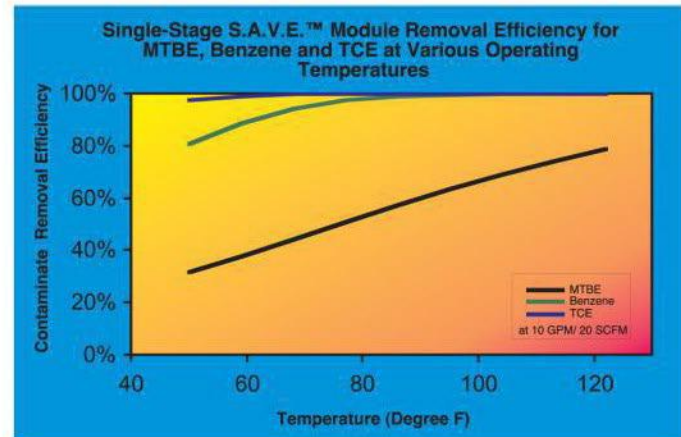
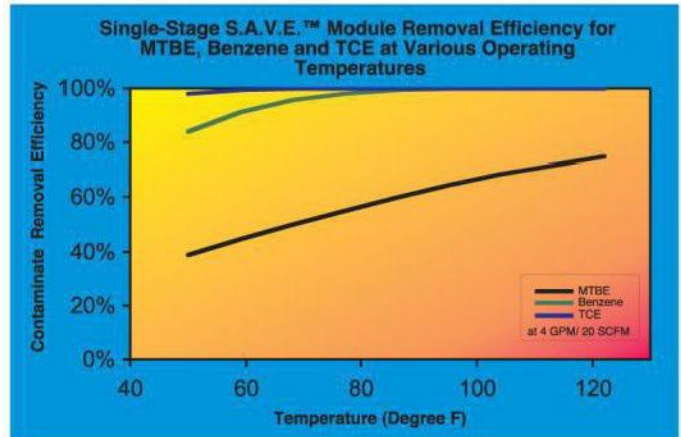
(Bioventing).

Groundwater with high levels of dissolved iron, calcium and other inorganic constituents must be pretreated before the spray aeration module to reduce maintenance costs. A complete system solution can be provided based on our customer's needs. The S.A.V.E.™ system is mounted on a dual-axle trailer with the ICE, to minimize space requirements and simplify transport and startup.

Automation of these modules using the Phoenix S.A.V.E.™ Controller makes system operation simple and user friendly. Innovative environmental solutions by RSI.



Note: Increasing groundwater temperature to accomplish removal efficiency shown may require additional heat beyond waste energy of the engine. Please see RSI representative for complete details.



Soil & Groundwater Remediation

Soil Venting, Bioventing, Dual Phase Extraction, and Air Injection

Soil Venting is an innovative technology for removing organic contaminants to remediate polluted soil zones. The organic contaminants can be in the soil in three different zones: as free "product" in pools or residual globules, dissolved in the groundwater, or as vapors in the vadose zone. Soil venting directly deals with the free product and the organic vapors in the vadose zone by applying a vacuum through wells and extracting the air in the contaminated zone. Soil venting also deals indirectly with groundwater contamination, by removing the overlying free product and vapors, promoting transfer of the contaminants into the vadose zone, where they are removed through the extraction wells.

Soil Vapor Extraction (SVE) the RSI way RSI's patented systems use the vacuum from the engine's intake manifold to extract the soil vapors. Air flow rate is governed by the cubic inch displacement of the engine, rpm, system load, and site specific conditions. For large sites with multiple wells, positive displacement blowers driven by the ICE can provide extraction flow rates up to 2,300 SCFM. Blower capacity in terms of total flow and vacuum pressure can be sized to meet each specific remediation design. For sites requiring higher vacuum (greater than 18" Hg, liquid ring vacuum pumps can be driven by the ICE. The ability to deliver up to 156 brake horse power with the eight cylinder engine allows us to meet every customer need.



Our Technology Meets EPA Demands



U.S. Patent: 4,846,134; 4,979,886

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Free Product Removal Our innovative technology is more efficient than traditional methods for removing free product. Placing a vacuum on the well counteracts capillary forces allowing for flow of the free product into the extraction well during the SVE process. Second, the extracted vapors are consumed by the normal combustion process of the engine, therefore no need for costly storage or disposal. And last, depending on the BTU value of the contaminants, the use of alternate fuel source is significantly reduced.

Bio-Slurping - Dual Phase Extraction (DPE) The introduction of the DPE module to the Soil Venting Equipment (SVE) system allows us to perform dual-phase extraction, removing the petroleum hydrocarbons pooled above the groundwater, and hydrocarbon vapors and contaminated water at the water table, which considerably reduces total project costs.



Soil & Groundwater Remediation

Bio-Venting/Air Injection

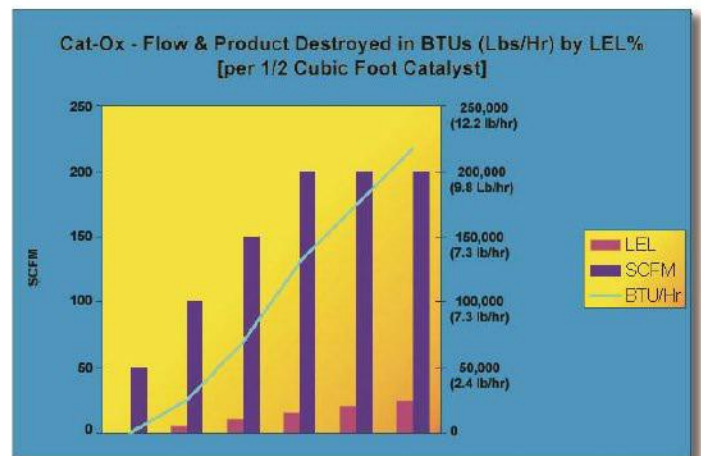
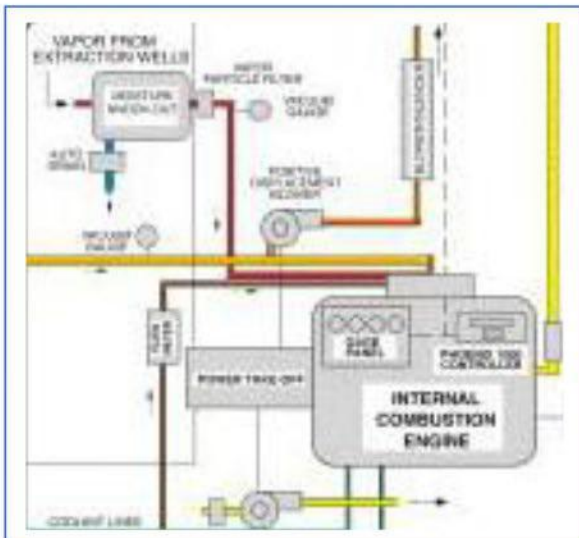
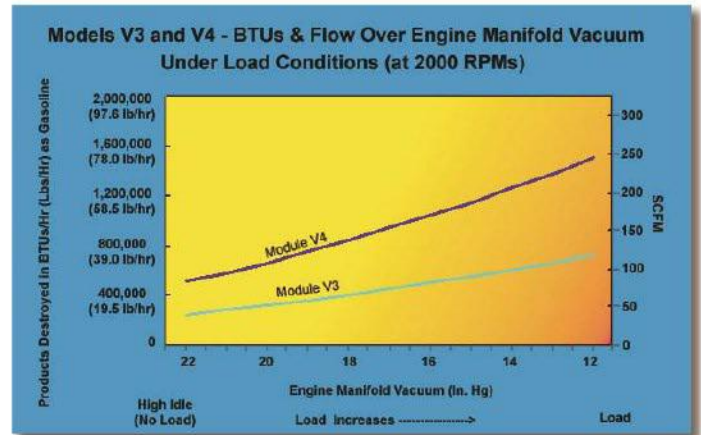
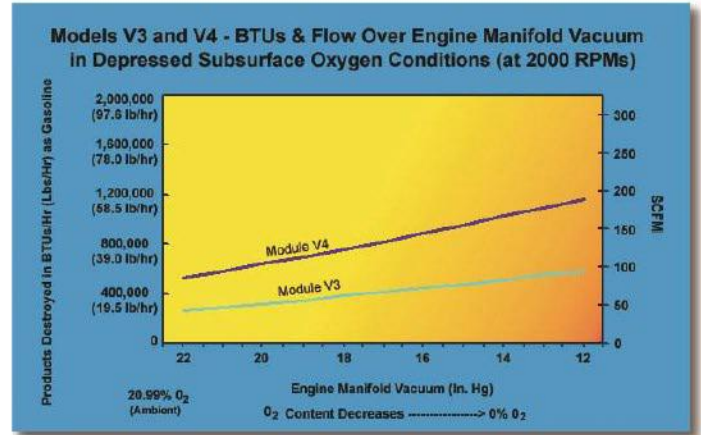
RSI's system is also used for Bio-Venting, which involves the flow of fresh air through the vadose zone to increase oxygen content and accelerate bioremediation. In Air Injection mode, heated air from the blowers, or compressors, can be routed via reinjection wells.

The above modules can be combined with the spray aeration system, the ICE and/or catalytic oxidizers to completely remove and destroy all of the contaminants. The ICE provides power to all components and in the case of petroleum hydrocarbon contamination, the extracted contaminants are used as fuel by the ICE.

Natural gas or propane may be needed as supplemental fuel if the amount of fuel extracted is below the ICE requirements. RSI's system's diversity provides truly innovative environmental solutions to the most challenging site conditions.

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VOC Emission Control

Off-Gas Treatment: Air Abatement

Organic vapors extracted from contaminated soil during Soil Venting or from contaminated groundwater treated in the S.A.V.E.™ system's Spray Aeration process typically requires treatment to meet Volatile Organic Compound (VOC) emissions standards. Depending on the concentration and composition of the organic vapors, RSI offers several treatment technologies.

Compressive Thermal Oxidation using RSI's specially designed Internal Combustion Engine For high concentrations of total petroleum hydrocarbons (TPH) from fuel spills, at or above the Lower Explosion Limit (LEL), compressive thermal oxidation via our computer controlled modified internal combustion engine (ICE) is the most cost-effective process on the market today. The ICE is also effective on TPH below the LEL by simply adding supplementary fuel from another source, for example, natural gas, propane or gasoline.

Chlorinated Organic Vapor Air Abatement Module

Chlorinated organic vapors can be treated via activated carbon adsorption units or in a catalytic unit specifically developed for chlorinated organics. The destruction of chlorinated organics results in the production of hydrochloric acid (HCl); the acid may be removed from the emissions using a scrubber system provided with this module. For low levels of chlorinated vapors in a petroleum hydrocarbon spill, the vapors may be treated in the ICE, following RSI's modified operating instructions with prior RSI approval.

RSI's Catalytic Oxidation Module

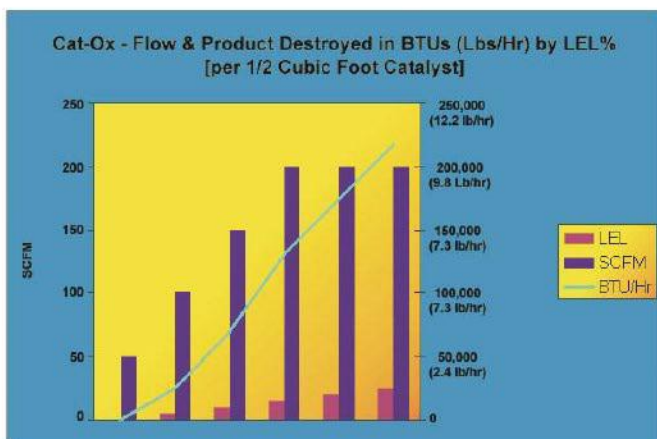
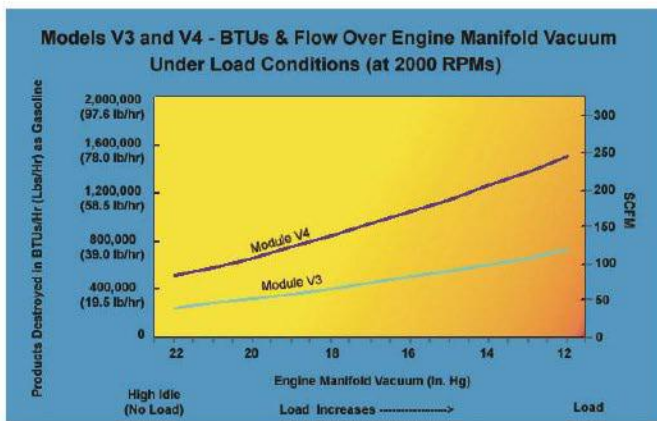
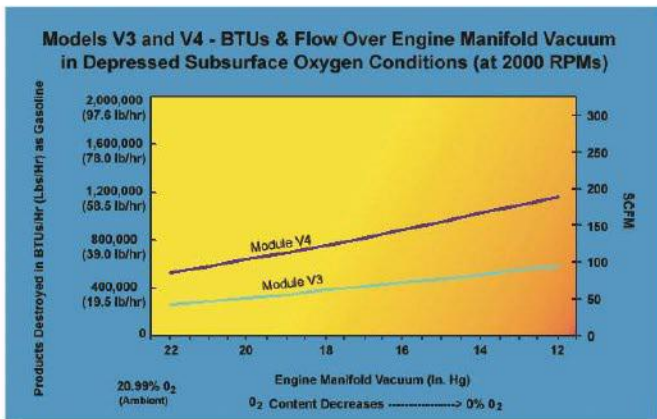
Our catalytic oxidation module destroys additional TPH vapors, adding overall performance not seen in the industry. It is also useful when the total combined gas flow rate from Soil Venting and Spray Aeration exceeds the destruction capacity of the ICE. The key to our success is that the catalytic module increases the total S.A.V.E.™ system capacity, with two off-gas treatment units (ICE and catalytic oxidation) operating simultaneously, in parallel. Our catalytic module requires no outside energy source as all required power is derived from the waste energy of the ICE. No one offers a better treatment cost per cubic foot treated than RSI's patented remediation systems.



Patent(s) Pending



VOC Emission Control



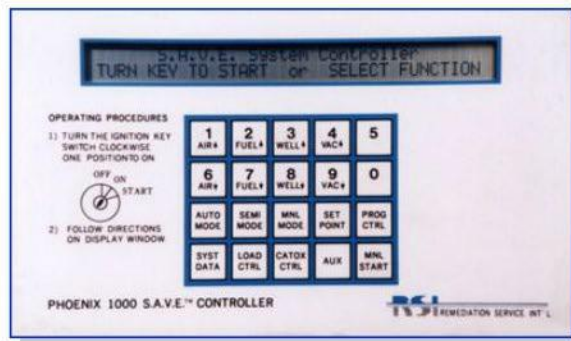
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The Phoenix S.A.V.E.™ Controller

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RSI developed the Phoenix engine controller to handle virtually any change in site conditions, from a slug of free product to a temporary loss of supplemental fuel. It maximizes vapor flow from the extraction wells and minimizes alternate fuel consumption simultaneously.

The electronic controller senses any deviation from the stoichiometric air-to-fuel (A/F) ratio to optimize contaminant destruction and meet stringent air emissions standards. With the ability to optimize system operation to meet Air Quality Control standards, the patented computerized control system is cutting edge technology.



The Project Manager

The optional "Project Manager" software module allows for control of the "Smart Valve Manifold System". This unique system optimizes BTUs extracted from the contamination source by purposely rotating from well to well and determining the most efficient combination of wells to extract from. This will reduce energy cost from alternate fuel and increase Contaminant removal rates. The system can be manually overridden for operator control, both on and off site.

Patents Pending

