Name of Process: TDT-3R™ Process	**Status:** Pilot plant test has been managed with feed capacity of approx. 10 kg/h to 150 kg/h for material treatibility study for decontamination of dense tetrachlorobenzol contaminated soil stemming from the Garé site in Hungary. Based on experiences commercial plant construction has been engineered and designed for 10 k-tpa (1.5 tons/h) and 36 k-tpa (5 tons/h) throughput capacities.
Vendor: Terra Humana Clean Technology Engineering Ltd. (subsidiary of Thermal Desorption Technology Group LLC. of USA) Web site: http://www.terrenum.net	
Applicable Pesticides and related POPs wastes: All chlorinated hydrocarbons including dense pollution, VOC's, SVOC's, PAH's in any variation in flow, variation in components and variation in concentration "as received", where the boiling point of the contaminated substances is up to 600 °C at material core temperature. The TDT-3R™ process design has also been developed to manage volume minimization and stabilization of LLW radioactive sludge wastes with 100 litre/hr throughput capacity.	

Introduction note:
As there are no "neutral" documents available on this technology yet, the vendors materials have been used in order to give the minimum necessary information on this method.

Technology description:
Low temperature thermal desorption treatment of dense contaminated soil in indirectly heated horizontally arranged rotary kiln with true reductive environment and vacuum.

The main component of the *Thermal Desorption Technology Recycle-Reduce-Reuse Terra Humana "TDT-3R™"* is a specially designed, indirectly fired, horizontally arranged rotary kiln (patented) reactor with no moving components inside. In the reactor the contaminated soil in a reductive environment is gassed-out in low vacuum (0-50 Pascal), between the temperature ranges of approximately 300°C - 350°C material core temperature.

Gas vapour from the thermal desorption process is directly combusted at a minimum temperature of 1,250 °C with minimum 2 second residence time, fast cooled to avoid recreation of dioxin and furan gas components and heat from its flue gas is recovered. In the case of halogenated contamination it is generally experienced that dioxin and furan gases are not created/recreated in a reductive environment and the pyrolysis gas-vapour phase does not contain dioxin-furan gasses. The remaining gas is cleansed in an efficient high capture wet gas multi venturi scrubber prior to discharge. Scrubber process water is cleansed prior to discharge and the neutralised precipitate with from the water treatment is off site disposed on permitted landfill.

The cleansed soil is indirectly cooled and discharged, and will contain outgassed porosus carbon char, which during the recultivation phase will keep the moisture content and provide protected sites for re- implanted micro-organisms. As the treatment process is executed in true reductive environment, the cleansed soil will not be burned out, e.g. oxidized to "dead soil", therefore recultivated revitalization of the top layer of the treated soil can be cost efficiently and rapidly managed.

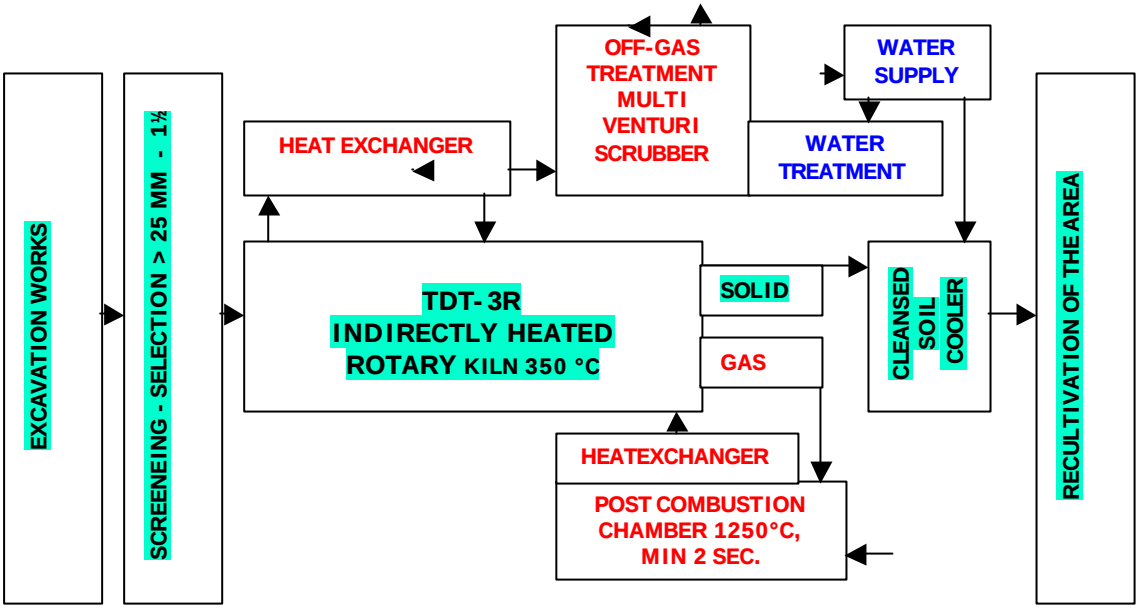
Process Technical Aspects

- High efficient indirect heat transfer to the basic material,
- Revolutionary technical solution for the rotary kiln sealing between the moving and stationary parts,
- Advanced technical solution for the continuous throughput of the feed stock,
- Advantageous and safe application even for high concentrated (>10,000 mg/kg up to any range) contaminated soil treatment "as received", with no requirement of blending
- Flexible operations: operates in a range of 25 % to 125 % of nominal capacity,
- Closed continuous input - output system,
- Simple - safe vacuum system, easy start up - shut down,
- Total heat recovery,
- The 3R rotary reactor system is of a simple technical - mechanical construction, containing no exotic technical construction and exotic materials,
- Mobile version available,
- Alternative throughput capacities are available from 10,000 tons/year capacity.

The TDT-3R™ meets the U.S. RCRA Miscellaneous Units 40 CFR 264 Subpart X for THERMAL DESORBERS and compatible E.U. Norms for THERMOLYSIS. Patented rotary kiln.

John Vijgen, International HCH and Pesticides Association, Fellowship report: "New and emerging techniques for the destruction and treatment of pesticides wastes and contaminated soils." NATO/CCMS Pilot Study: Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater (Phase III)"

Process diagram:



Performance:

Treatment efficiency:

The TDT-3R™ provides high treatment efficiency in terms of efficient heat transfer by indirectly means for removal of volatile contamination in any composition and concentration. The downsized environment in absence of air provides providing opportunity to treat contaminated soil with variation in flow, composition and concentration of toxic components. The downsized environment also provides low volume of gas-vapour flow, which is post burned in 1,250 °C during min. 2 sec residence time, off-gas is fast cooled and cleansed in a high performance Multi Venturi off-gas scrubber. Process modelling has been executed for chlorinated compounds, which has been proven by pilot scale tests with feed capacity of approx. 150 kg/h and soil moisture content average 26 % for hydrocarbon contamination and with 10 kg/h feed capacity for dense tetrachlorobenzene contamination, whereas minimum 99,5% DRE has been reached at 350 °C material treatment temperature. By rising the treatment temperature to approx. 400 °C in the full-scale design it is expected that minimum 99,9 % efficiency will be reached, while still maintaining the cost efficient performance of the treatment.

Dioxins and Furans [2]:

The main thermal desorption – Thermolysis process avoids creation of dioxin D and furan F gases by its nature. The high temperature post burning and fast cooling of the off-gas flow eliminates recreation of D/F. The re-creation of D/F is also avoided by the construction design, furthermore flux of soot and particles into the gas vapour phase, imperfect burn of organic components in the post combustion phase, flux of heavy metals into gas-vapour phase and oxidation of heavy metals in the solid phase.

Throughput:

Typical full scale plant throughput designs are of the order of 10,000 to 36,000 tons per year capacity with considerations of typically 6000 working hours per year. The contaminated soil feed material directly treated “as received” may be of any variating composition and concentration of volatile pollutants with boiling point of any range less than 600 °C. For soil decontamination treatment the advantageous low 300 °C – 350 °C material core temperature is applied.

Wastes/Residuals:

Process water on site cleansed and recycled, sludge from scrubber is removed for landfill disposal (volume is depending on the input concentration of contaminated soil).

Reliability:

On the pilot test program 80% plant availability was achieved, while the full-scale plants has been designed for 6000 hrs and up to 7200 hrs per year continuous operation.

Limitations:

Contamination with non-volatile components only (such as heavy metals, except Mercury), where no pyrolysis separation of components is possible. Explosives. Liquids.

John Vijgen, International HCH and Pesticides Association, Fellowship report: "New and emerging techniques for the destruction and treatment of pesticides wastes and contaminated soils." NATO/CCMS Pilot Study: Evaluation of Demonstrated and Emerging Technologies for the Treatment of Contaminated Land and Groundwater (Phase III)"

Transportability:
Both stationary and mobile versions are available.

Conclusion:
The Swedish vendor offers a very flexible and cost efficient thermal desorption unit with indirectly heated means, suitable for on site decontamination of soils "as received" with variation in flow, composition and concentration of toxic components, especially for dense chlorinated hydrocarbons. The process is including full energy recovery and comprehensive treatment of all residual streams as well. The vendor states, that the TDT-3R™ process is better, safer, faster and less costly than known solution for treatment of the same material flow. The status of the offered technology in 2002 is post innovation - prior commercialization.

The technology supplier was only able to deliver this information on treatment. Independent assessments are needed to evaluate the technology in the future at full scale.

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**Note: This NATO/CCMS fellowship report does not certify any particular technology, but tries to summarise the state of the art of the concerned technology on the basis of data delivered by the company or other source, which have been made available to the author and refers the reader to original documents for further evaluation. Without the efforts of the Technology supplier it would not have been possible to set up this fact sheet.*
*** Note:The text for this report is verified by the Technology supplier on 11. December 2002*

References:

1. U.S. EPA's Fifth Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International, Chicago, Illinois, May 3-5, 1994.
2. ADPA, American Defence Preparedness Association, Environmental Restoration Opportunities Conference, Munich, Germany, October 25-27, 1994.
3. Thermal Desorption Technology treatment of obsolete pesticides followed by integrated revitalisation, G. Edward Soméus, Thermal Desorption Group LLC of North America, Central European Office, Forum Book, 6th International HCH and Pesticides Forum, 20-22 March 2001, Poznan, Poland
4. Integrated methods and applications for cost efficient treatment of dense soil pollution, stemming from chemical, pharmaceutical and petrochemical industrial operations (Hungarian Ministry of Education, OMFB-02439/2000 - BIO-00096/2000), applied research and industrial application project development 2000 – 2002.
5. http://www.terrenum.net/tdtapplicgeneral.htm, Last updated: 15/10/2002

Patents:
Applied patents: US 5, 707,592, Jan. 13, 1998