

MICROWAVE THERMAL DESORPTION

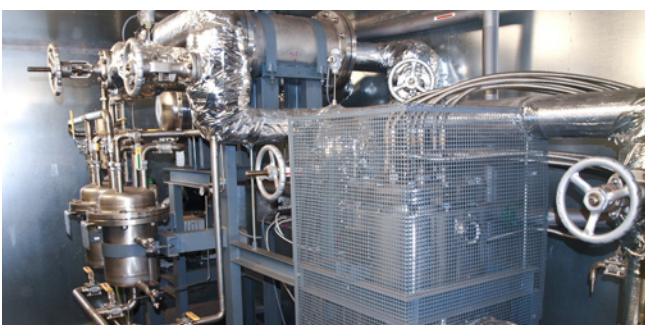


PRINCIPLE

The thermal desorption technology is based on heating the solid contaminated materials via microwave irradiation in an inert atmosphere, when the adsorbed pollutants are released into the gas phase.

The pollutants are concentrated in the liquid condensate, which is then combusted in incineration plant or destructed by other chemical process. Decontaminated soil can be used as an inert material for reclamation. The technology is suitable for treating waste materials contaminated by wide spectra of pollutants, including the persistent organic pollutants (POPs) with boiling point up to 400 °C.

Thanks to using microwave irradiation for heating the material, the energetic demand is much lower than when conventional heating technologies are used. Also the detention period is shorter; especially when materials very well absorbing microwave irradiation are treated (soil, rubble etc.)



Inside arrangement of mobile container unit

DESCRIPTION

Half-scale microwave thermal desorption unit is mounted in the mobile 20' container. The unit can operate in both atmospheric and sub-atmospheric mode. It consists of a mixed batch thermal desorption reactor with volume of 250 L, 6 kW generator of microwave irradiation (magnetron) and condensation system.

Special condenser is used for desublimation of pollutants (some polycyclic aromatic hydrocarbons and chlorinated pesticides sublimate straight to the solid phase).

Nitrogen gas is used as an inert medium inside the reactor. Control of the unit is realized through the PLC board, where all the operational parameters are shown (temperature, pressure, stirrer rotation speed, magnetron output, cooling water flow rate etc.)



Sight into the batch reactor

Main advantages of the technology

- High efficiency of decontamination with relatively short time of heating phase
- Easy system of process operation and monitoring
- Safe operation
- Lower energetic demands compared to conventional electric heating method
- Possible to place the technology inside a mobile container

Potential limitations

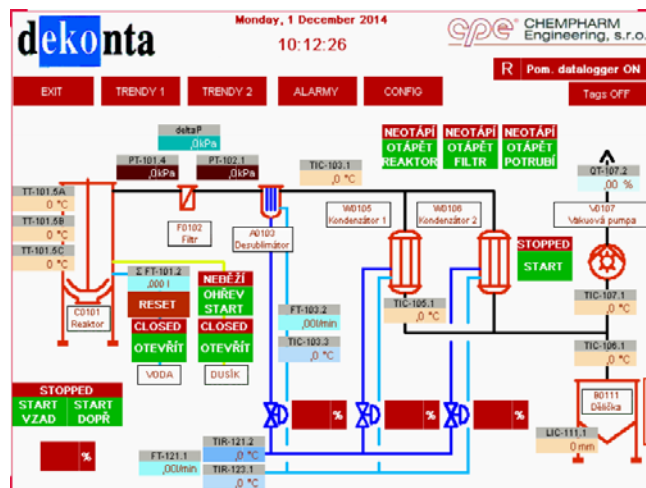
- Contaminated material must be capable to absorb microwave irradiation
- Preliminary treatment necessary: grinding and sieving. Grain size must be maximally 5 mm and also pieces of glass, plastic, metal and cloth must be separated
- Maximum concentration of pollutants in solid matrix: organochlorine pesticides: 30,000 mg/kg, polychlorinated biphenyls: 40,000 mg/kg, polyaromatic hydrocarbons: 40,000 mg/kg, non-polar extractive substances: 200,000 mg/kg. *Higher content of the above mentioned substances may cause corrosion or incrustation of the technology (condensation pipes and especially membranes of pressure sensors)*

Services and products

- Laboratory and half-scale tests of thermal desorption (including tests on client's site)
- Rent of the half-scale testing unit for microwave thermal desorption
- Design and supply of a pilot scale technology for microwave thermal desorption
- Contaminated materials processing by the technology for microwave thermal desorption

Data for technology design

- Type of the material to be processed
- Type and concentration of the pollutant
- Required capacity of the unit
- Pollutant final concentration limits



Process parameters shown on the PLC board

TECHNOLOGY APPLICABILITY

Microwave thermal desorption is suitable for processing different solid materials (e.g. soil, building waste) and paste materials (e.g. oil sludge), contaminated with organic pollutants (including POPs) and mercury.

With regard to the specific method of heating it is necessary to assess the potential of the matrix to absorb microwave irradiation. For particular material employability verification, a half scale mobile unit was developed by DEKONTA (maximum batch 100 kg).

The unit is installed inside a mobile container, thus it is easy to transport it to the customer's site and operate the technological tests.

REFERENCE PROJECT

During the demonstration project, the half-scale container unit processed soil and rubble contaminated with a mixture of organic pollutants. The level of contamination was as follows: petroleum hydrocarbons (TPH) 11,000 – 17,000 mg/kg; hydrocarbons $C_{10} - C_{40}$ 12,000 – 14,000 mg/kg; polycyclic aromatic hydrocarbons (PAHs) 23,000 mg/kg (mainly naphthalene); polychlorinated biphenyls (PCBs) 260 mg/kg; hexachlorocyclohexane (HCH) 48,000 mg/kg.

Solid and semisolid materials were heated by microwave irradiation in the mixed reactor, temperature raised from 20 °C to 350 °C in the inert atmosphere. During the first phase, the batch was heated to the water boiling point and then the temperature isotherm was kept (after water evaporation a steep temperature increase appears). During the second phase individual organic contaminants were gradually desorbed, depending upon their boiling points. During the whole process, the inner pressure was kept at 10 – 20 kPa.

AVERAGE EFFICIENCY OF DECONTAMINATION FOR DIFFERENT POLLUTANTS AT 350 °C AND 10 kPa

Pollutant	TPH	$C_{10} - C_{40}$	Σ PAHs	Σ PCBs	α HCH	β HCH	γ HCH	δ HCH	ϵ HCH
Efficiency [%]	> 95	99	95	97	99	98	99	99	99

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