ConSoil 2005 - Abstract form

Title of abstract	Development of a new thermal desorption process		
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Most appropriate theme (see Call: theme A-G)	D (remediation concepts & technologies)	**ORAL presentation** (type O) **or POSTER** (type P)	P

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Topics:
Development of a new thermal desorption process for the treatment of organic contaminated soils: laboratory experiments, construction and test of a pilot unit, modelling works.

Abstract

The diversity of the polluted sites, the types of pollution and their extents confront each day the remediation companies with new challenges, in particular as regards optimization of the energy costs and reliability of the equipment. The usual techniques of thermal desorption are relatively energy cost. It is to answer these new challenges that technology F.A.R. "Forced Air Recirculation" was developed.

1. Principle of the FAR Technology

The principle of operation of this unit is as follows (figure 1): the ground to be treated is placed in a container in which are laid out of the perforated stainless tubes. During the operation of the installation, these tubes are traversed by gases at high temperature (400-500°C) coming from the combustion chamber. During their circulation in the tubes, these gases heat the ground of the container and cause the evaporation and the desorption of the organic contaminants of this one. Contrary to the case of the traditional devices of thermal desorption, times of residences of the grounds polluted in the system could be very significant (day-weeks). The desorbed pollutants migrate towards the tubes from where they are conveyed, by diffusion and convection, towards the tubes of circulation of gases and penetrate there by the perforations practised in the side walls of those. Once within the tubes, the desorbed gases (water vapor and pollutants) are entrained by gases of heating towards the combustion chamber. The outgoing gases of the container of decontamination feed, partly, the burner of the combustion chamber. The device is equipped with a purging making it possible to regularly evacuate a small part of gases of the system and to keep the same pressures in the system. The burner is also equipped with an auxiliary feed of fuel and air.

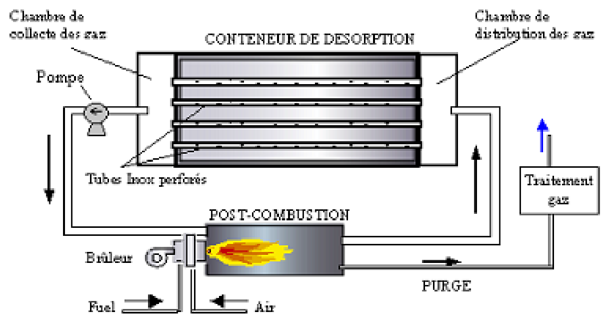

Figure 1 : New process principle

2. Laboratory experiments

In the laboratory experiments, the heating tube is simulated by a cylindrical electric resistance of 1000 Watts (2 W/cm²) being 320 mm long for a diameter of 35 mm and placed at the centre of the cell of laboratory (the container). This resistance is surrounded by a steel tube (48 mm diameter) perforated with perforations 3 mm in diameter. The upper extremity of this steel tube is connected to a system of aspiration and condensation of gases (in the place of the pump with gas, combustion chamber and system of purging on the pilot unit). The container consists of a terra cotta pot filled with 30 kg of sample of polluted ground. It is equipped in its centre with the heating resistance and insulated thermally (figure 2).

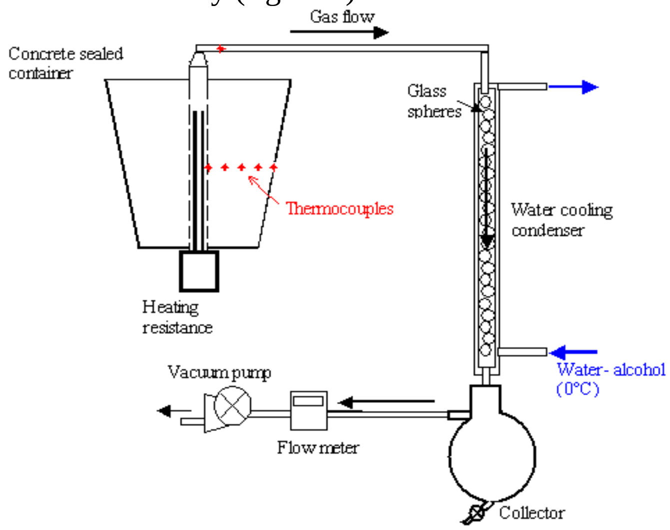

Figure 2 : Laboratory experimental device

Results of thermogravimetric analyses were used to specify the operating temperature of the resistance.
The results of decontamination of a sand polluted by 10.000 ppm of gasoil, obtained after 7 days of treatment at 400°C, are presented in figure 3: more precisely, the analyses of samples of solid taken at the beginning and the end of treatment, near the heating element (Ech. près R.) and near the lateral wall (Ech. près P.) are given. The analyses are restricted to the C10-C40 cuts which are the principal elements of the gas oil.
At the end of the treatment and very close to the wall of the container, the residual quantity out of hydrocarbons is of 79 ppm and the temperature is of 170 °C.

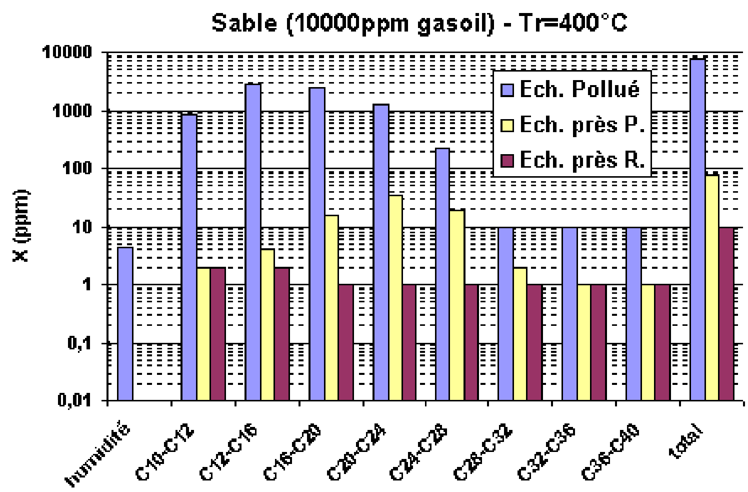

Figure 3: Soil gasoil content before and after thermal decontamination

3. Pilot unit

A pilot unit of a capacity going from 20 to 150 tons is already operational (figure 4). It's energy consumption goes from 1000 to 1500KJ/(kg of treated ground) and the residual pollutants do not exceed the 60ppm after a 6 days treatment of grounds containing 10.000 ppm initially.

Figure 4 : Pilot unit (*View of the flexibles connecting the screws at the end of the dirt soil pile to the collecting gas pipe)*

Many temperature measurements were taken at various places of the installation, throughout all treatment, so as to be able to carry out a complete energy balance of the process and to have data to validate the mathematical models under development.

4. Modelling work

Mathematical models are developed to:

- Identify and include/understand the phenomena limiting decontamination
- Evaluate the impact of some possible chemical reactions on the process operation (pyrolysis of the contaminants, combustion,…)
- Detail the energy balances
- Optimize the operating conditions of the process (level of the temperatures, rate of feed of fuel to the combustion chamber…)
- Optimize the design of the process (diameter of the tubes and openings on those, mode of reversed circulation of gases…)

These models use the following software: Flowing, Porflow, Matlab.

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