Chapter V

Detection and treatment of pollutants and waste

1. Introduction

Controlling the source of pollution must be the first management option considered because, not only does it contribute to the overall approach to reducing emissions of substances responsible for chronic exposure of populations, but it also contributes to the overall approach to improving the quality of environments. Furthermore, without controlling the sources, it is not economically or technically relevant to try to control the impacts. If it is impossible to completely remove the source of pollution, it will nevertheless be necessary to ensure that the impacts from residual sources are controlled and acceptable for populations and the environment.

2. Pollutant detection

2.1. In water and soil

For the detection of toxic substances in water, companies are developing alert tools based on measuring the stress of phosphorescent bacteria. The decrease or loss of fluorescence indicates the presence of a toxic substance. It is measured automatically every minute for a quarter of an hour: the slope of the curve delivered indicates the concentration of the toxic substance. For the measurement of soil pollution, companies are launching four detectors: for explosives, hydrocarbons, PCB-type transformer insulators and aromatic polycycles. The kits allow the tests to be carried out in less than half an hour.

2.2. Remote sensing of atmospheric gases

There are laboratories that have a remote sensing system for atmospheric gases by infrared emission of the scanner type. This remote detection device, the

SIGIS 2 (Scanning Infrared Gas Imaging System - Bruker, Ettlingen-Germany) operates in passive mode. It does not require an artificial infrared source since it uses, as a source, the natural emission of gaseous bodies.

The SIGIS 2 allows remote detection (up to a few kilometers), identification and quantification of any gas plume present in the atmosphere.

Currently, most gas detectors used are fixed specific sensors, which only allow one-off measurements (at a single point) and can only detect a single gas (single-gas detectors).

The advantage of SIGIS2 is that it is a mobile system that can spatially and simultaneously detect several gases present in a plume (multi-gas detector). Thanks to an infrared camera, SIGIS 2 can also be used for night-time measurements.

The combined use of 2 or even 3 SIGIS 2s opens the way to the 3-dimensional reconstruction of a gas plume. This device can be intended for any type of company or urban site that needs to control gas emissions, whether for environmental monitoring purposes or for site security purposes.

Fig 1. Bruker SIGIS 2 atmospheric gas detection device.

2.3. Particulate concentration measurement system for industrial chimneys

The increasingly strict limitation of admissible levels for industrial discharges increasingly leads to questioning the metrological means used until now on industrial chimneys.

It is in this context that a new means of measurement has been developed that can be used by industry in order to make the monitoring of emissions into the atmosphere more effective and thus better control industrial processes. The challenge is to offer manufacturers a system capable of measuring both abnormally high levels and very low levels, sometimes of the order of a hundred µg/m3, thus offering the possibility of anticipating any drift by intervening very early on. This high sensitivity also makes it possible to optimize maintenance periods and therefore the associated costs.

Types of companies concerned:

- Household waste incinerators
- Special waste incinerators
- Cement plants
- Paper mills
- Glassworks
- Production plants

3. Classification of the different decontamination techniques

The different decontamination techniques can be classified according to:

- the nature of the processes used,
- the treatment location,
- the fate of the pollutants.

It should be noted that the rehabilitation of a site will often implement different techniques.

3.1. Classification according to the nature of the processes used

The different decontamination techniques can be classified according to the nature of the processes used, namely:

- Physical processes: the principle consists of using fluids (water or gas), present in the soil or injected, as a vector to transport the pollution to extraction points or to immobilize it.

- Biological processes: they consist of using micro-organisms, most often bacteria (but also fungi and plants), to promote the total or partial degradation of pollutants. Some bioprocesses also make it possible to fix or solubilize certain pollutants.

- Thermal processes: they use heat to destroy the pollutant (e.g. incineration), isolate it (e.g. thermal desorption, thermolysis, etc.), or make it inert (e.g. vitrification, etc.).

- Chemical processes: they use the chemical properties of pollutants to, using appropriate reactions, render them inert, destroy them or separate them from the polluted environment.

3.2. Classification according to the treatment location

Decontamination techniques can also be classified according to the treatment location. The following treatments are distinguished:

- Off-site treatments (or ex situ): they involve the excavation/extraction of the polluted environment (waste, soil, water) and its evacuation to a suitable treatment center (incinerator, technical landfill, etc.).
- On-site treatments (or on site): they consist of excavating the polluted soil or water and treating it on the site itself.

- In-situ treatments (or in place): they correspond to a treatment without excavation: the soil and groundwater are left in place. This involves either extracting the pollutant alone, or degrading it or fixing it in the soil.
- Containment: this consists of preventing/limiting the migration of pollutants.

3.3. Classification according to the fate of pollutants

Remediation techniques can be classified according to the fate of pollutants. There are two possibilities:

- Immobilization: it involves techniques that modify the mobility and/or toxicity of pollutants by two types of processes:

-Modification of the pollutant (change in behavior, toxicity) by acting on the level of redox, complexation, precipitation.

- Modification of the receiving environment: reduction of permeability and porosity: by solidification or stabilization or by confinement,

- Destruction (total or partial) by the chemical, thermal, physical and biological processes previously mentioned.