

ABIOTIC OXIDATION OF RAW AND DEPOLLUTED SOILS FROM COKING PLANT SITES: EVOLUTION OF ORGANIC COMPARTMENTS

Coralie BIACHE^{1,2}, Laurence MANSUY-HUAULT¹, Colette MUNIER-LAMY²
and Pierre FAURE¹

¹ UMR CNRS 7566 G2R, Université Nancy I, BP 239, 54506 Vandoeuvre Lès Nancy Cedex, France. (Tél. : 33 3 83 68 47 43 – Fax : 33 3 83 68 47 01) – Coralie.Biache@g2r.uhp-nancy.fr

² UMR CNRS 7137 LIMOS, Université Nancy I, BP 239, 54506 Vandoeuvre Lès Nancy Cedex, France.

The evaluation of organic contamination in industrial wastelands and especially in ancient coking plant sites is frequently carried out by TOC (total organic carbon) determination and/or analyses of specific pollutants contents (such as polycyclic aromatic hydrocarbons - PAH) included in the US-EPA (Environmental Protection Agency) list priority pollutants (Keith and Telliard, 1979) because of their mutagenic and carcinogenic properties (Lundstedt, 2003). However, studies on organic matter which occurs in polluted soils can not be limited to some specific molecules. Organic matrixes in these types of polluted soil can be considered as source of pollution or trap of contaminants depending of bio-physico-chemical conditions. As a matter of fact, to understand evolution of such polluted soils in the environment, it is essential to take into account the totality of the organic compartment. Especially, the study of the organic matter must be furthered to improve our understanding of its reactivity during industrial treatments or under natural evolution.

The aim of this work is, (i) to study modifications of the OM composition after different remediation treatments applied on polluted soils coming from old coking sites, and, (ii) to evaluate impacts of such treatments on their reactivity notably during abiotic oxidations. As a matter of fact, low temperature oxidation, carried out at 100°C on untreated and treated soils, allows to accelerate oxidation processes without implying high temperature chemical reactions which are not supposed to occur during natural oxidation (Faure et al., 1999; Elie *et al.*, 2000). Five soils were investigated : a soil treated by bioremediation, which consist to stimulate the indigenous micro flora on excavated soil under ideal conditions (temperature, moisture, aeration, nutrients, ...), two soils treated by thermal desorption carried out at 500°C during an hour, and two raw soils.

The extractable organic matter (EOM) was isolated for each soil with dichloromethane in an accelerated solvent extractor (ASE) and characterized at molecular scale using gas chromatography – mass spectrometry (GC-MS). Polycyclic aromatic hydrocarbons (PAH) have been quantified as also their oxygenated equivalents because they are known to be potentially generated during oxidation of PAH and to be toxic ((Lundstedt, 2003).

Results concerning treated soils showed a decrease in the EOM yield as well as in the 16 PAH content, whereas the TOC stays fairly stable thus suggesting a condensation of the aromatic structures. After artificial oxidation, soils show lower contents of 16 PAH while oxygenated PAH proportion increases. Different molecular indexes (such as fluorene/fluorenone ratio) strongly changed during the oxidation experiment, suggesting that they can be used as markers of the oxidation degree.

In parallel, single extractions, followed by Fe and Zn measurement contents in water soluble, exchangeable, acid-soluble, alkaline-soluble, linked to amorphous ferrous oxides and linked to crystallized ferrous oxides fractions were carried out with ICP-AES. The mobility of Zn and Fe increases during oxidation, probably due to the alteration of organic matrixes.

ACKNOWLEDGMENTS

The authors would like to thank the French government, the "Conseil Régional de Lorraine" and the CNRS for their financial support, as well as the GISFI (scientific group for research about brown fields, www.gisfi.prd.fr).

REFERENCES

- Elie, M., Faure, P., Michels, R., Landais, P. and Griffault, L. (2000). "Natural and Laboratory Oxidation of Low-Organic-Carbon-Content Sediments: Comparison of Chemical Changes in Hydrocarbons." *Energy & Fuels* **14**(4): 854-861.
- Faure P., Landais P. and Griffault L. (1999) Behavior of organic matter from Callovian shales during low-temperature air oxidation. *Fuel*, **78**, 1515-1525
- Keith, L. H. and Telliard, W. A. (1979). "Priority pollutants I - a perspective view." *Environmental Science and Technology* **13**(4): 416-423.
- Lundstedt, S. (2003). Analysis of PAHs and their transformation products in contaminated soil and remedial processes. *Department of Chemistry Environmental Chemistry*. Umea (Sweden), Umea University: 56.