

## Ecole Doctorale des Sciences Fondamentales

### Title of the thesis: Impact of water multi-contamination on the pure and formulated pesticide and/or antibiotic biodegradation

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### Summary :

To conform to the new European and National Directives concerning the use of pesticides, agricultural practices have replaced high dosage pesticide by mixtures of formulated active ingredients, each one being sprayed at lower dose. The result is a multi-contamination of soils and waters (by parent molecules and degradation products). Nowadays, another problem is linked to the increasing use of pharmaceutical molecules for human health but also for veterinary care. They are commonly detected not only in surface and ground waters but also on agricultural soils after spreading of sludge or farm effluents (manure). The impact of this multi-residue contamination (cocktail effect) on the fate of the individual molecule is not often taken into account in the literature. Nevertheless, this should allow us to investigate cumulative, synergic or antagonist effects and therefore to have a better assessment of the overall real impact on ecosystems, in particular on their capacity to degrade the various contaminants present (synergy or inhibition), toxicity and global risk assessment.

The aim of this research work is to study the impact of a mixture of molecules (**pure or formulated pesticides and/or antibiotics, parent molecules and/or degradation products**) on the biodegradation and toxicity (microbial growth, Microtox®...) of each molecule individually. For this, (1) microbial strains able to degrade these molecules will be isolated by enrichment techniques from agricultural soils treated with these molecules and/or wastewater treatment plant sludge. The metabolites formed will be identified by various analytical techniques (LC-MS, NMR) in order to establish the biodegradative pathways; (2) the impact of the mixture of pure and formulated molecules on the biodegradation of each one (modulation of kinetics, metabolic pathway) will be studied; (3) this impact will also be assessed from a toxicity point of view by using a standardized method (Microtox®), monitoring the growth of different microbial strains and comparing it for addition of either single molecules or a mixture. (4) Simultaneously, we would like to use the isolated strain(s)/consortia to develop a bioremediation process in laboratory soil microcosms. These microcosms will be incubated under different environmental conditions (temperature, humidity, etc.) in order to define the optimal decontamination conditions. The evolution of

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each strain we supply initially, as well as their biodegradative activities, will be monitored. Chemical monitoring of the parent molecule and its metabolites will also be carried out.

This subject is part of a regional interdisciplinary research programme on pesticides (entitled “Pesticides: From the field to the plate”) dedicated to set up the French Pesticide Regulation (Plan Ecophyto) and of the Fédération des Recherches en Environnement of our University Clermont Auvergne (UCA).

The subject being at the chemistry – microbiology interface, the applicant should have knowledge and/or expertise in analytical chemistry and in particular a background in HPLC, LC/MS and NMR. In addition, a first experience (some skill) in microbiology would be appreciated.