Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes the PhD subject and supervisor proposed by the French Polytech network of 14 university engineering schools. Please contact the PhD supervisor by email or Skype for further information regarding your application.

Supervisor information

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University name	Université Clermont Auvergne
Country	France

PhD information

Title	Electrocoagulation as a tool for refractory compounds and heavy metals removal in wastewater treatment.
Main topics regards to CSC list (3 topics at maximum)	V-9. Hydrologie et utilisation continue des ressources du sol et de l'eau

	Hydrology and continued use of resources of the ground and water
Required skills in science and engineering	Chemical Engineering, Chemical Physics, Physical Chemistry.

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Subject description (two pages maximum)

Freshwater resources are limited and comprise only 2.66% of the total global water resources. They include mainly groundwater, surface water (lakes and rivers), polar ice and glaciers. Only a smaller fraction, about 0.6% of the water resources, can be effectively used as drinking water. Due to the combined effects of global warming, population growth and industrial development, water scarcity becomes a key problem in many countries of the world. For this reason, wastewater which has been altered by human activity, whether domestic, industrial or agricultural, must necessarily be treated, with the aim to preserve the resource, while promoting cost and energy savings. Non-treated wastewater may, indeed, makes the resource unsafe for people and animals, and disrupt the aquatic ecosystem. For example, domestic wastewater may contain many, such as detergents, drugs, estrogen, dyes and endocrine disruptors, that is to say all synthetic substances that cannot be destroyed naturally. Their presence is directly related to their daily use by human. Some of them may be toxic to the environment or may, at least, modify the ecosystems. A key problem is that these cover thousands of compounds that cannot be followed individually. For a long time, these were disregarded because they could not be detected, but their accumulation and the advances in analytical tools have highlighted their presence in the water resource since the 1980s and they are in continuous increase. That is why, in the last ten years, research on the behavior and the impact of these molecules on the environment and human health have been intensified, together with that on the development of effective water treatment technologies.

As just said, since the beginning of the 21st century, the world is facing a huge water shortage crisis resulting from urbanization, continuous population growth, land use change, industrialization, food production practices, increased living standards and poor water use practices and lack of efficient wastewater management strategies. Therefore, it is of utmost importance to develop efficient and cost effective technologies for wastewater management. These technologies should be considered as part of an integrated, full life cycle, ecosystem-based management system that operates across all three dimensions of sustainable development (social, economic and environmental), geographical borders, and includes both fresh and marine water.

One of the emerging technologies that proved its efficiency in treating different types of wastewater is electrocoagulation (EC). EC, which is an advanced, economic, non-specific electro-chemical process that simultaneously removes heavy metals, suspended solids, emulsified organics and many other contaminants from water using electricity. It is an alternative treatment process to the more traditional chemical and biological processes familiar to wastewater treatment professionals.

Keeping in mind that all the polluted waters finally return to the ground water tables, the main goal of this PhD research is to use electrocoagulation to prevent massive pollution of the water resources. As this research area is quite large, we will particularly focus on the agricultural (nitrates, phosphates, COD …) and hospital (containing high concentration of refractory compounds) wastewater.
The first studies will be done in batch mode to understand, and thus model, the different mechanisms of interaction as a function of the compounds under study, then, the further experiments will be conducted in continuous mode. A special attention will be made of the cost analysis of the overall process.

This PhD will be under the supervision of:

- Fabrice Audonnet (75%)
- Christophe Vial (25%)