Ph-D open position: dissertation in France and Brazil, CIFRE industrial contract

Title: Extracting valuables from sludges by innovative methods based on ionic liquids

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In the general context of sustainable development and ecological concerns, Aperam, a stainless steel producer of world-wide reputation (plants in France, Belgium and Brazil), committed itself not to landfill waste anymore by the end of 2020. The production of stainless steels currently implies the use of acids in the several surface treatments undergone by the alloy. This induces the formation of sludges and degraded baths which are simply neutralized and landfilled because of the lack of efficient and cost effective way to revalorize them. It is often seen that the main obstacles to the treatment of these sludges are their content of F and S coming from the acids and other surface treatment baths used.

A company-academic partnership composed of Aperam, LEPMI (Grenoble France) and UNESP (Sao-Paulo, Brazil) thus offers a Ph-D position to develop innovative protocols to recover on the one side, the metallic elements present in the sludges/baths and, on the other side, the acidic aqueous solutions in order to recycle both of them within the plant. Traditional treatment methods based on precipitation, ion exchange or solvent extraction do not offer sufficiently high selectivity and lead to the production of high volumes of liquid and/or solid wastes. The LEPMI laboratory has recently submitted a patent on a very innovative and eco-friendly separation method based on the use of hydrophilic ionic liquids, ILs, (cheap, non-volatile, non-flammable compounds) to form so-called aqueous biphasic systems (ABS)[1]. Upon addition of ionic liquid to aqueous phases such as the Aperam samples, and depending on physico-chemical parameters (temperature, IL concentration, acidity etc.), a reversible change from monophasic to biphasic state occurs. The biphasic state appearance induces a partition of the metallic elements dissolved in the solution between the two phases. Preliminary results are very promising, evidencing the selective and highly efficient separation of one metallic ion from one of the complex Aperam baths.

The first objective of the work is to characterize the ability of several ABS systems to extract and separate the various metallic elements present in Aperam samples. The sustainability of the whole process will be sought by recycling the ionic liquid and the acidic phases, while the metallic element should be recovered under a solid form in compliance with industrial constraints and processes.

The candidate will benefit from an analytical plateform at the LEPMI campus site, from analytical facilities at the Aperam-Isbergues location (R&D center) and chemical engineering competences at the Brazilian laboratory. The major part of the research work will be performed at LEPMI, Grenoble, while on average, one week every one or two months at Isbergues are planned, together with stays in the Brazilian laboratory.

The candidate should have a solid knowledge in solution and analytical chemistry. Competences in liquid/liquid extraction are a must. Skills in ionic liquid chemistry would be a plus but are not mandatory. The candidate will be hired under a contract with Aperam, thus being eligible to all the company advantages. At the end of the 3 year contract, the oral defense of the work and the manuscript can be done in English.

[1] M. G. Freire, A. F. M. Claudio, J. M. M. Araujo, J. A. P. Coutinho, I. M. Marrucho, J. N. C. Lopes, and L. P. N. Rebelo, *Chem. Soc. Rev.* 2012, **41**, 4966.