

## **Life cycle assessment of industrial processes used in the dairy industries**

### **• Laboratory description**

The project will be carried out between two research groups of UMET (Interface Processes and Hygiene of Materials and Engineering of polymeric systems) in collaboration with the Laboratory of Mechanics of Lille (Laboratoire de Mécanique de Lille, LML).

The UMET laboratory (Unit of Materials and Transformations) was created in January 2010 following the merger of four former laboratories of the Lille campus. It hosts a large part of the research in Materials Science of the University of Lille. The laboratory includes 52 professors and assistant professors, 11 CNRS researchers, 20 technical and admin staff, 53 PhD students, and 9 researchers on temporary contracts or emeritus, accounting for a total of about 150 members, including 83 permanent staff. The laboratory is divided into five research groups:

- ✓ Molecular and therapeutic materials
- ✓ Physics of minerals
- ✓ Metallurgy and engineering of materials
- ✓ Interface Processes and Hygiene of Materials
- ✓ Engineering of polymeric systems

All groups work in materials science, but with different applications. The UMET laboratory belongs also to a larger consortium (research federation) called "Fédération de Recherche Michel-Eugène Chevreul", that hosts laboratories related to materials science in Northern France. The UMET is one of the three largest members of the consortium. Among other tasks, the consortium is in charge of running large scale experimental facilities (NMR, electron diffraction, X-ray diffraction, mass spectroscopy, vibrational spectroscopy...). The UMET is hosting the common Research Center of Microscopies of the University of Lille within its building and provides the associated technical staff.

The Laboratory of Mechanics is equally a CNRS affiliated research structure, which is specialized in the study of the mechanical behaviour and properties of different materials for industrial applications and under divers solicitations. It is composed of around 100 permanent staff and has for academic supervisors the University Lille 1, the engineering schools Ecole Centrale de Lille and ENSAM (Ecole Nationale d'arts et Métiers).

### **• Research project**

Fouling in food-processing industries leads to the functional decline of thermal and hydrodynamic equipment performances, decreased product quality and lack of sterility as well as decrease of the surface hygiene. These last points particularly induce a severe sanitary risk by favouring the development of pathogenic agents. Food contamination creates an enormous social and economic burden on communities and their health systems. These serious consequences force the food-processing industries, and particularly the milk-processing industries, to take drastic and expensive daily cleaning measures leading also to environmental concerns. Indeed, the frequent cleanings result in a pronounced impact due to the high amounts of detergents and energy required for cleaning generating excess effluent. One way among others to solve this problem is for example to develop antifouling surface treatments to durably reduce the fouling and cleaning frequencies in the dairy industry. However, the environmental footprint of such treatment was never reported in the literature.

In that frame, the objectives of this project are to develop a methodology permitting to assess the environmental footprint and to consider the sustainability criteria of processing / cleaning cycles / alternative technical solutions proposed in the literature and developed in our research teams. In particular, this includes the consideration of the main steps of the Life Cycle Analysis (LCA) methodology as they are defined by the actual ISO normalisation (the 14040-14044 standards). A particular attention will be

given to some important points, respectively: i) the definition of the main system boundaries and of the functional unit of the considered system, (considering the quality and the nutritional value of the products), ii) the selection of the relevant impact categories (choice of indicators covering all relevant environmental, economic and social impacts), iii) the handling of allocation criteria.

New data quality indicators allowing to assess the uncertainty (methodological, technical, and related to the collected or available data) and variability (geographic and temporal) will be developed. In particular reliability, completeness, temporal, geographical and technological correlation will be considered, they will be evaluated by considering the main collected parameters of the developed processes and materials combined with statistical methods.

The project will include three main steps:

- ✓ The LCA of the industrial references processes. Based on the bibliographic data of the standard conditions used in the milk industries a first environmental assessment will be developed, the obtained results will constitute the comparison base for the alternative processes that will be assessed.
- ✓ Use of the LCA methodology for the assessment, the selection and the analysis of the most relevant processes and cleaning sequences.
- ✓ Investigate the extrapolation of the LCA regarding a change of the scale (from Lab to pilot scales).

- **Qualifications/Requirements**

The candidate should have a PhD thesis in the field of materials or engineering process including the sustainable approach. He/she should demonstrate the ability to work in a team, have a good record of research and quality such as conscientiousness, enthusiasm...

Benefits: the knowledge of an LCA software would be appreciated.

- **Additional skills**

Grant: 2400€ brut/month

Duration: 1 year post doctoral position starting 1<sup>st</sup> November 2015

Employeur: ENSCL

Job location: Villeneuve d'Ascq - France

- **Submission of Applications**

Resume and cover letter including a statement of interest in the position should be sent before 30/09/2015 to Sophie DUQUESNE and Guillaume DELAPLACE.

**Sophie DUQUESNE**

ENSCL

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