Study on the industrialization of supercritical processes in the frame of an R&D project

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1. Introduction

Supercritical fluids processes are now coming to a mature level of industrialization for a large range of applications. Indeed, during the latest International Symposium of Supercritical Fluids (ISSF 2018) held in Antibes (France), the different industrial case studies[1-5] illustrated very well the significant number of contributions of SCF in our daily lives (cork stopper, medical patch, food products - sesame oil, ginseng, CBD products) from all over the world (USA, Europe, Asia). On a research level, more and more projects are focusing on the use of supercritical processes as a recycling alternative for post-consumer products (e.g. plastics, waste from electrical and electronic equipment).

One of the major obstacles to overcome for the industrialization of a process is to pass through the barrier of laboratory to industrial scale. In the frame of an R&D project (SUPERMET project[6-7]), the idea was to conduct industrial scale-up studies (taking into account the state of the art of current industrial $scCO_2$ processes) right from the beginning of the project in parallel to laboratory scale experiments. For this purpose, a study has been conducted in order to provide a perspective on the industrial level of supercritical processes and to evaluate the path to industrialization for the process developed in the SUPERMET project. The objective of this current contribution is to share the main outcomes of the study and how industrial know-how can be used at the beginning of an R&D project.

2. Materials and Methods

The sources used for the study of the industrialization process were reviews[8], internal IFS information, and public information from equipment manufacturers and finished products (information from websites, LinkedIn). The study is a snapshot to date, which may evolve, and has been carried out as exhaustively as possible with respect to the information available. It could be supplemented by a survey for each company identified, but this was not the aim of the study for the SUPERMET project. In this study, only autoclaves with a nominal capacity greater than 100 L were considered to be consistent with the volume of products addressed by the SUPERMET project.

Figure 1. Position of SUPERMET process

3. Results and discussion

Industrial applications of supercritical fluid processes are characterized by volume heterogeneity. However, they can be further classified as follows: (1) markets with very low volume and high added value such as

pharmaceuticals, medical devices; (2) markets with high volume and lower added value (food products, packaging materials). The study is divided into two parts. Part I focuses on the global approach of all the relevant markets in order to learn about the industrialization methods, volumes, and products currently on the market for supercritical processes. Part 2 focuses on material applications, including those of the project being industrialized. The study provides a classification of applications and processes according to volume and operating conditions.

4. Conclusions

The industrialization study has shown that the capacities and the operating conditions addressed by the SUPERMET project are consistent with the industrial capabilities. This study has been completed with a preliminary Life Cycle Assessment (LCA).

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