Roberta Campardelli

Fixed-term assistant professor

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Education and training

2007
Bechelor Degree in Chemical Engineering
La fermentazione alcolica del mosto d'uva - 110/110 cum laude
University of Salerno - Salerno - IT

2009
Master Degree in Food Engineering
Estrazione supercritica di emulsioni applicata alla produzione di microsfere nutraceutiche - 110/110 cum laude
Univeristy of Salerno - Salerno - IT

2013
PhD in Chemical Engineering
Supercritical assisted processes for the production of biopolymeric micro and nanocarriers - Excellent
University of Salerno - Salerno - IT

Academic experience

2013 - 2018
Research fellow
University of Salerno - Salerno - IT
Innovation in unit operations using supercritical fluids

2018 - ONGOING
Researcher (RTDA)
University of Genoa - Genoa - IT
Researcher of Chemical Plants (SSD ING-IND/25)

Language skills

English
Independent

Spanish
Independent

Teaching activity
I have the responsability of the course of Unitary Operations of 6 CFU, second semester third year, bachelor degree in Chemical Engineering. The course aims to provide students with the basic notions of some unit

operations with the aim of acquiring the knowledge necessary to determine and quantify the most important parameters in the preliminary design of the equipment.

Research interests

My research activity concerns product and process innovation, using in particular supercritical carbon dioxide. In recent years, in fact, among the innovative processes in the field of chemical engineering supercritical fluids assisted processes have gained increasing interest for the good control of the particle size of the powders and for the reduction or elimination of the use of organic solvents. The most commonly used supercritical fluid is carbon dioxide, which has critical values that are easy to reach, it is economical, it is not toxic, it does not create environmental problems and it is not flammable. Furthermore, it has a critical temperature close to the ambient temperature, so it is possible to conduct low temperature processes.

The principal use of supercritical fluids is in the extraction and fractionation processes. Some of my research activities have involved the use of these processes for the recovery of high added-value products from food industry waste.

During the years, I also developed innovative applications of supercritical fluids aimed at obtaining particles for drug delivery applications.

For example, a research line has been developed for the production of micro / nanoparticles and microcapsules for the controlled release of drugs through the process of Supercritical Emulsion Extraction, called SEE; this process is based on the selective extraction of the solvent by the CO2 from the oil phase of an emulsion. In the production processes of microparticles and microcapsules based on the use of emulsions, the polymer and, optionally, the drug are dissolved in the organic solvent of the oil phase of the emulsion. For the production of microparticles the starting emulsion is of the oil-in-water type, while for the production of microcapsules the starting emulsion is of the water-in-oil-in-water type. To obtain the particles, the organic solvent of the oil phase is removed by conventional evaporation or extraction. In the SEE process the organic solvent is extracted by supercritical CO2. Solvent extraction is faster and more efficient, leading to particle production with controlled size distribution and high encapsulation efficiencies.

Moreover, I have also activated a research line dedicated in particular to the production of nanoparticles directly produced in water-stable suspensions, in order to increase the bioavailability of water-soluble drugs. An innovative production process dedicated to the production of nanoparticles has been developed. The process was named with the acronym SAILA (Supercritical Assisted Injection in a Liquid Antisolvent). The process is based on the formation of an expanded liquid consisting of supercritical carbon dioxide and an organic solvent miscible with water, in which the solute to be obtained in nanoparticles is dissolved. The ternary mixture (organic solute-solvent-supercritical CO2) in the state of expanded liquid is depressurized through an injector in an aqueous solution

containing a surfactant. The aqueous solution plays the role of liquid antisolvent. In fact, to obtain a precipitation of the dissolved solute in the organic solvent used for the production of the expanded liquid, solvent and anti-solvent must be mutually miscible, whereas the solute must be soluble in the solvent but insoluble in the antisolvent. The produced particles are nanometric with dimensions less than 100 nm and are stable in the water suspension for months.
An important part of my research activities developed in recent years, from 2013 to date, concerned the development of a new process, assisted by supercritical fluids, for the production of liposomes. The objective of this part of the research was to overcome the limitations of the techniques currently used for the production of liposomes. The idea at the basis of the new process developed during the years of study on liposomes, called SuperLip (Supercritical assisted Liposome formation), was to reverse the main production steps of liposomes. In fact, in this process droplets of water are first formed, which will act as precursors of the liposomes, and subsequently the enveloping of the lipid layer is obtained around the water droplets. In detail, the SuperLip process consists in an atomization of an aqueous solution (where the active principle to be encapsulated is dissolved) inside a forming vessel containing a mixture formed by CO2-ethanol-phospholipids, at the operating conditions selected to guarantee the supercritical state of the ternary mixture. Inside the formation vessel the drops of water, generated by the atomization through an injector with a fixed diameter, come into contact with the phospholipids. Thanks to the favorable interactions between the droplets of water and the phospholipids, mediated by supercritical CO2, the rapid covering of the drops of water is obtained leading to the formation of liposomes. This process is therefore designed to work in continuous; the liposomes can be obtained in a single production step with high encapsulation efficiencies, since all the drug that is contained in the drop of atomized water is entrapped in the liposome.