# Special issue on sterilization with supercritical carbon dioxide

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Preface

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Among all the recent industrial applications of supercritical fluid technology, sterilization processes are ones that are likely to spread rapidly in the near future.

Bacterial or viral inactivation by supercritical $CO_2$ is an alternative to thermal and non-thermal sterilization treatments which have certain limitations. Conventional sterilization methods such as ethylene oxide treatment or ionizing radiation cannot be used for all types of materials. This is particularly the case for polymers that are omnipresent in the sector of medical devices where there is a real need for a safe and efficient sterilization method. Moreover, it has been proven that ethylene oxide poses toxicity problems and therefore, its use will be banned in a few years.

Sterilization or bioburden lowering using supercritical $CO_2$ has been studied over the last thirty years and its implementation in the industry has emerged over the past two decades mainly in the sector of food and beverages, and more recently in the pharmaceutical field. The efficiency of supercritical $CO_2$ for achieving a complete sterilization is no longer to be demonstrated. The relevant operating parameters, the different process configurations and the various inactivation mechanisms of supercritical $CO_2$ have been addressed in the literature; many reliable data are now available for implementing microorganism inactivation for a wide range of applications. Nevertheless, there is still a need for more data given the huge number of microorganisms in various environments that can be considered, the potential constraints for performing their inactivation and above all, very stringent and evolving regulatory frameworks.

This Special Issue aims to show the actual trends in supercritical sterilization. The studies presented deal with the inactivation of different types of microorganisms, either vegetative or sporulated forms. This is of interest since depending on the referent standards, it is required to collect data either on biological indicators or on microorganisms that are likely to contaminate the studied medium. In addition to tests with biological indicators such as *GeoBacillus stearothermophilus* or *Bacillus atrophaeus*, when it comes to demonstrate the efficiency of the supercritical sterilization referring to standards, often it is also required to study the inactivation of a panel of strains representative of the different types of microorganisms (bacteria, fungi, virus, parasite,…). Besides, the presented papers highlight that the coupling of sterilization with a different operation such as drying, cleaning or product formulation is worth to be performed, allowing the implementation of innovative and efficient compact processes.

Lastly, it can be seen that in the current difficult context of sanitary crisis, supercritical $CO_2$ has its place for achieving bacterial as well as viral inactivation for either Protective Personal Equipment (PPE) or medical devices. It is highlighted here that the sterilization can also be performed on a packaged product.

To end, all the reported studies here emphasize the benefits of using supercritical $CO_2$ for microbial inactivation in various fields of applications.

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