

# **SYNTHESIS OF POLYURETHANE AEROGELS AND THE EFFECT OF THE STRUCTURE ON THERMAL CONDUCTIVITY**

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Nowadays there is a huge need to develop new thermal insulators with improved properties for various sectors such as construction, transportation, food refrigeration and medical products [1]. This fact is especially noticeable in the construction sector of the European Union as the legislation on energy efficiency in buildings is increasingly demanding [2].

Rigid polyurethane foams (PU), which are based on the reaction between isocyanate and polyol, are one of the most versatile materials. Rigid polyurethane foams are mainly used as thermal insulators and there are several studies focused on reducing the thermal conductivity of these materials by using for instance nanoparticles [3][4][5]. Nevertheless, the low thermal conductivities required to be employed as super-insulating materials are not reached. For that reason, PU aerogels are an innovative and promising solution to improve the thermal insulation provided by PU foams.

Aerogels are nanostructured cellular materials with a low density which possess numerous interesting properties such as a large inner surface area, high sound-absorption and very low thermal conductivity among others. In the few detected reports previously published thermal conductivity values of 17 mW/mK have been measured [6], a very promising value but in which there is still margin for improvements. This is the main objective of our research: to produce PU based aerogels with reduced thermal conductivities. In this research, we present the synthesis and structural characterization of PU aerogels produced by the sol-gel process followed by supercritical drying looking for strategies to optimize the materials porous structure.

During our research, the gelation process is controlled by reducing the solubility of the precursors in the reaction medium which leads to the possibility of stopping the chemical reactions at given times. This allows studying the temporal evolution of the process by using different techniques, such as FTIR or SEM. Structure changes are followed by ex-situ analysis of the formed aerogels through scanning electron microscopy (SEM) as it can be seen in Figure 1.

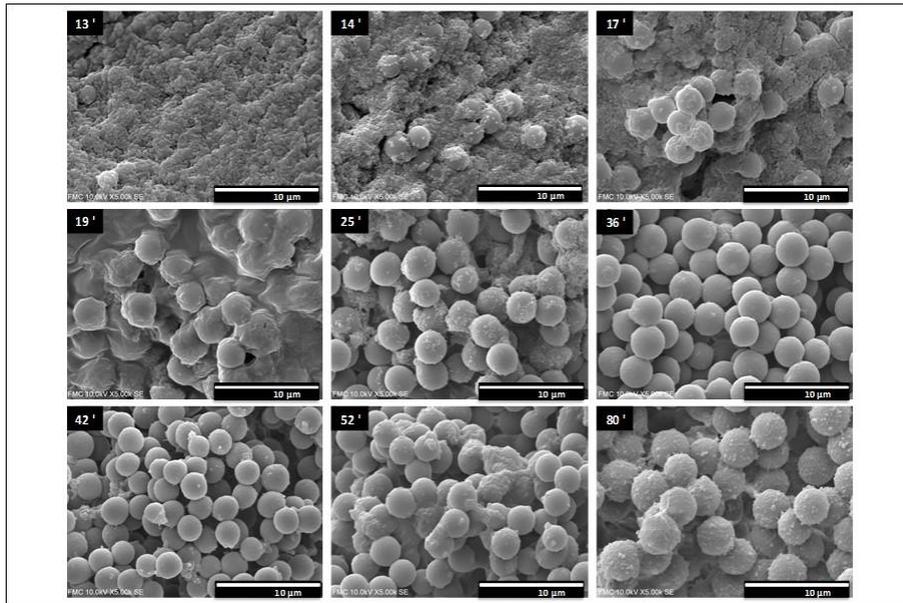


Figure 1. Evolution of the aerogels structure by SEM micrographs at different times of the gelation process.

From this information we analyse the process kinetics and the main phenomena taking place during the sol-gel process with the aim of improving the cellular structure to reduce the thermal conductivity.

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