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Abstract Formulary

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Title: Advantages of automation and online monitoring of physical conditions during hot super-critical drying of aerogels

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ABSTRACT (Space limited to 2200 characters)

Hot super-critical (SC) drying was once a key element in aerogel production. Yet after an explosion in an aerogel industrial plant (Sweden, 1984), a safer method, cold SC drying took its place as the main drying procedure, while hot SC drying became a niche method [1, 2].

Though hot SC drying is still considered unsafe, it does offer advantages over cold drying; eliminating solvent exchange, reduces aerogel shrinkage and other deformations; drying systems are simpler, therefore, easier to maintain. Additionally, gels dried in alcohol may become hydrophobic [3], as opposed to cold drying, in which gels are hydrophilic (unless treated by sililation).

Despite the fact that hot SC drying has already been industrialized decades ago, still there is no consensus over the "best" drying conditions, even when considering silica aerogels alone [3, 4, 5, 6], other aerogels might require different drying conditions.

In collaboration with Parr Inst. Co., we designed and built a hot SC drying system that meets strict safety regulations. The system utilizes programing and automation for control over temperature and pressure (instead of manual operation), and features online monitoring and logging of both. It allows us to analyze thermodynamic transitions that occur during the process, and optimize the drying conditions.

Furthermore, designed to collect extracted solvents, the system helps identify reactions taking place during the drying process. For instance, ethanol indeed participates in the substitution reaction mentioned above, yet it may also condense to ether; while both reactions produce H2O as byproduct, the latter isn't as well-known in the aerogel community. Identifying such reactions may help prevent damage that occurs to aerogels by exposure to H2O at high temperature [7].

[1] Aeorgel.org.

[2] Tewari et al., Mat. Let., 3, 363-367, 1985.

[3] Husing et al., J. Non-Cryst. Solids, 186, 37-43, 1995.

[4] Casu et al., J. Non-Cryst. Solids, 315, 97-106, 2003.