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ON THE OPTIMIZATION OF ADSORPTION SYSTEMS

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Porous materials present a structure replete of grooves with diameter typically smaller than one micrometer. This attribute implies in huge superficial area, making this kind of material interesting to a wide range of applications, among which stand out water purification, air depollution and gas storage. Depending on the nature of each application, there are specifics sets of relations [1] regarding diameter, volume and dispersion of pores in order to optimize the given goals. Facing the optimization problem of material distribution, complex geometries are expected and, thus, some design method generic enough is necessary. Therefore, in this work, the Topology Optimization Method (TOM) is implemented aiming to achieve optimal structures regarding the storage of gas in porous materials by the adsorption phenomenon, which includes the description of heat transfer, fluid dynamics and adsorption kinetics [3]. The TOM is implemented by combining the Finite Element Method (FEM), for solving the respective differential equations, with an optimization algorithm, in order to solve the optimization problem. In determining the distribution of material inside the domain, a material model based on Darcy equation [2] is employed, by using a permeability coefficient to alternate between solid (null permeability) or fluid (full permeability). Along with the maximization of stored gas, the optimization problem also seeks the minimization of the adsorption time, aiming to meet the requirements for the commercial use of such technique. Resulting geometries are presented with their gas storage metrics, as well as temperature and pressure distributions.

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