Simulation of a metal organic framework-based adsorbed natural gas storage tank

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Abstrak

An adsorbed natural gas storage tank was simulated in this work, with the objective being to predict the filling time, the filling capacity and the storage efficiency. A high-capacity HKUST-1 type metal-organic framework was used as adsorbent. The time-dependent phenomenological model of the adsorbed natural gas storage tank was developed considering mass, momentum and energy transfers. The cylindrical tank was 1.09 m in length with a radius of 0.15 m, and was equipped with an inlet hole for gas inflow. The simulation results show that the temperature increase in the tank due to adsorption heat is very significant. This affects the adsorption ability of the bed inside the tank, so the storage efficiency is consequently low. For the inlet gas flowrate of 50 L/min, the storage efficiency is 38% and increases to only 47% at 5 L/min. Corresponding filling capacities for the two flowrates are not very different, i.e. 89 V(STP)/V and 109 V(STP)/V. However, the difference in the filling times is extremely significant, which are 16 min at 50 L/min and 255 min at 5 L/min.