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Abstract

A mathematical model is developed for carbon dioxide adsorption on hollow fiber post infused with physically impregnated poly(ethylenimine) silica sorbent. The model includes detailed mass transfer mechanisms and is rigorously validated under different operating conditions of flue gas flow rate, number of fibers withing the module, fiber length and particle size. A fundamental model formulation for the sorbent polymer diffusivity including the temperature and the sorbent concentration dependency is proposed. The proposed model formulation is based on free volume theory model of polymer diffusion and effectively predicts the experimental observations. The model is able to predict the breakthrough curves at many different operating conditions and module designs such as conditions varied with flue gas flow rate, fiber length, fiber packing fraction and support silica particle size. The concave trend in the temperature dependency of breakthrough capacity that shows a maximum around 45^o C - 60^o C is analyzed using the developed model.