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Modelling the transient behaviour of a fixed bed considering both intra and inter-pellet diffusion for adsorption of parachloro-meta-xylenol (PCMX)

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ABSTRACT

Phenols and Phenolics are considered to be potentially hazardous water pollutants. Parachloro-metaxylenol (PCMX) is the major component of several disinfectants, produced commercially by well-known pharmaceutical companies. Adsorption of PCMX in various combinations of adsorbents, both natural and artificial, has been studied. Specially, water hyacinth (Eichhornia crassipes [Mart] Solms-Laubach) stems were used as adsorbent in combination with powdered activated carbon (PAC) and granular activated carbon (GAC). Five equilibrium isotherm models, namely, Tempkin Isotherm, Freundlich Isotherm, Langmuir Isotherm, Redlich-Peterson Isotherm and Toth Isotherm were studied and parameterized. The dynamics of fixed-bed adsorption columns for modeling is a demanding task due to the strong nonlinearities in the equilibrium isotherms, interference effects of the competition of solutes for adsorbent sites, mass transfer resistances between fluid phase and solid phase and fluid-dynamic dispersion phenomena. A mathematical model has been studied for a fixed bed isothermal adsorption column with porous adsorbent. Simulations were carried out to understand the specific influence of inter-pellet diffusion and external film resistance. The effect of flow rate, bed length and initial concentration of adsorbate were studied. Rapid occurrence of breakthrough time was observed for higher flow rates of effluent, lower bed height and high initial concentration of effluent.

Keywords: Pharmaceutical waste water; Water hyacinth; Parachloro-metaxylenal; Dynamic simulation; Intra pellet diffusion; Breakthrough

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