Removal of multiple contaminants using column sorption

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Abstract: We develop a mathematical model to describe an adsorption process where two contaminants are simultaneously removed from a gas mixture as it flows through a packed column. Both species compete to occupy the available sites, including displacing previously attached molecules. The system is described by mass balances for the two species coupled to an attachment model. A numerical solution is first developed. The results show that, after making certain assumptions concerning the system parameters, the column may be split into a region where competition dominates the adsorption process, and a second region where the weaker contaminant is able to be adsorbed without being displaced. In both regions, it is possible to find travelling waves which may be used to construct an analytical expression for the breakthrough curves of both contaminants. The model results are verified by experiments on the competitive adsorption of the siloxanes D4 and L2 on activated carbon. Extensions for larger number of components are explored.

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