

## *A Generalized Design for Affinity Chromatography Columns*

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In affinity chromatography, an adsorbent with a high selectivity for a target solute is used to isolate the target molecule from other impurities. With sufficient selectivity, the target molecule can be isolated in a highly purified and concentrated state. Common applications of affinity chromatography include Protein A chromatography for antibody purification and Immobilized Metal Affinity Chromatography (IMAC) for protein purification. The well-known design method based on constant-pattern mass transfer zone analysis does not apply to small feed batches, which are insufficient to form constant-pattern frontal waves. Other literature design methods rely on simulation or experimental trials that can be time-consuming and costly. In addition, it can be difficult to optimize the process to achieve the desired purity, yield, and throughput. In this study, a convenient graphical design method based on intrinsic adsorption parameters (void fractions, adsorption isotherm, and solute diffusivity), mass transfer parameters, and dimensionless groups is developed for affinity chromatography systems with Langmuir isotherms. Only a small number of experiments are needed to obtain these parameters. The method is tested with literature data for Protein A chromatography for antibody purification, and close agreement is obtained. Graphs can be used to examine the effects of material properties, capture yield, and throughput on column utilization. In addition, it can easily adjust to meet various design requirements and can take into account variations in the intrinsic parameters. Various sorbents can be evaluated for cost effectiveness based on the intrinsic parameters, making this method applicable to a broad range of affinity chromatography systems.