acib
Austrian Centre of Industrial Biotechnology
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Programme line: K2-Centres
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High throughput process development & advanced bioprocess with disposable Unit Operation, 01/2015 – 12/2019, multi-firm

Suitability of pre-packed chromatography columns for purification of biopharmaceuticals

Disposables are getting increasingly popular in the biopharmaceutical industry. Pre-packed chromatography columns are regarded as disposables with the advantage of outsourcing column packing and validation to specialized companies. In this acib-project we demonstrate the capability of pre-packed columns to replace conventional self-packed chromatography columns in terms of packing quality and scalability. The outcomes of this project help to reduce the time-to-market of biopharmaceuticals significantly and enable more flexible responses to changes in market demands.

Disposables in bioprocessing

Biopharmaceuticals are traditionally produced with stainless steel equipment. However, in recent years there was increasing interest in disposables made of polymers, which do not have to be cleaned after usage but are discarded. Besides to the abolition of the cleaning and the concurring cleaning validation, disposables offer increased flexibility, faster change over times and the prevention of cross-contamination between different products produced in the same facility. While the use of disposables in upstream processing is already common, industry is still reluctant in the area of downstream processing at especially larger scales with the only exception of disposable filters. Disposable pre-packed chromatography columns provide the additional advantage of outsourcing of the laborious and time intensive column packing and qualification processes to specialized companies. Despite pre-packed columns are routinely used for high throughput screening in process development, they are not frequently used at larger scales since there are not enough studies demonstrating sufficient packing quality and scalability between different column volumes.

Major results
Suitability of pre-packed columns

Researchers from the Austrian Centre of Industrial Biotechnology (acib) have developed innovative concepts proving that pre-packed chromatography columns are suitable in replacing conventional stainless-steel columns. On the one hand, they emphasized on a fundamental understanding of the packing quality of pre-packed columns, both by experimental evaluation of the packing structure and by computer simulations (Fig. 1). Further, in-depth investigations of extra column effects, peak analysis and the impact of the packing structure on column performance were performed. On the other hand, the performance of pre-packed columns was evaluated over very wide scales ranging from 0.2 mL laboratory up to 57 L production scale columns (Fig. 2) and found to be satisfactory for protein separations. Besides, they showed that pre-packed columns can be con-
sistenty produced at the required quality for more than ten years and that the performance of pre-packed columns was equal or better than that of conventional columns.

Impact and effects

Most importantly, pre-packed chromatography columns are suitable in replacing conventional columns for separation of proteins without any trade-offs in column performance from laboratory to production scale.

The gained results add a crucial understanding in predictions from small to large scale, interpretation of results and troubleshooting of process deviations using scale down models.

The evidence of the remarkable and consistent performance of pre-packed columns allows industry to use them at all scales without any prejudices. Their incorporation to standard development and production processes allows to save production costs and time but also to decrease the time-to-market during the development of biopharmaceuticals.

Fig. 1: Computational fluid dynamics (CFD) simulation of a pre-packed column

Fig. 2: Buffer preparation for experiments on large scale pre-packed columns

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