

CLEANING CHALLENGES IN SOLID-LIQUID-SEPARATION

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ABSTRACT

In the food and pharmaceutical industry strict requirements are necessary to guarantee high product qualities and a high level in consumer protection. Cross contamination by other products or contamination by material migration from equipment is unacceptable. In consequence strict requirements concerning the cleanability of used equipment exist. Therefore, hygienic design criteria are necessary for the design of the equipment which must be adapted to both the manufacturing and production processes.

In a variety of applications the bottle neck of the cleaning procedure is the filter media. It is directly exposed to the product and offers large surfaces that can be affected by residues. One way filters are recognized as state of the art in critical applications. Opening of the process room for changing the filter media has to be avoided in cases such as, manufacturing of toxic or highly active pharmaceutical products. Financial considerations specific to equipment must be taken into account for filter media cleaning necessities. This study evaluates the fundamental analysis of cleaning mechanisms of woven media to validate filter media cleaning.

The first part of the study addresses the insoluble impurities. In a well defined procedure the media loaded with particles is exposed to a flow and the fluorescent particles are counted before and after to determine the prosperity of cleaning. The adhesion force determined in an ultracentrifuge and the wall shear stress on the surface of the filter media determined by a CFD-simulation lead to a momentum balance on a single particle. The momentum balance offers the possibility to determine on all areas of the surface whether the particles can be removed or not. This approach establishes the possibility to predict the degree of cleanability.

The second part of the study deals with soluble impurities. After a well defined contamination step the impurities are visible as a thin crystalline film on the surface of the media. Calculation of the cleaning kinetics enables the determination of the mass transfer coefficient. Acknowledgement of the non-dimensional numbers Re , Sc and Sh makes it possible to rank the cleanability of different media. As the Sh -Number increases so does the cleaning efficiency. Once the mass transfer coefficient is determined it is possible to calculate the most appropriate filter media for cleaning purpose.

The transfer of this study to technical applications offers several benefits; a two step cleaning procedure with a short intensive flow with high Re -Numbers and an additional smooth treatment with a solvent that is highly effective in cleaning. This study influences also the development of new filter geometries. The distribution of the wall shear stress at the surface of the media has a very high impact on the overall cleaning result.

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