Influence of Fiber Geometry on the Performance of Hemodialyser Membrane

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Abstract

The hemodialyser also known as the "Artificial kidney" is a mechanical device that serves to be a splendid tool in filtering the impurities and excess water from the body by the process of diffusion. Clearance rate is used as a key factor to analyse the separation of solutes from the blood.The hemodialyser module holds thousands of hollow fibers that filter the toxins especially urea from the blood. Many of the hemodialyser membranes available in the market have fibers oriented in straight and crimped (undulated) patterns.Crimped means that the fibers have been subjected to impart waviness in their structure. The objective of this work is to study the influence of fibers with varying geometry and structure.

In this paper the structure of Fresenius Polysulfone - Hemoflow (F6HPS) membranes were developed as 3D models in various fiber orientations namely straight fiber and fiber with 8 crimps and the clearance of solutes were analyzed using COMSOL Multiphysics®. The hemodialyzer membrane consists of paths for the blood and dialysate to flow. These two domains were modeled using Transport of Diluted Species interface. The solutes present in the blood gets transported to the dialysate path through a porous medium. This domain is characterized by species transport through porous media interface. These two interfaces are the interfaces present in the chemical species transport module.

The simulation results show that crimped fiberhas better clearance rate than straight fiber.

Figures used in the abstract

Figure 1: Concentration profile of urea post dialysis in straight and crimped fibers of hemodialyser