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Adsorptive Media Selection for Bilirubin Removal: An Adsorption Equilibrium Study

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Abstract : The liver is a complex, large-scale biochemical reactor which plays a unique role in the human physiology. When liver ceases to perform its physiological activity, a functional replacement is required. Actually, liver transplantation is the only clinically effective method of treating severe liver disease. Anyway, the aforementioned therapeutic approach is hampered by the disparity between organ availability and the number of patients on the waiting list. In order to overcome this critical issue, research activities focused on liver support device systems (LSDs) designed to bridging patients to transplantation or to keep them alive until the recovery of native liver function. In recirculating albumin dialysis devices, such as MARS (Molecular Adsorbed Recirculating System), adsorption is one of the fundamental steps in albumin-dialysate regeneration. Among the albumin-bound toxins that must be removed from blood during liver-failure therapy, bilirubin and tryptophan can be considered as representative of two different toxin classes. The first one, not water soluble at physiological blood pH and strongly bounded to albumin, the second one, loosely albumin bound and partially water soluble at pH 7.4. Fixed bed units are normally used for this task, and the design of such units requires information both on toxin adsorption equilibrium and kinetics. The most common adsorptive media used in LSDs are activated carbon, non-ionic polymeric resins and anionic resins. In this paper, bilirubin adsorption isotherms on different adsorptive media, such as polymeric resin, albumin-coated resin, anionic resin, activated carbon and alginate beads with entrapped albumin are presented. By comparing all the results, it can be stated that the adsorption capacity for bilirubin of the five different media increases in the following order: Alginate beads < Polymeric resin < Albumin-coated resin < Activated carbon < Anionic resin. The main focus of this paper is to provide useful guidelines for the optimization of liver support devices which implement adsorption columns to remove albumin-bound toxins from albumin dialysate solutions.

Keywords : adsorptive media, adsorption equilibrium, artificial liver devices, bilirubin, mathematical modelling
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