THE EFFECT OF *STREPTOMYCES COELICOLOR* DEVELOPMENT ON THE HYDRODYNAMICS OF A VERTICALLY ORIENTATED MEMBRANE GRADOSTAT REACTOR

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Abstract

One of the major factors that influences the optimum operation and application of Membrane bioreactors (MBR's) is the flow of the fluid through the membrane, which is regulated by the transmembrane flux or transmembrane pressure. The transmembrane flux, in turn, is greatly influenced by the membrane hydraulic permeability; and the permeability of the microorganism attached to the membrane. In this study an empirical correlation for the bacterium *S. coelicolor* biofilm hydraulic permeability attached to the external surface of a capillary membrane, used for the production of secondary metabolites, is presented. This relation was based on a two phase logistic fit of the biofilm growth kinetics, taking into account uneven growth (tapering) of the biofilm. The model was applied to a vertically orientated, pressure controlled, membrane gradostat reactor (MGR) operated in the dead-end mode. The developed permeability correlation was further used in the investigation of the effect of bacterium growth on velocity and pressure profiles of the nutrient solution in the lumen of the membrane. The velocity profiles emanating from the application of the model were in correspondence with the observed flux decline in pressure controlled MGR's. The hydrostatic pressure profiles pointed to the existence of a critical hydraulic permeability of the biofilm, below which there is recirculation of the nutrient solution to the lumen of the MGR. Even at hydraulic permeabilities much higher than the predicted κ_{crit}, this recirculation was marked by the existence of the secondary metabolite Actinorhodin in the lumen of the membrane.

Keywords: Biofilm growth kinetics; Biofilm hydraulic permeability; Capillary membrane; Mathematical modelling; Membrane gradostat reactor; Secondary metabolites; *Streptomyces coelicolor*.