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OPTIMAL FEED TEMPERATURE FOR THE DECOMPOSITION PROCESS OF HYDROGEN PEROXIDE OCCURRING IN THE REACTOR WITH FIXED-BED OF COMMERCIAL CATALASE

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Abstract: Fixed-bed reactors are important workhorses in biochemical industry because of their efficiency, low cost, and type of construction, operation, and maintenance. These (bio)reactors are widely em-ployed since use of immobilized enzymes offers an easy product separation, less enzyme loss, in-crease in thermal and operational enzyme stability, enzyme protection against harmful environmental stress, and a better control of process. Design and optimization of fixed-bed reactors are not an easy task and often involve an inherent trade-off between different and conflicting objectives. Particular-ly, in case of bioprocesses, optimal conditions assurance can be a very challenging task (even if the process model is available) because of enzyme deactivation which is not always taken into account to predict proper bioreactor. The factors responsible for enzyme deactivation characteristics in rela-tionship to the main enzyme catalysed reaction can be decisive in choosing the reactor operating mode and optimal operating conditions for biotransformations course. Biocatalyst deactivation dependent on substrate concentration (parallel deactivation) is the specific one and makes enzyme activity both function of time and position. Such deactivation mechanism is related to catalase which has intensively been applied for elimination of residual hydrogen peroxide in various domains such as textile, food, and semiconductors industries, as well as the waste waters treatment and cosmetics and pharmaceutical formulations in biosensor system. One can notice that the optimal operating conditions in a continuous packed-bed reactor for hydrogen peroxide decom-position are not easy to implement in industrial practice, because of the dependences of state varia-bles being a functions of time and reactor length. Additionally, when working with immobilized enzymes (especially catalase), internal and/or external diffusional resistances are likely to occur re-gardless method of immobilization used. Practically, in the most simple way, an optimal operating strategy can be accomplished by searching for a suitable feed temperature yielding the maximum bioreactor productivity. Hence, the objective of the present study was to search for – under constant feed flow rate – the optimal feed temperature of the fixed-bed reactor performing hydrogen peroxide decomposition by immobilized onto the non-porous glass beads Terminox Ultra catalase. The optimal feed temperature was obtained by maximizing time-averaged hydrogen peroxide conversion accounting for the lower and upper temperature constraints as well as diffusional resistances expressed by global effective-ness factor. The obtained results can improve the knowledge of the hydrogen peroxide decomposed by catalases from various sources and the selection of operating conditions.