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EFFECTIVENESS FACTOR APPROACH FOR CHEMICAL ABSORPTION PROCESS

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Abstract

Absorption of gases into liquids, with chemical reaction, is an important unit operation useful in many fields, especially synthesis of new products and waste gas treatment. Gas treatment means the separation of pollutants: acid gases, organic sulphur compounds, and other contaminants which may be found in gaseous streams. The absorption into liquid is a process almost exclusively used for removal of contaminants. The removal refers to retention of the majority of acid gases present in high concentration down to a level such as 0.1 % in the treated gas. The gas-liquid processes are carried out in a variety of equipment's including packed towers, bubbling absorbers, spray columns, falling film contactors etc. The absorber selection and design require models describing the interaction between mass transfer and chemical reaction. For design purposes, it may be used the concept of enhancement factor (E), related to the positive effect of the reaction rate on the physical mass transfer.
The aim of this paper is to develop a mathematical model that allows the analysis of gas-liquid processes in the intermediate reaction regime. The effectiveness factor approach for gas liquid reactions is developed in this paper by using the concept of fractional conversion in the liquid film (X_F), which precisely indicates the kinetic regime. This new approach for gas-liquid reactions is presented in the current study. When reaction rate does not improve the mass transfer (slow and very slow reaction) the effectiveness factor concept can be used to describe this interaction.
The elaborated mathematical model allows the determination of effectiveness factor values for practical intervals of Hatta (Ha) modulus and modified Sherwood (Sh) number. The development concept is similar with model used in the modelling of the heterogeneous catalytic reactions.
The proposed mathematical model has shown that in the intermediate regime (when $0.01<X_F<0.99$), the effectiveness factor approach is more convenient.

Key words: chemical absorption, effectiveness factor, gas-liquid processes, modelling

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