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SCALE-UP UNDER CALCULATING A WORKING ZONE OF CHEMICAL APPARATUSES WITH ACCOUNTING TO THE DISTRIBUTION OF PHASES

Abstract. In this work, the new approach to modelling the scale factor under the calculation of an efficiency of mass transfer in the reactors has been submitted. The approach is based on the dividing the apparatus work volume into zones with different ratios between interacting phases streams. The expressions obtainedcan be applied to the design of chemicalreactors with allowance for the scaling phenomena.

Keywords: scale-up, chemical apparatus, packing, degree of conversion, mass transfer.

Introduction. Numerous experimental studies and experience of industrial exploitation show that when calculating devices of large unit capacity from experimental data obtained from small-scale experimental installations, it is primarily to ensure the calculated efficiency of their operation. It is established that this efficiency tends to decrease with an increase in the sizes of the apparatus [1, 2]. This phenomenon has been called the scale effect and has recently become the subject of research by many scientists [1-3].

The presence of stagnant zones, recirculation sites and areas with a complex hydrodynamical structure in the apparatus volume creates major problems in the development of mathematical models. However, even a workable model is not always correctly used in the design of an industrial device due to the noted problem of a scale transition, since the structure of the streams can change with a change in the overall sizes of the apparatus and its power [4, 5].

This paper deals with an approach to this problem, based on some ideas proposed in [2], which makes it possible to give a fairly simple technique for estimating the influence of the scale factor on the mass transfer efficiency, suitable for use in engineering calculation methods.

The approach is based on the idea that the entire volume of the apparatus has divided into zones with different ratios of interacting flows. It is assumed that the structure of the streams in the isolated small volume cell of the reactor corresponds to the structure of flows in the laboratory apparatus with the same flux ratio and uniform phase distribution [2].

Mathematical model. In order to take into account the uneven distribution of flows, it is assumed that each volume element can be associated with the local value of the bulk mass transfer coefficient obtained on laboratory installations of small size with a known flow structure [6, 7].

The equations for the interaction of phases in elementary volumes are as follows:

$$\frac{\partial Y}{\partial z} = L(z,r)\frac{\partial X}{\partial z}; \tag{1}$$

$$\frac{\partial Y}{\partial z} = K_V(z,r)\frac{d\chi}{dV}, \tag{2}$$