INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The present study reports the feasible applications of the millichannel based packed bed geometries as the efficient transport devices. Before the application of any millimetric channel geometries as the transport devices, the hydrodynamics, mixing, and flow characteristics for the flow of fluids through them to be very well known. The pressure drop characteristics of single-phase as well as aqueous-organic liquid-liquid two-phase flow through the rectangular straight and serpentine millichannels, both in packed and unpacked conditions, using medium sand as the packing material were described in the present context. The experimental results are enunciated with the available models for both unpacked and packed channels. Empirical models are developed to predict the pressure drop and friction factor for both single and two-component liquid-liquid flows through the prescribed straight and serpentine geometries based on the operating variables. The variation of local entropy generation rate at a particular temperature gradient in the two-phase flows through the unpacked straight channel is enunciated.

The RTDs of a liquid tracer for the air-water two-phase concurrent flows through the millimetric packed multichannel devices (consist of 11 number of same dimensional parallel channels) with the variable heights were measured by the conductivity measurements and represented by the axial dispersion model (ADM). The axial dispersion coefficients, as well as the specific energy dissipation values, were estimated. The effects of the operating variables, pressure drop, and the geometries on the hydrodynamics and the mixing properties were well expressed. Based on the experimental data, new correlations were proposed and compared with the available literature.

The mass transfer (extraction) studies were also performed to investigate the effect of copper ion concentration in the solution, extractant concentration in the solvent, solution pH, mixture velocity of the phases, and the temperature on the copper extraction from a copper-laden solution. Lastly, the hydrodynamics and the mixing characteristics for the single-phase flow through a millimetric multichannel packed bed device was studied to meet the specific requirements of the small-scale transport systems.

This study will be helpful in designing millichannel-based packed bed transport devices, along with the synthesis and characterization of the various kind of adsorbent materials.