

## **Numerical simulation of liquid spreading in a random packed bed in a trickling flow regime**

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### **ABSTRACT**

Packed-bed columns are commonly used in process and chemical engineering. Enlarged contact area improves heat and mass transfer of counterflowing media ensuring desired process efficiency. Modelling of such flow systems is a challenge as it has to account for the mutual interactions of fluid phases flowing inside a structured or random packing of a complex geometry. Depending on column loads, fluids properties, packing element type and size the liquid may flow either as a thin film or it may form rivulets or droplets. Moreover, the wall effects and flow channelling may occur as well as liquid accumulation in bed cavities. All these effects influence the packing section wettability and consequently the actual contact area between phases.

The paper present the numerical simulation of a liquid spreading taking place during the 2-phase gas-liquid countercurrent flow in a random packed bed composed of Raschig rings. The Euler-Euler 2-fluid approach has been applied to resolve the flow. The impact of packed bed elements on the gas and liquid flows has been introduced into the model by the source terms in the momentum equation. The increased flow resistance has been modelled with the use of an adequate correlations taking into account the packing element type and size, media flow rates and their material properties [1]. The liquid redistribution has been simulated by implementing the probability density function distribution of the velocity vector orientation in a packed section, which has been adopted from the Volume of Fluid (VOF) simulation conducted in a corresponding packed bed with realistic geometry. The volume fraction distributions obtained for varying flow rates have been found to be fully consistent with the theoretical predictions provided by the advection-diffusion model [2]. The spreading factor, responsible for the distributing action of the packed bed, has been found to be independent of liquid flux.

### **REFERENCES**

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- [2] Z. Cihla and O. Schmidt, "Studies of the behaviour of liquids when freely trickling over the packing of cylindrical tower", *Collect. Czechoslov. Chem. Commun.* **23**, 569-577 (1958).