NUMERICAL SOLUTIONS OF POPULATION BALANCES IN PARTICULATE SYSTEMS

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Abstract

The dynamic behavior of a population of small particles is a subject of interest in various engineering fields. These areas include atmospheric physics, precipitation, crystallization, pharmaceutical manufacture, aerosol formation, colloid chemistry, growth of microbial and cell populations, and so on. Most of such systems involve simultaneous nucleation, growth, aggregation and breakage of particles. Population balances, in their integro-differential equation form, are a widely used tool for simulating these processes. Since, population balance equations can only be solved exactly in simplified cases, numerical solutions are usually needed.

This work focuses on the derivation of numerical schemes for solving population balance models with simultaneous nucleation, growth, aggregation and breakage processes. Two numerical methods are proposed for this purpose. The first method combines a method of characteristics (MOC) for growth process with a finite volume scheme (FVS) for aggregation and breakage processes. For handling nucleation terms, a cell of nuclei size is added at a given time level. The second method purely uses a semi-discrete finite volume scheme for nucleation, growth, aggregation and breakage of particles. Note that both schemes use the same finite volume scheme for aggregation and breakage processes. The proposed techniques are tested for various combination of these processes. The numerical results are validated against available analytical solutions.

References

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