Modeling Gas Diffusion Through Expanded Polystyrene Using Cellular Automata

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EXTENDED ABSTRACT

Modeling of the diffusion of gases through EPS can aide the lost foam casting industry in understanding the methods that can alter pyrolosis products during a metal pour. These products are thought to have a significant impact on the quality of a metal pour. Cellular automata (CA) present a reasonably effective and accurate method of modeling these diffusion processes and have been proven to provide good correlation with experimental data. The previously accepted method of implementing these CA models was to allow every particle in a mass occupied cell location to randomly walk until every particle was acted upon. The method presented within involves the partitioning of numbers to avoid the need to randomly walk each particle when a CA model cell site was occupied with multiple particles. This produces a reduced operations count and inherent increase in execution speed of the model.

The research led to the disproof of the validity of earlier models and the introduction of new methods for modeling gas diffusion in EPS. Several numerical experiments were performed and the stability of the opposing methods was analyzed. The partitioning method of cellular automata was shown to be numerically stable while the equi-distribution method showed questionable sensitivity to initial conditions. The equi-distribution method proved to not be representative of the stochastic process of gas diffusion and is therefore unfit to model these processes without extensive modification. A blending of the two methods was proposed for future study to gain both the speed of equi-distribution and the stability of partitioning schemes.