Water Spreading on Floor by Explicit Moving Particle Simulation Method

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Abstract: In order to simulate the flooding phenomenon in nuclear power plant caused by the water tank breaking, LOCA and so on, validation of water spreading on floor needs to be studied. In this paper, the Explicit Moving Particle Simulation method is employed to analyze water spreading on floor. The simulation results, especially the leading edge behaviors, are compared with the experimental data. Besides, convergence of the particle sizes is investigated. Additionally, simulation with the polygon wall boundary model is also presented in this study.

Keywords: numerical simulation, water spreading, moving particle simulation, explicit method

1. Introduction

Water tank breaking, LOCA etc. would cause the flooding in the nuclear power plant, which is very important for the safety. Unfortunately few research has been carried out due to lacking of effective research approach. The Explicit Moving Particle Simulation method[1] is one of the particle methods in which large deformation of free surfaces can be easily simulated. Besides, the pressure field is calculated explicitly and massively parallel computing can be applied in EMPS method.

2. Comparison of calculation and experiment results

Water spreading on a floor is calculated by EMPS. The geometry is depicted in Fig.1. Fig.2 presents the calculated results with different particle sizes as well as the experimental data in Ref.2. The leading edge speed of the experiment is slower than that of the calculations due to the friction between fluid and wall. In addition, with the decreasing of the particle size, the leading edge speed becomes faster but the convergence trend is clear.

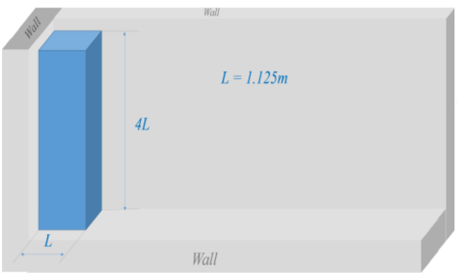

Figure 1. Geometry of collapse of water column

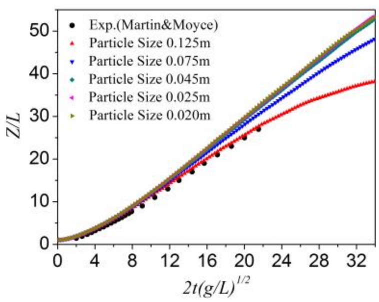

Figure 2. Motion of leading edge

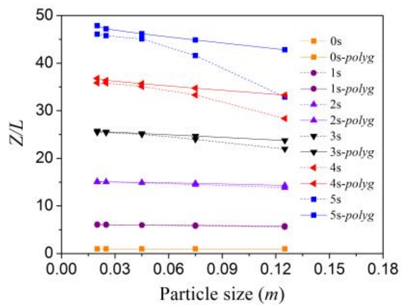

Figure 3. Convergence of particle sizes

3. Polygon wall boundary calculation

In this part, the polygon wall boundary model[3] is applied to compare with the particle wall boundary model. Fig.3 shows the convergence of the particle sizes. Obviously, it can be seen from the comparison that the leading edge speed using the polygon boundary is better than that using the particle boundary especially when the particle size is large.

4. Conclusion

Water spreading on a floor has been simulated by EMPS method. Validation of water spreading process by EMPS is carried out. The leading edge speed is sensitive to the particle sizes while the convergence trend is obvious. Besides, a relatively more practical leading edge speed is achieved by the polygon wall boundary model.

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