Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

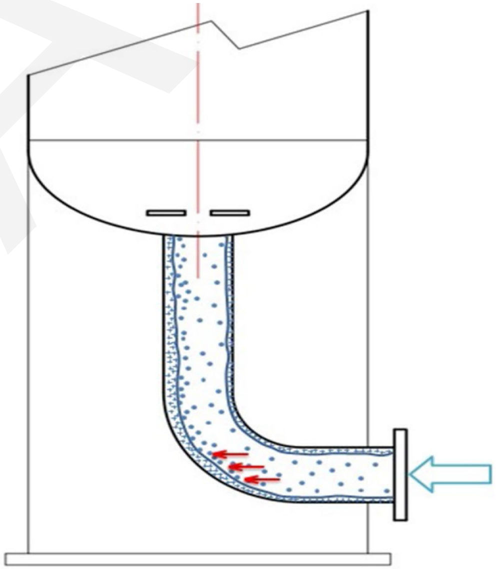
Numerical simulation of gas-liquid flow through a 90° duct bend with a gradual contraction pipe

Dong-fang HU

Cite this as: Dong-fang HU, Zheng-liang HUANG, Jing-yuan SUN, Jing-dai WANG, Zu-wei LIAO, Bin-bo JIANG, Jian YANG, Yong-rong YANG, 2017. Numerical simulation of gas-liquid flow through a 90° duct bend with a gradual contraction pipe. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 18(3):212-224.

http://dx.doi.org/10.1631/jzus.A1600016

Bends Used in the Industry



- Bends are frequently used to change the direction of a pipe.
- The centrifugal effect arising from a bend leads to separation of a multiphase fluid.

Experiment and Simulation Method

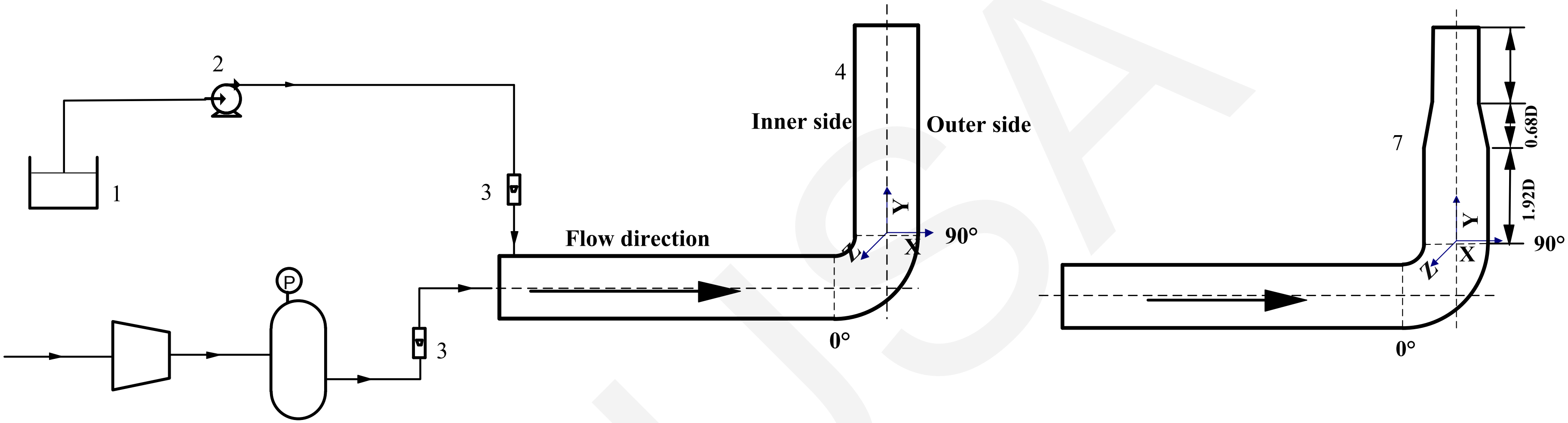


Fig. 1 Schematic diagram of the experimental facility

- A three-dimensional steady Eulerian-Eulerian approach was adopted.
- The simulation method was validated by the static pressure obtained by experiment.

Mechanism of Redistributing Fluid

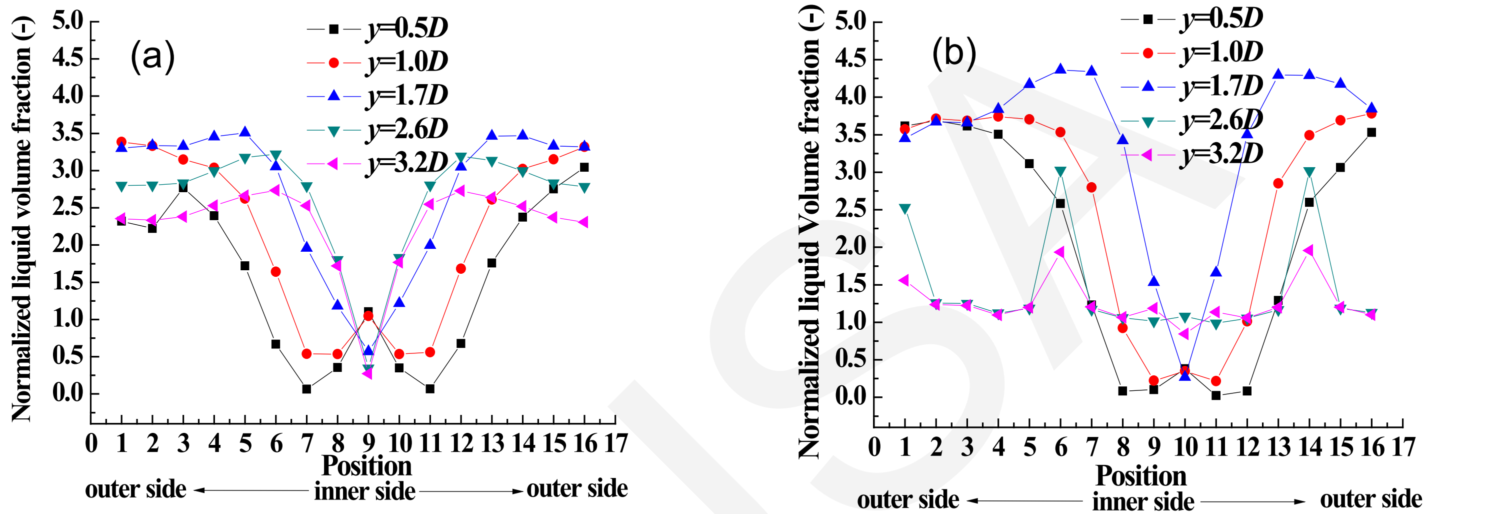


Fig. 7 Liquid distribution near the wall of the vertical section on the circular section at different elevations, v_g =14.4 m/s, x_l = 7.71%: (a) NOC pipe; (b) C pipe

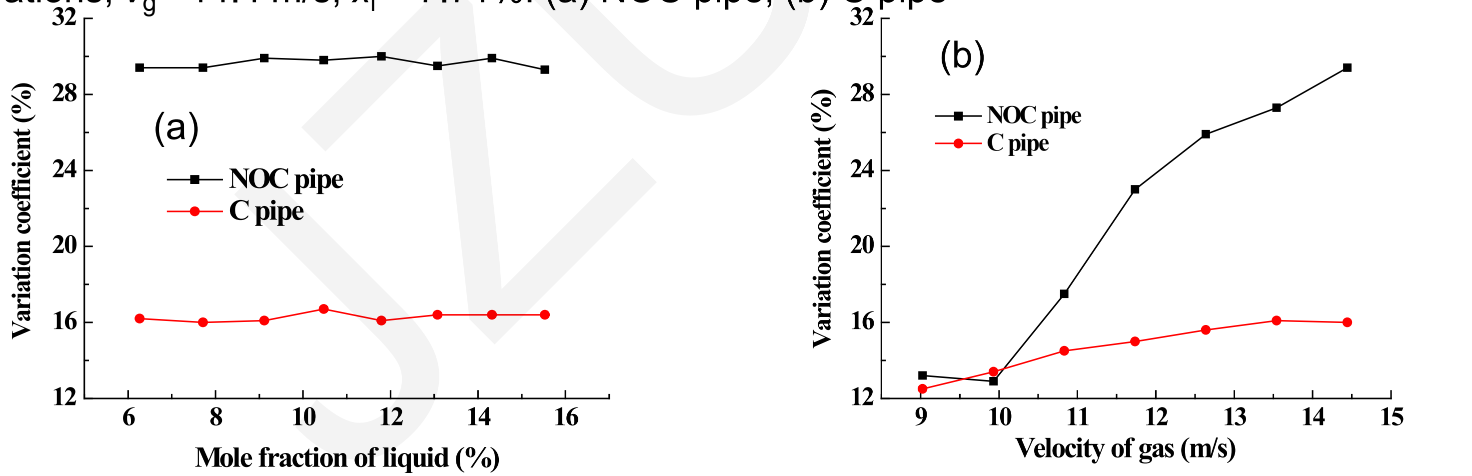


Fig. 8 Variation coefficient of liquid volume fraction at the exits of the two pipes: (a) v_g =14.4 m/s; (b) x_l = 7.71%

Mechanism of Redistributing Fluid

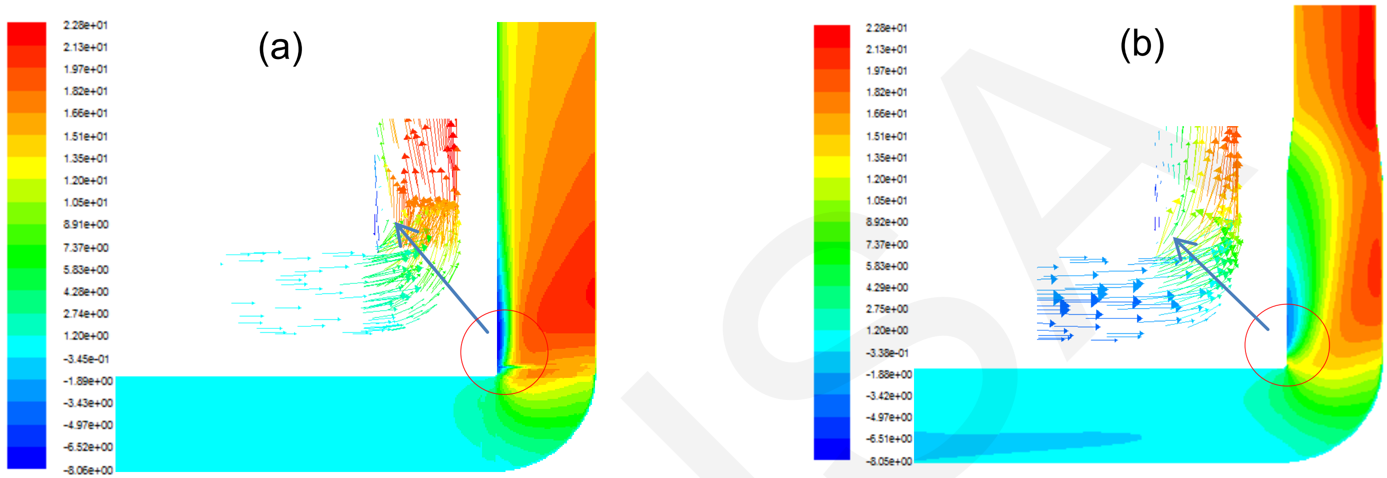


Fig. 10 Liquid velocity in the vertical direction, v_g =14.4 m/s, x_l = 7.71%: (a) NOC pipe; (b) C pipe

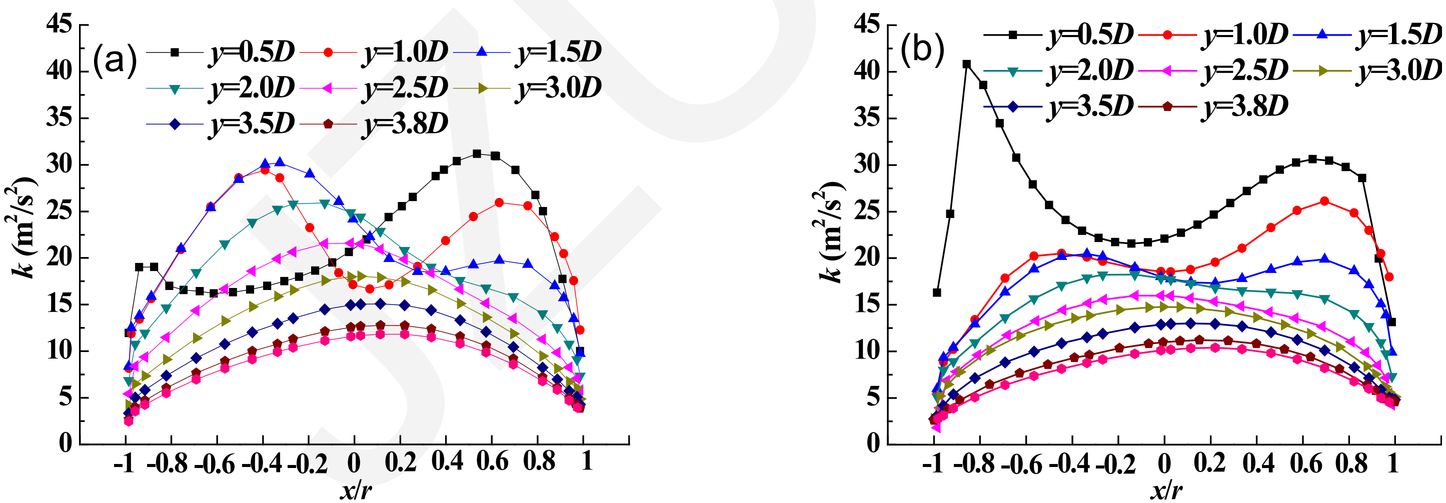


Fig. 13 Distribution of *k* along the X axis on the cross section at different elevations, v_g =14.4 m/s, x_l = 7.71%: (a) NOC pipe; (b) C pipe

Conclusions

- The applied numerical method was a three-dimensional steady Eulerian-Eulerian approach with a standard *k*-*ε* turbulent model and a Schiller-Naumann gas-liquid drag model. The simulation results showed good agreement with the experimental data.
- Liquid was uniformly distributed at the exit of the C pipe.
- The pressure in the C pipe was greatly altered by the GCP as well as the trajectories of the fluid and secondary flow.
- This study was a preliminary attempt to investigate the effect of a GCP on fluid redistribution downstream of a bend.
- Further work should be done to determine the relation between the structure of a GCP and its effectiveness, including the contraction ratio, length and location of a GCP in the vertical segment.