5 - 14 Flow Field Measurement of Window Spallation Target

Xu Xiaowei, Qiang Chengwen, Zhao Qiang, Wang Fei, Li Long and Yang Weifeng

The spallation target coupling accelerator and subcritical reactor produces is key component of ADS[1−2]. The LBE spallation target with window is popular because of its feasibility in last decades, but the target window material should bear beam radiations and liquid metal corrosions. A detailed study for the flow field of the target conducted in an approximately 1:1 sized window spallation target model was carried out by visualization experiments and numerical simulation. Water was used as the working fluid in the experiment. The flow pattern inside the spallation area is visualized by means of the particle image velocimetry (PIV). The flow range of the present experiment is between 8.3 to 20 m^3/h, several typical flow patterns were observed.

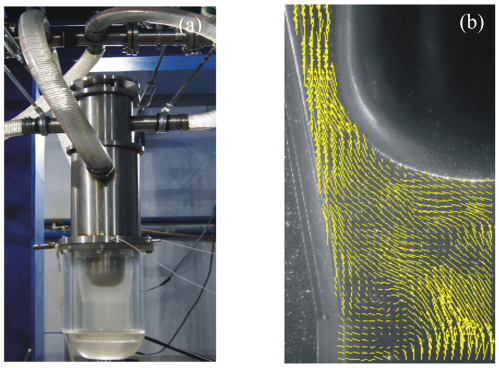
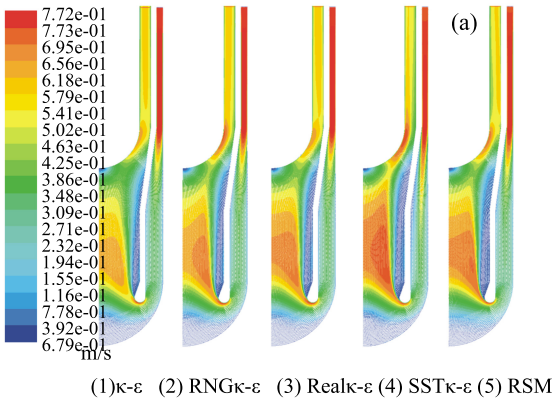


Fig. 1 (color online) (a) The window spallation target, (b) PIV image.

As indicated in Fig. 1, the flow structure in the spallation area is a zero attack angle flow around a rotator. During the experiment, flow field is stability. But sometimes the flow rate in the lower section of the divergent segment has suddenly become smaller. The formation of the double vortex secondary flow can be transmitted over the center of the flow channel. It makes flow field in the lower section of diverging instability.

The numerical simulation results are summarized in Fig. 2. Computational fluid dynamics analysis was performed by using FLUENT. Five turbulent models (standard k-ϵ, RNG k-ϵ, Real k-ϵ, SST k-ε, RSM) were utilized to calculate the flow at different velocity. The calculated results are given and compared with the experimental data. It is shown that using RNG k-ϵ model with the corresponding wall functions can accurately simulate the flow of the window spallation target.



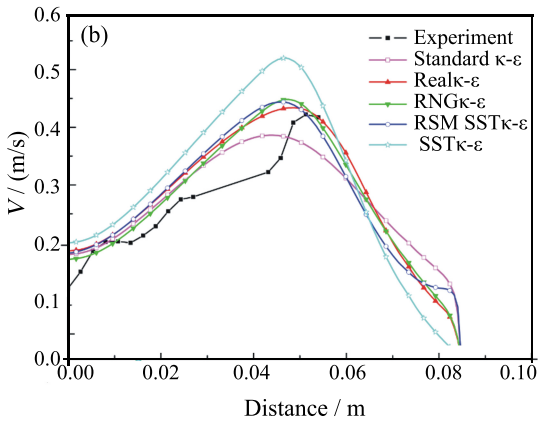


Fig. 2 (color online) (a) Velocity contours calculated by five turbulence models. (b) Comparison of the velocity between numerical simulation and experiment.

References

[1] A. Cadiou, A. Guertin, T. Kirchner, et al., Megapie-test (contractn ° fikw-ct-2001-00159) Final Summary Report on Target Design[R].

[2] K. Arul Prakash, G. Biswas, B. V. Rathish Kumar. International Journal of Heat and Mass Transfer, 49(2006)4633.