Journal of Zhejiang University-SCIENCE A

Cite this as: Yu Zhang, Kai-lin Zhang, Yuan Yao, 2019. Effect of seal clearance on the separation performance for a gearbox sealing system of a high-speed electric multiple unit. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 20(5):358-367. https://doi.org/10.1631/jzus. A1900004

Effect of seal clearance on the separation performance for a gearbox sealing system of a high-speed electric multiple unit

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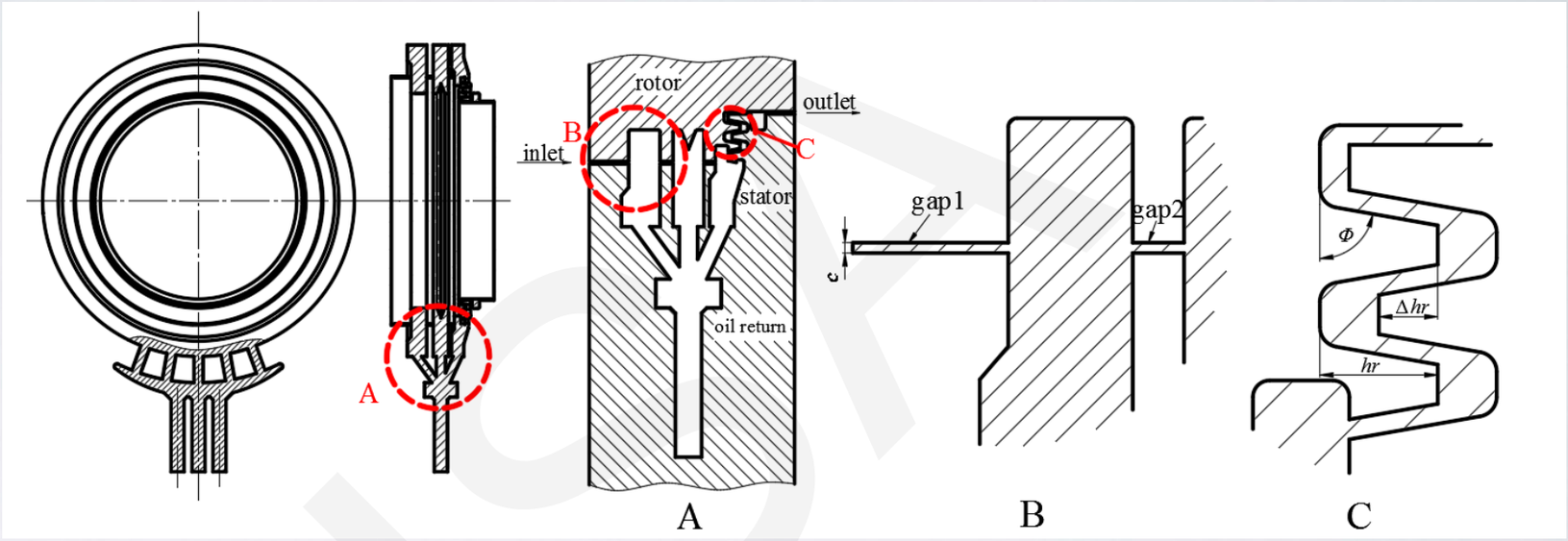
Key words:

Gearbox sealing system; Seal clearance; Separation performance; DPM; Droplet-wall collision model



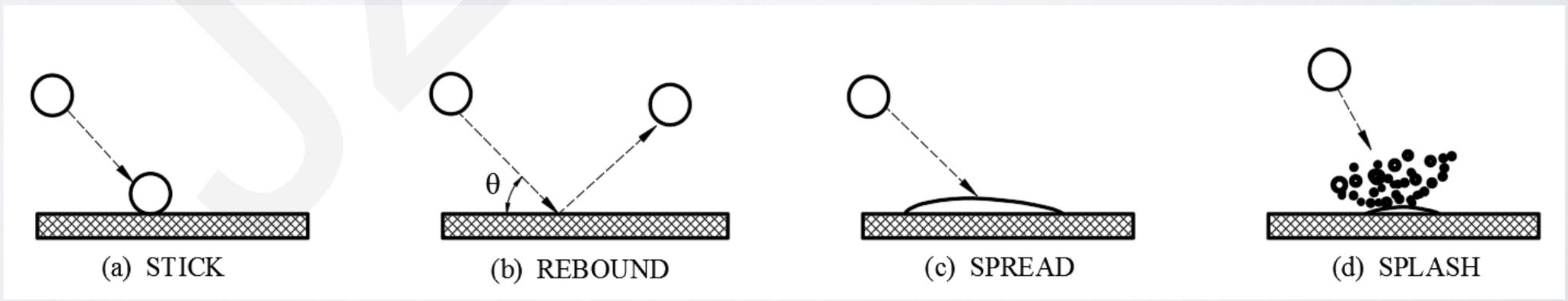
Model

Physical model



Mathematical model

1. DPM model
2. Droplet-wall collision model



Result and discussions

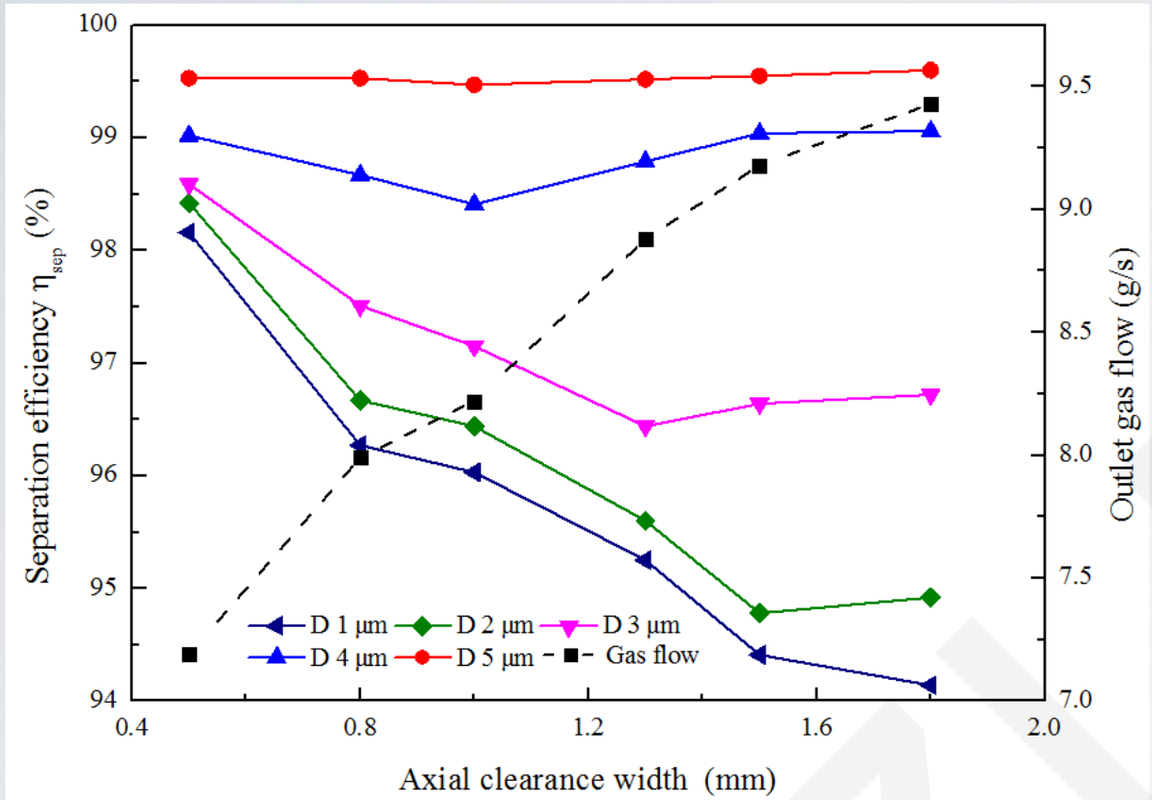
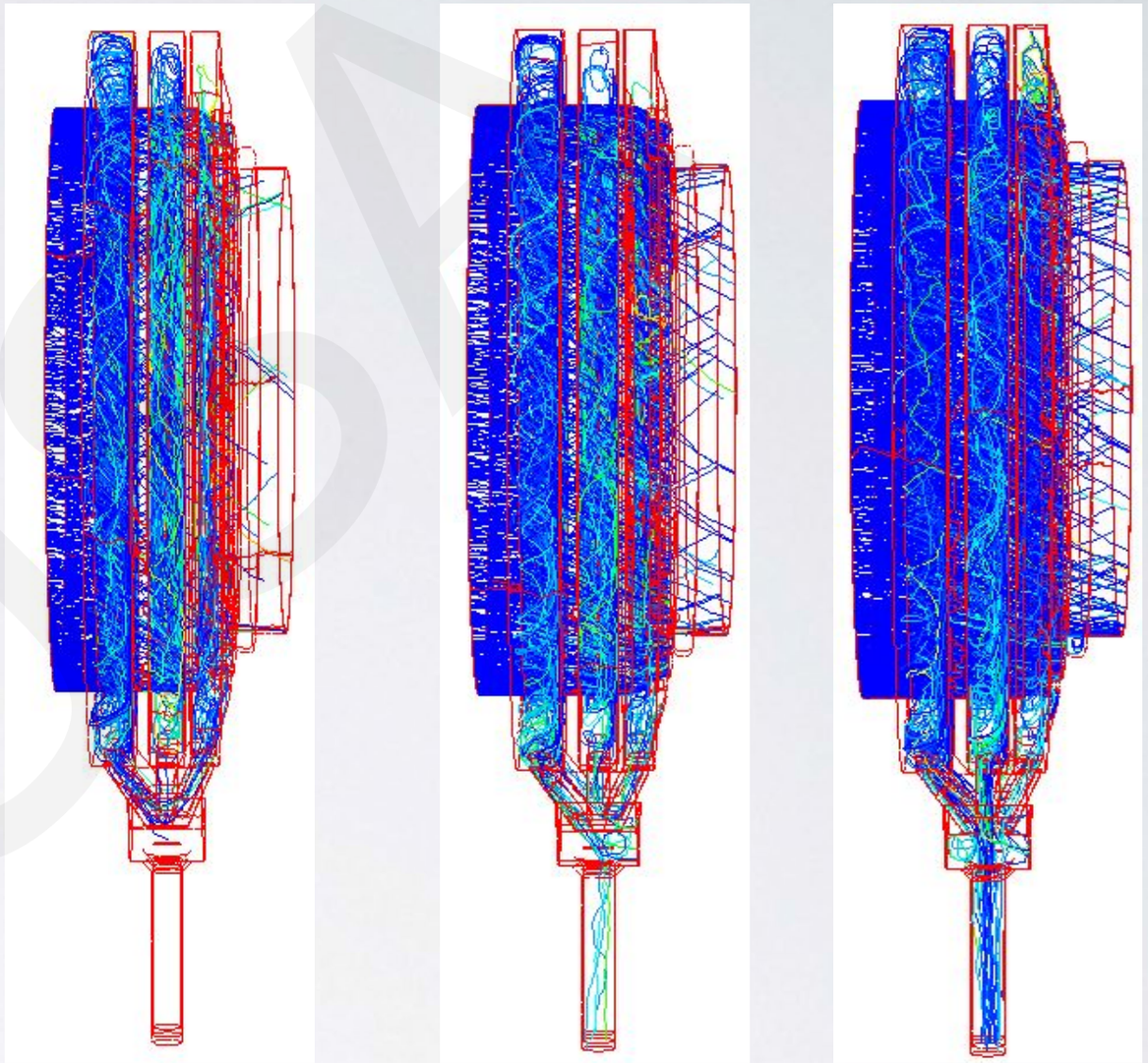


Fig. 4 Effect of axial clearance width on separation efficiency and outlet gas flow



(a) 0.5 mm **(b) 1.0 mm** **(c) 1.8 mm**

Fig. 5 Trajectory of oil droplets (1 μm) under different axial clearance widths

Influence factors:

airflow drag force

mass inertial force

acceleration inertial force

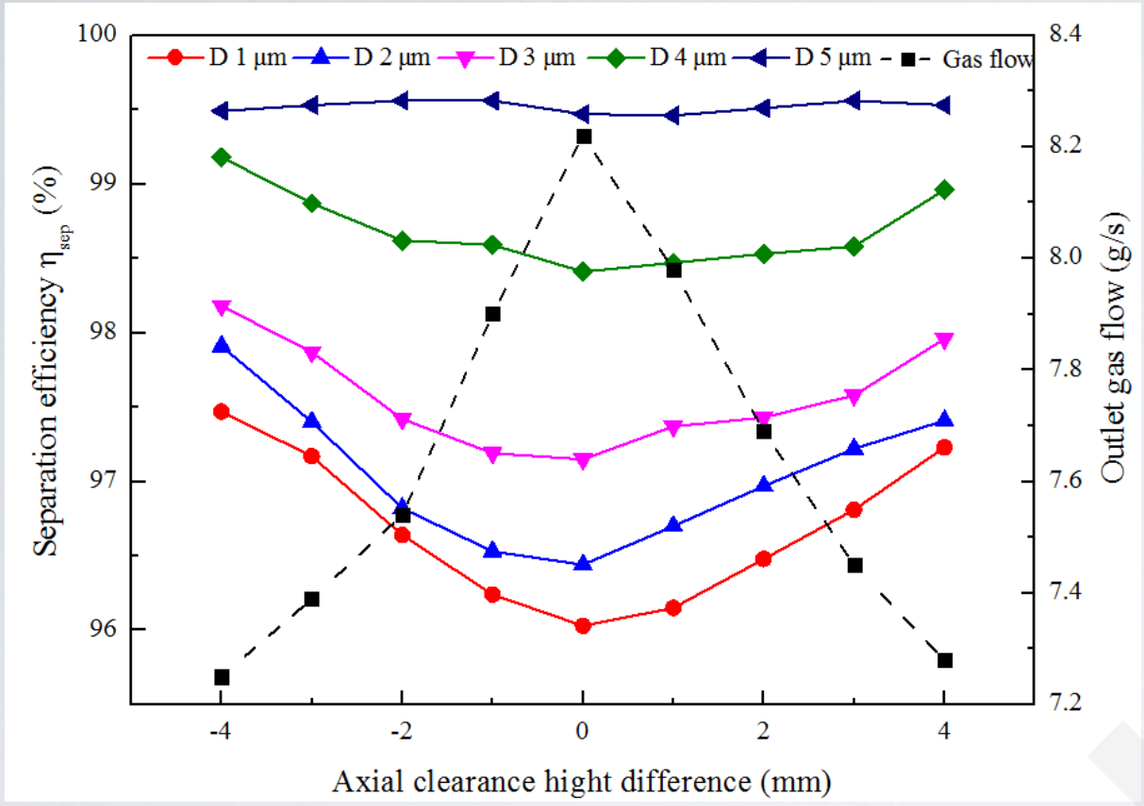


Fig. 6 Effect of axial clearance height difference on separation efficiency and outlet gas flow

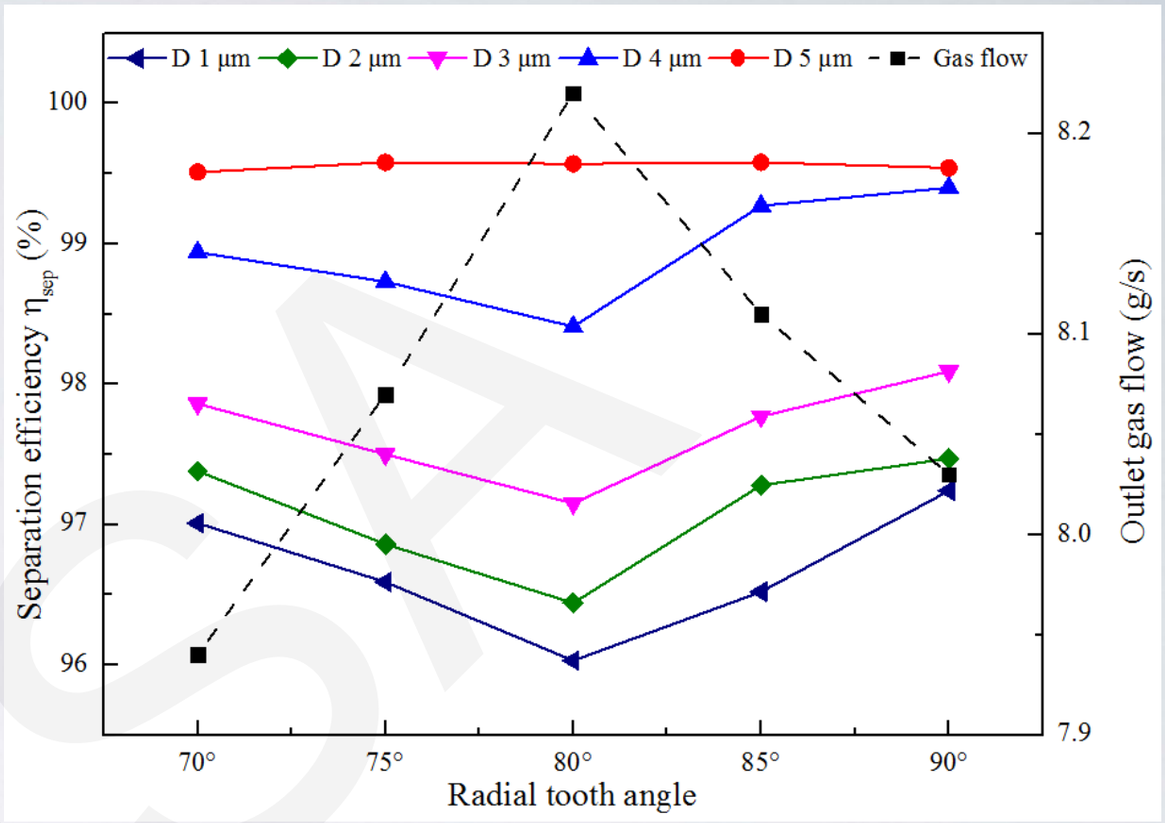


Fig. 7 Effect of radial tooth angle on separation efficiency and outlet gas flow

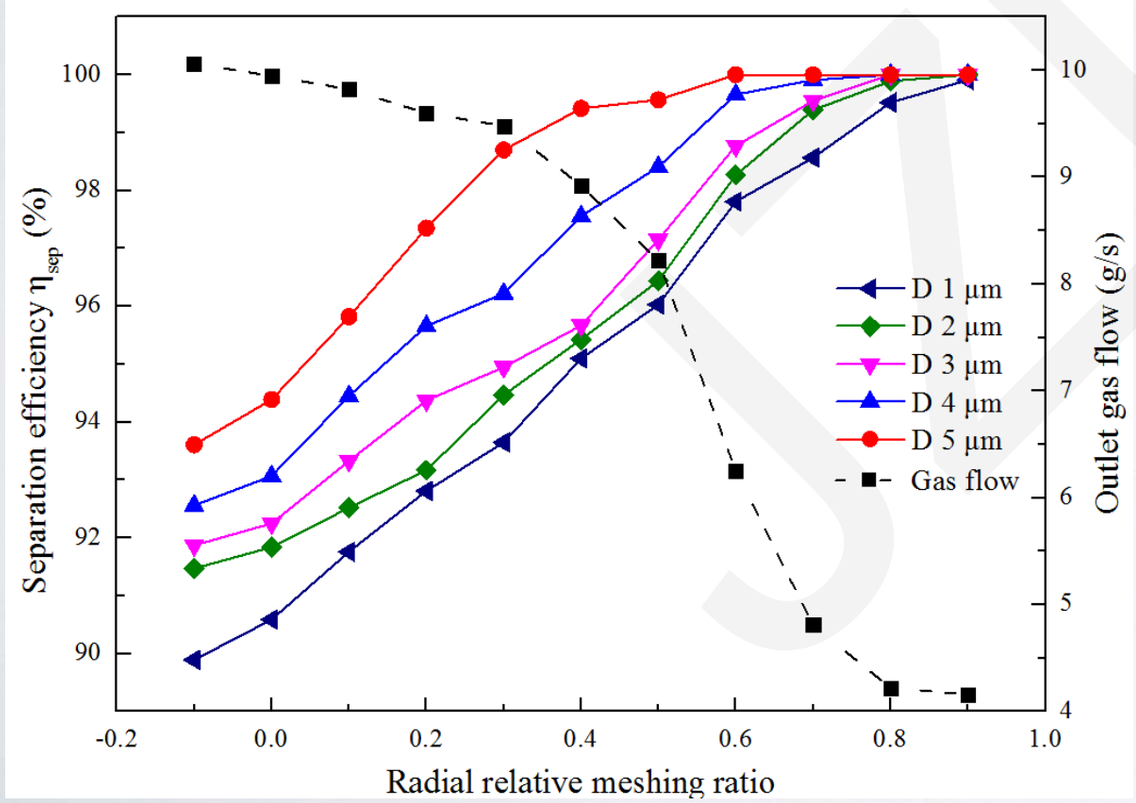


Fig. 8 Effect of radial relative meshing ratio on separation efficiency and outlet gas flow



Conclusions

1) Oil droplet inertia force and airflow drag force are the dominant factors affecting oil-gas separation. Stronger inertia force and weaker drag force lead to higher separation efficiency. Meanwhile, mass inertia force is the major factor, while acceleration inertia force and airflow drag force are secondary factors.
2) As the axial clearance width increases, the separation efficiency of small oil droplets (1 μm) decreases, while the separation distance of large droplets (5 μm) remains unchanged. Meanwhile, the separation efficiency of intermediate droplets (2-4 μm) decreases and then increases. The increase in the axial clearance height difference enhances the oil-gas separation efficiency.
3) As Φ increases, the oil-gas separation efficiency decreases and then increases, while the separation efficiency is lowest when Φ is 80° . On the other hand, the oil-gas separation efficiency increases as η increases such that the oil and gas is completely separated.
4) The influence of seal clearance on separation efficiency becomes weaker as the oil droplet diameter becomes larger.