Hydrodynamics of Shaking Baffled Cylindrical Vessel with Rotary Motion

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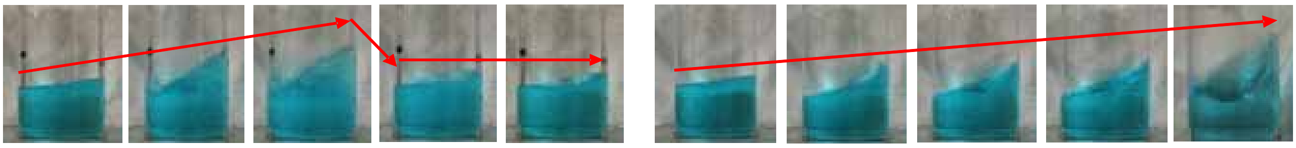
The hydrodynamics of a shaking baffled cylindrical vessel with rotary motion was studied by the observation of the height of wave and the particle dispersion in the vessel. The phenomena of suddenly decreasing wave height can be observed at one shaking frequency in the case using the baffled vessel. This frequency can also be correlated with only Froude number and baffled conditions, and it did not depend on the Reynolds number. And it found that the operating condition becomes narrow by comparison with the non-baffled vessel.

Hydrodynamics in Baffled Shaking Cylindrical



100rpm 140rpm 155rpm ($N_{max,P}$) 157rpm 190rpm — (a) With baffle

100rpm 140rpm 155rpm 157rpm 190rpm — (b) Without baffle

Fig.1 Effect of shaking frequency on wave height (*D*=200mm, B_w=10mm, *d*=10mm, water)

Figure 1 shows the phenomena that the elevated height of liquid free surface on the vessel wall suddenly decreases with baffled vessel more than $N_{max,P}$. To achieve complete mixing (***out of phase condition***), a shaking baffled vessel must be operated at the shaking frequency less than $N_{max,P}$.

Correlation of Shaking Frequency of Maximum Power Consumption and Power Number

< Shaking Frequency of Maximum Power Consumption >

$$Fr_{max,P} = 0.44(B_W/D)^{-0.17}(n_B)^{-0.24}(d/D)^{0.51} \quad (1)$$

< Power Number >

$$N_P=1.8\times 10^3 Re^{-0.25} Fr^{1.5}(d/D)^{1.5}(B_W/D)^{-0.13} n_B^{0.3} \quad (P>0.5\text{W}) \quad (2)$$

- $N_{max,P}$ did not depend on the viscosity of liquid.
- The power consumption of baffled vessel was higher than that of non-baffled vessel in the range of the shaking frequency when the rotational flow developed in the vessel.
- The correlation deviation of Eq.(2) was almost equal to that of the non-baffled vessel.

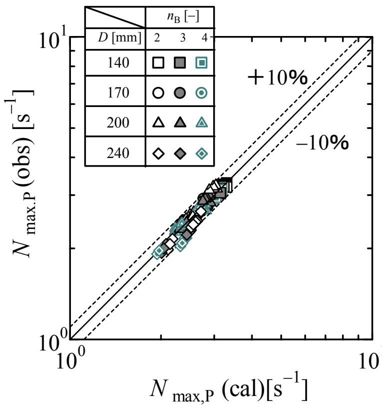


Fig.2 Comparison of calculated $N_{max,P}$ with observed one

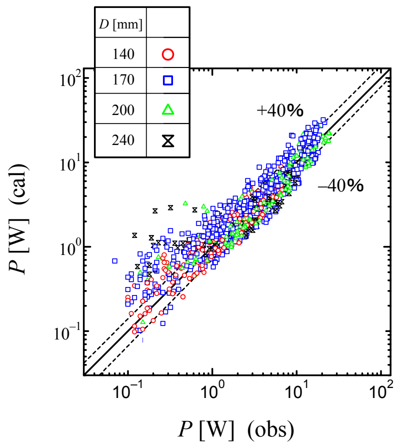


Fig.3 Comparison of calculated power consumption with observed one