Observation of Insulating Particle Motion in Electrically Conductive Fluid under Oscillating Electromagnetic Field

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Non-metallic inclusions in a molten steel are removed using the buoyancy force acting on them because they induce some serious defects in the products. Their rising velocity is proportional to the square of their diameter. However, micron-size inclusions still remain in products because their slow rising velocity is not enough to overcome entrapment into solidified steel. Therefore, collision and coagulation among inclusions have been considered as one of the convenient phenomena because they enhance rising velocity of the inclusions. An oscillating electromagnetic field has a potential as an effective tool for the collision enhancement[1]. Since oscillating particle motion in a fluid is still under discussions[2], investigation is required. However, direct observation of inclusion motion in the molten steel is difficult.

In this study, insulating polymer particles motion in an electrically conductive and transparent aqueous solution were directly observed under the imposition of an oscillating electromagnetic field for the purpose of clarifying the insulating particle motion in the conductive fluid under the oscillating electromagnetic field.

Polymer particles of 500μm in diameter were dispersed into a $CuSO_4$ aqueous solution containing tracer. A vertical alternating current, **I** of 4Hz in frequency and a horizontal static magnetic field, **B** was simultaneously imposed on the aqueous solution to excite an oscillating electromagnetic force, **F** in horizontal direction as shown in Fig. 1. According to the theoretical analysis, particle motion was governed by the oscillating electromagnetic force and friction drag under this experimental condition. The particle motion was observed by CCD camera.

The particle oscillation was excited accompanying with a weak convection flow of the aqueous solution under the imposition of the oscillating electromagnetic field. Oscillating part of the particle motion was a simple sinusoidal motion of 4Hz in frequency. Its amplitude was smaller than the prediction using the theoretical solution. Thus, it is considered that additional resistance force affects the particle motion.

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References

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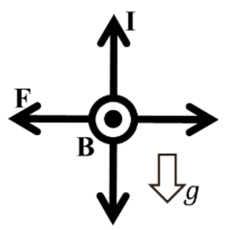

Fig. 1 Direction of alternating current, **I**, static magnetic field, **B** and oscillating electromagnetic force, **F**