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Development of Prediction Method of Generation Rate of Crystal Fragments Due to Collision with Impeller Blade in a Stirred Type Crystallizer

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Summary

Stirring operations in a crystallizer often induce particle abrasion caused by particle collision and subsequent secondary nucleation. This study developed a method of measuring the generation rate of attrition fragments in a stirred vessel filled with anti-solvent (Silicone oil) using potash alum as a model crystal. Potash alum particles will not dissolve and agglomerate in the oil. Therefore the change of parent particle shape and attrition fragments caused by crystal attrition can be observed clearly. A time series of SEM images of both abraded parent crystals and attrition fragments caused by crystal collision with impeller blades was taken during several tens of hours. The time evolution of the total number and size distribution of crystal attrition fragments were analyzed based on an image processing algorithm using SEM images of attrition fragments. Furthermore, abraded volumes of parent crystals were quantified based on the edge length of the parent crystal surface. The relation between the generation rate of attrition fragments and the change of shape of a parent crystal were clarified.

Results show that both the number of attrition fragments and the abraded volume of parent crystals increase rapidly initially, irrespective of the impeller speed and vessel size. Then they saturate after about 40 h. A Rosin–Rammler distribution showed good agreement with experimental data of fragments size distribution. The parent crystal cone shape became rounded with stirring time, although the flat surface of the parent crystal did not change to any great degree. So, attrition fragments are generated mainly from cones of a parent crystal. The attrition fragment generation rate decreased drastically with the parent crystal cone roundness, and was found to be correlated with the abraded ratio of the parent crystal. It is important to consider the roundness of crystal cones when the generation rate of attrition fragments is estimated.