Study on volatilization and condensation of feed particles in powder-particle Fluidized Bed

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Abstract

In the fluidized bed, the reactivity of C particles classified on the Geldart particle classification chart is high. However, when fluidizing using these C particles in a fluidized bed, the C particles are highly sticky and easily form secondary particles, which can cause non-fluidization. Therefore, fluidization with C particles alone is considered difficult.

A powder particle fluidized bed uses fluidized particles with a particle size of several hundreds of μm (B particles) that are easy to fluidize as media particles, and fluidizes while retaining fine particles (C particles) of 40 μm or less on the surface[1]. As a feature of the powder fluidized bed, it is possible to maintain a fluidized state without blowing fine particles to the reaction gas by holding fine particles with strong adhesion/aggregation properties around the medium particles, and collision between the fine particles and the medium particles to prevent the formation of aggregates by destroying the aggregates. Examples of applications include industrialization such as decarbonation of a mixture of silicon carbide and carbon, slurry drying etc.[2]

However, since the zinc produced by the reduction of zinc oxide in this study is a vapor, the fine powder of the raw material changes from solid to gas, condenses in the gas phase, and is recovered as fine powder outside the fluidized bed. Until now, no reaction experiments have been conducted in a granular fluidized bed reactor in which the reactant changes from solid to liquid or gas. Therefore, in this study, as the first study of the reduction of zinc oxide using a granular fluidized bed, we investigated the amount of fines recovered, the chemical form of fine product particles, and the reaction form by temperature for each operating condition, The purpose is to clarify what kind of problems occur in this process.

In this study, the reduction volatilization behavior of zinc oxide was tested using the granular fluidized bed. **Fig. 1** shows the results of the amount of product fine particles scattered at that time. As a result, it can be seen that as the temperature increases, the reaction rate increases and the time until the reduction ends is shortened. In addition, at 5 wt%, the reduction was performed smoothly as the temperature increased, and the amount recovered in the cylindrical filter paper was also high. However, at 10 wt%, the amount recovered was higher at 800℃ than at 850℃. It is conceivable that the condensed zinc of the reduced zinc has increased as a cause of this, and the agglomerated zinc is clogged in the branch pipe. Therefore, it was found that reduction under 10 wt% is optimal under the experimental conditions. Further, at 700℃, condensation and adhesion did not occur in the quartz tube and the branch tube, and almost no reduction reaction occurred, so it was found that the reduction starting temperature was about 760℃.

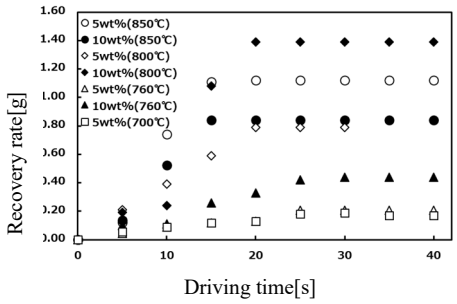

Fig. 1 Recovery ratio of product fine particles with time

Next, **Fig. 2** shows the particle size distribution of the recovered fine particles in the cylindrical filter paper at 5 wt%, U_{mf}, 50% H_2-50% N_2 at temperatures of 760℃, 800℃, and 850℃. From the results in Fig. 3, it was confirmed that the recovered product was recovered in the form of fine particles. It can also be seen that the average particle size of the recovered particles decreases with increasing temperature. The reason is that when the temperature rises, the ZnO oxide film is destroyed by the reduction reaction.

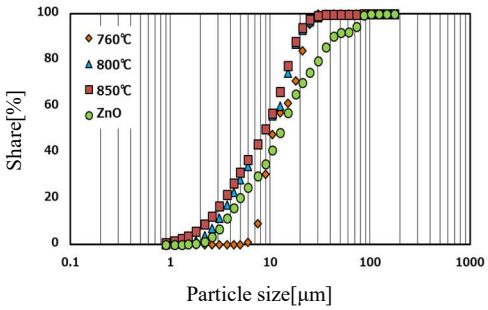

Fig. 2 Changes in particle size distribution of reactant ZnO powder and product powder after reduction in PPFB

References

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2) T. Nakazato; "Recent developments in fluidized bed technology (in Japanese)," *Ryudosogijutsuno Saikinno Shinten*, pp.33-41, Kagaku Kogyosha (2008)

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