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Fundamental Study on Mg Metal Production from Bittern Using Al Scrap

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Summary

Magnesium alloy is a promising material leading to the reduction of a greenhouse gas generation by the improvement of fuel economy of a transportation equipment. However, its wider use is restricted by the supply anxiety due to the exclusive possession on primary metal production by China, and by the total amount of exhausted CO_2 during its life cycle. In this study, the fundamental study to realize environment-friendly Mg metal production using domestic resource in Japan has been carried out based on our primary study supported by the Salt Science Research Foundation 2019 Research Grant (#1906). Some subjects on thermochemical reduction of MgO from bittern using Al metal scrap was studied, actually.

It was indicated from the investigation on the influence of CaO as auxiliary material that the stable by-product was $Ca_{12}Al_{14}O_{33}$, which suggests the necessary amount of CaO is about 60% of MgO in mole. Since the necessary amount was 100% of MgO in Si reduction, Al reduction has an advantage in the necessary CaO amount over Si reduction. It was shown that Mg metal was obtained by the reduction using Al sawdust, but that the reduction rate was lower than by using Al powder. Grinding of Al sawdust was effective to better the reduction rate, and reduction rate was improved by using fine powder obtained by grinding.

Mg metal was obtained even from the specimen containing $MgCl_2$, NaCl and $CaCl_2$. $MgCl_2$ and NaCl was co-deposited with Mg metal when these chlorides were added in MgO, whereas $CaCl_2$ was not seen in Mg metal deposit when $CaCl_2$ was added in MgO. The reduction rate became worse by the addition of $MgCl_2$ or NaCl in the specimen, whereas $CaCl_2$ addition did not deteriorate the reduction rate seriously. It was also investigated that CaF_2 and $CaCl_2$ worked as the so-called fusing agent; the reduction rate was improved by CaF_2 addition, but $Ca_{12}Al_{14}O_{32}F_2$ was formed as by-product instead of $Ca_{12}Al_{14}O_{33}$. It was shown that $CaCl_2$ seemed not to be effective as fusing agent.