

Synthesis of Trimethyl Borate from Barium Perborate with Nitric Acid as Leaching Agent

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Abstract—Borohydrides are promising materials for hydrogen storage, however, their dehydrogenation process via hydrolysis reaction generates aqueous solution with high boron concentration. Chemical oxo-precipitation process has been demonstrated to recover boron as barium perborate crystals from aqueous solution. In order to fulfill the cycle of borohydrides, this work developed a leaching esterification process to synthesize trimethyl borate (TMB), a precursor of NaBH_4 , from barium perborate crystal. Nitric acid was added as a leaching agent during the esterification reaction between barium perborate and methanol to promote the dissolution of boron by precipitation of barium nitrate. The dissolution ratio depended on the dosage of nitric acid, while the yield of TMB was affected by the levels of methanol and water. Under optimal conditions (barium perborate = 5 g, $[\text{HNO}_3]/[\text{Ba}] = 2$, $[\text{CH}_3\text{OH}]/[\text{B}] = 16$, esterification for 4 h and distillation for 1 h), 97.6% of boron was leached out and 77.7% of boron was converted to TMB.

Keywords—Trimethyl borate; Esterification; Leaching; Barium perborate; Barium nitrate