Methodology To Produce Hard Coherent Water Adsorbent Using Modified Fusion Method

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INTRODUCTION

Ethanol or bioethanol is recognized as alternatives to fossil fuel. This biofuel offer potential environmental benefits such as reduced toxic gas and lower greenhouse emissions (Walls et al., 2011). It can be produced from renewable sources and can be used without engine modification when blended with gasoline (Padala et al., 2012). In order to be blended with gasoline to produce gasohol, the ethanol must be anhydrous (Pereira et al., 2012). Conventional distillation process is able to purify ethanol-water mixture up to 89.4 % mol ethanol due to the formation of minimum boiling point azeotrope composition of 89.4 % mol ethanol and 10.6 % mol water at 2012). In order to be blended with gasoline to produce gasohol, the ethanol must be anhydrous (Pereira et al., 2012). Conventional distillation process is able to purify ethanol-water mixture up to 89.4 % mol ethanol due to the formation of minimum boiling point azeotrope composition of 89.4 % mol ethanol and 10.6 % mol water at 78.2 °C and atmospheric pressure. Various ways have been used to produce anhydrous ethanol such as azeotropic distillation, extractive distillation, vacuum distillation, adsorption processes, membrane processes etc (Kumar et al., 2010).

One of the attractive methods was adsorption using water adsorbent. It was claimed that adsorption was one of the technique that used less energy (Simo et al., 2007; Huang and Chang, 2009). There were varieties of methodology to produce water adsorbent especially zeolite A from various silica and alumina sources.

Haden et al. (1961), described the method for making hard and coherent zeolite A from kaolin, Al₂O₃·2SiO₂·(2-4)H₂O. To produce zeolite A, the ratio of silica to alumina should be 1.177 (±0.030) by weight. This ratio can be adjusted by additional source of alumina or silica in clay-alkali mixture. The clay must be dehydrated by calcination at a temperature of about 427 -871°C, preferably at 649 – 816°C.Calcination below 427°C is not sufficient and nullite is formed when the temperature exceeding 871°C. According to this patent, the amount of alkali to be used is in stoichiometry:

\[ 2\text{NaOH} + \text{Al}_2\text{O}_3·2\text{SiO}_2 → \text{Na}_2\text{O·Al}_2\text{O}_3·2\text{SiO}_2·\text{H}_2\text{O} \]

Sodium hydroxide or potassium hydroxide or mixture of both can be used as the alkali source. The range of alkali aqueous concentration should be around 30 – 50%, preferably at 40 – 50%. Low concentration yield fine powder or soft aggregate. Excess of alkali should be washed before crystallization takes place. It was reported that no zeolite A is formed when 50% weigh excess of NaOH was used. The alkali-clay mixture can be mechanically shaped by extrusion, milling, molding etc. Later, the reaction between clay and alkali is carried out at low temperature, 21°C – 46°C, preferably at 38°C to avoid the formation of sodalite at 52°C.