A kinetic study of gaseous potassium capture by coal minerals in a high temperature fixed-bed reactor - DTU Orbit (09/12/2018)

A kinetic study of gaseous potassium capture by coal minerals in a high temperature fixed-bed reactor

The reactions between gaseous potassium chloride and coal minerals were investigated in a lab-scale high temperature fixed-bed reactor using single sorbent pellets. The applied coal minerals included kaolin, mullite, silica, alumina, bituminous coal ash, and lignite coal ash that were formed into long cylindrical pellets. Kaolin and bituminous coal ash that both have significant amounts of Si and Al show superior potassium capture characteristics. Experimental results show that capture of potassium by kaolin is independent of the gas oxygen content. Kaolin releases water and forms metakaolin when heated at temperatures above 450°C. The amounts of potassium captured by metakaolin pellet decreases with increasing reaction temperature in the range of 900-1300°C and increases again with further increasing the temperature up to 1500°C. There is no reaction of pre-made mullite with KCl at temperatures below 1300°C. However, the weight gain by mullite is only slightly smaller than that by kaolin in the temperature range of 1300-1500°C. A simple model was developed for the gas-solid reaction between potassium vapor and metakaolin pellet at 900°C.

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