Release and transformation of chlorine and potassium during pyrolysis of KCl doped biomass

The formation of CH$_3$Cl and the transformation of chlorine and potassium during pyrolysis of biomass were investigated. Model biomass compounds (cellulose, xylan, lignin and pectin) and pine wood doped with KCl were pyrolysed in a TGA at different heating rates (10–1000 °C/min), temperatures (300–850 °C), and KCl contents (0–5 wt%). The volatiles were collected and analyzed for CH$_3$Cl concentration by GC–MS. The solid residue was analyzed by ICP-OES for the contents of total and water soluble K and Cl. Considerable amounts of CH$_3$Cl, corresponding to 20–50% of the fuel chlorine, were formed in pyrolysis of KCl doped pine wood, lignin and pectin samples, suggesting a methylation ability of these biomass on KCl by their methoxyl groups. Lignin and pine wood could supply methoxyl groups for reaction with as much as about 2% KCl doping, and pectin had an even greater capacity. Organic K was found in the solid residue of all samples, further supporting the occurrence of reactions between KCl and the organic matrix in biomass. With a holding temperature of 500 °C, an increase of heating rate from 10 °C/min to 500 °C/min significantly reduced the yield of CH$_3$Cl from KCl doped wood/lignin/pectin, while no further reduction effect was observed at 1000 °C/min. For a heating rate of 500 °C/min, an increase of holding temperature from 300 °C to 850 °C caused a decreased yield of CH$_3$Cl.