

Study on Pyrolysis of Sludge and Waste Mixtures from the Paper Industry

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ABSTRACT

The pyrolysis of the sludge and waste from the paper industry was investigated in this study. The pyrolysis products were analyzed to evaluate the probability for resources recycling as a chemical and gas-liquid fuels. The contents in this study include establishment of the pyrolysis model as well as analyzing the pyrolysis products and the distributions of the product concentration. For the kinetic analyzes, the thermogravimetric analysis experiments were performed at the heating rates of 2, 5 and 10 K/min. The results indicated that the pyrolysis of sludge in nitrogen environment is a three-stage reaction, which can be expressed as followings. $dX=0.42dX_1/dt+0.38dX_2/dt+0.2dX_3/dt$ $dX_1/dt=9.17 \times 10^{13} \exp(-40.33/(RT))(1-X_1)^{7.04}$ $dX_2/dt=1.86 \times 10^{11} \exp(-36.47/(RT))(1-X_2)^{6.76}$ $dX_3/dt=3.33 \times 10^{10} \exp(-52.57/(RT))(1-X_3)^{0.48}$ Under the heating rates of 2, 5 and 10 K/min, the total rate equations of waste mixtures pyrolysis (including sludge and not including sludge) in N₂ environment can be expressed the sum of the individual rate equations according to the mass percentages of it. The coefficients of determination were 0.997, 0.997 and 0.994 for pyrolysis of waste mixtures (including sludge), and 0.996, 0.997, and 0.996 for pyrolysis of waste mixtures (not including sludge), respectively. For the products analysis, the percentages of solid, liquid, and gases products were obtained for sludge and waste mixtures (including sludge and not including sludge) pyrolysis at constant temperature. The results also indicated that the solid residues reduced as the pyrolysis temperature increased. The total amount of liquid products increased as the pyrolysis temperature increased. But it is not obvious. The total amount of gases products increased significantly with the pyrolysis temperature increased. H₂, CO, CO₂, CH₄, C₂H₄ were main species in the gases products. The maximum concentration of hydrocarbons 2959 ppm for waste mixture (not including sludge) pyrolysis reaction. The calorific values of solid residues were to present a positive relationship to the content of fixed carbon. The percent recoveries were above 85% for pyrolysis of the sludge and waste from the paper industry.

Keywords : paper industry ; mix waste ; pyrolysis ; sludge

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