

FEATURES OF TEMPERATURE CONVERSION OF PYROLYSIS PRODUCTS OF POLYPROPYLENE AND AUTOMOBILE TIRES

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Abstract: Based on the available experimental data on the pyrolysis of polypropylene (PP) and automobile tires (AT), a numerical simulation of the conversion of their direct gas-phase products to hydrocarbons up to C₅ inclusive was performed. The calculations were carried out for constant initial atmospheric pressure and for the temperature range from 600 to 900 K. Numerical modeling of the kinetics of the process showed that different detailed kinetic mechanisms (DKM) predict similar qualitative features of the conversion of pyrolysis products of PP and AT. However, calculations showed that the temperature at which the conversion occurs differs significantly in different DKM. In course of the conversion of pyrolysis products of PP and AT, the fraction of methane and molecular hydrogen is increased and the main source of molecular hydrogen is the conversion of C₄ and C₅ hydrocarbons. With an increase in the initial temperature, the conversion of PP pyrolysis products proceeds smoothly, while during AT pyrolysis, a significant induction period and a subsequent sharp, explosion-like rise of the temperature were detected.

Keywords: pyrolysis; recycling; polypropylene; automobile tires; gasification products; conversion of pyrolysis products; numerical modeling; chemical kinetics; detailed kinetic mechanism

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Figure Captions

Figure 1 Time profiles of the concentration change of the initial polypropylene pyrolysis products at $T_0 = 900$ K and $P = 1$ atm for mixture 1, simulation results by the HAL-00772058 DKM [21]: 1 – H₂; 2 – CH₄; 3 – C₂H₄; 4 – C₂H₆; 5 – C₃H₆; 6 – C₃H₈; 7 – iso-C₄H₈; and 8 – C₅H₁₀

Figure 2 Time profiles of the concentration change of the initial polypropylene pyrolysis products for mixture 1 (a) and initial pyrolysis products of waste tyres for mixture 2 (b) at $T_0 = 800$ K and $P = 1$ atm, simulation results by the CRECK DKM [20]: 1 – H₂; 2 – CH₄; 3 – C₂H₄; 4 – C₂H₆; 5 – C₃H₆; 6 – C₃H₈; 7 – iso-C₄H₈; and 8 – C₅H₁₀

Figure 3 Time profiles of the concentration change of the initial pyrolysis products of waste tyres at $T_0 = 800$ K and $P = 1$ atm for mixture 2, simulation results by the HAL-00772058 DKM [21] (a) and DKM [22] (b): 1 – H₂; 2 – CH₄; 3 – C₂H₄; 4 – C₂H₆; 5 – C₃H₆; 6 – C₃H₈; 7 – iso-C₄H₈; and 8 – C₅H₁₀

Figure 4 Time profiles of the temperature changes during the conversion of the initial pyrolysis products of waste tyres for mixture 2 (a) and initial polypropylene pyrolysis products for mixture 1 (b), simulation results by CRECK DKM [20]: 1 – $T_0 = 600$ K; 2 – 700; 3 – 800; and 4 – $T_0 = 900$ K

Table Caption

Gas composition from the pyrolysis of polypropylene and waste tyres (% , mole fraction)

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