COPYROLYSIS OF DIMETHYL ETHER AND ETHANE UNDER PULSED ADIABATIC COMPRESSION

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Abstract: The copyrolysis of dimethyl ether (DME) and ethane has been studied in a rapid compression machine with free flied piston over a range of temperature 970–1666 K and the degree of conversion 0.26%–96.1%. The main (hydrogen, CO, methane, ethylene, formaldehyde, and acetylene) and secondary reaction products were determined. Among them, methanol, acetaldehyde, ethanol, and methoxyethane were identified from oxygenates. The composition of the mixture of products qualitatively corresponds to the products of DME pyrolysis and DME/CH_4 copyrolysis, but significantly differs in the yield of hydrocarbons. The addition of ethane to DME (DME/C_2H_6 = 2.5/2.0 %(vol.)/%(vol.)) leads to a decrease in the degree of conversion of DME, especially at low and moderate degrees of conversion. Soot formation was detected when DME was heated to a maximum temperature of 1666 K with a conversion rate of more than 96%.

Keywords: dimethyl ether (DME); ethane; pyrolysis; rapid compression machine (RCM); formaldehyde; ethylene; acetylene; propylene

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Figure Captions

Figure 1 Dependences of the maximum temperature (*1*) and pressure (*2*) on the compression ratio

Figure 2 Dependence of the conversion degree of DME (*1*), C_2H_6 (*2*) and total conversion (*3*), residual content of DME (*4*) and C_2H_6 (*5*), and pyrolysis product yields on the maximum compression ratio ε_{max}: *6* — CO; *7* — C_2H_4; *8* — CH_4; *9* — sum of formaldehyde and unidentified oxygen-containing products; *10* — H_2; *11* — C_2H_2; *12* — C_6H_6; *13* — methanol; *14* — acetaldehyde; *15* — methoxyethane; *16* — ethanol; *17* — 1,3-butadiene; *18* — C_3H_6; *19* — C_3H_8; *20* — vinylacetylene; *21* — sum of C_{7+} hydrocarbons (except for toluene); *22* — methylacetylene; *23* — toluene; *24* — sum of C_5 hydrocarbons; *25* — allene; *26* — *n*-butane; *27* — sum of but-1-ene and isobutene; *28* — sum of *trans*-but-2-ene and *cis*-but-2-ene; *29* — diacetylene; *30* — sum of C_6 hydrocarbons (except C_6H_6); *31* — unidentified compound; *32* — but-2-yne; and *33* — but-1-yne

Figure 3 Selectivity of the main products of DME and ethane copyrolysis: *1* — H_2; *2* — CH_4; *3* — CO; *4* — C_2H_4; and *5* — sum of formaldehyde and unidentified oxygen-containing products

Figure 4 Dependence of the conversion degree of DME on the maximum temperature. Compositions of initial mixtures (%(vol.)): *1* — DME 2.5, C_2H_6 2.0, Ar 95.5; *2* — DME 2.4, CH_4 2.4, H_2 0.6, Ar 94.6 [20]; and *3* — DME 2.3, H_2 0.7, Ar 97.0 [19]

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