

#### 17.4 **Isothermal and Non-isothermal Kinetic Analyses of Mahogany Oil Shale with TGA**

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Production of oil from oil shale can be a viable alternative approach to compensate for the fast depleting sources of conventional petroleum. The organic part in oil shale, namely, kerogen, undergoes chemical decomposition on thermal heating or pyrolysis producing an oil-like liquid substance that can be used to produce transportation fuels. The yield and quality of products depend on the source material; geological origin, organic contents and constituents, and on reaction conditions; retorting temperature, pressure, and reaction time. It is important to understand the rate at which the chemical transformation takes place, so that appropriate kinetic models can be developed and used to study in reservoir simulators or in process models for retorting the shale at the surface. In this paper, we provide new kinetic data on the decomposition of Green River shale from the Uinta Basin in Utah.

Crushed Mahogany oil shale (100 mesh) was used in this study. Thermo-gravimetric analyses were carried out by using thermal gravimetric analyzer (TGA, TA instruments Q500). Comprehensive isothermal and non-isothermal kinetic studies were carried out. Isothermal kinetics were examined between temperatures of 300-600°C while heating rates of 0.5 to 50°C/min were used in the non-isothermal studies. Reactions were carried out both in nitrogen and air environments. Weight loss and derivative of weight loss data obtained from TGA were analyzed in detail. These characteristic signatures were similar to the TGA signatures for other shale types reported in the literature; however, some distinct differences were observed. Various mathematical approaches were used to determine first-order kinetic parameters; activation energy ( $E_a$ ) and frequency factor ( $A$ ). Kinetic parameters for experiments in nitrogen and air environments are provided in the paper. For example, in isothermal analyses, the values of  $E_a$  and  $A$  obtained were, 134.8 (KJ/mol) and  $1.2E+09$  ( $\text{min}^{-1}$ ) respectively in the nitrogen environment, and 100.5 (KJ/mol) and  $5.1E+07$  ( $\text{min}^{-1}$ ) respectively in the air environment. These values were consistent with the values reported for other shale types. For non-isothermal experiments, the kinetic data were derived by four different methods, namely, direct Arrhenius plot, integral method, Friedman approach and the maximum rate method. The tradeoff between activation energy and frequency factor and the combined use of non-isothermal and isothermal TGA measurements were also considered. A theory of decomposition emerged from these analyses.