Thermodynamics and kinetic analysis of oil shale pyrolysis using isoconversional methods

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Introduction

Production of shale oil by pyrolysis of Ellajun oil shale (Jordan) was investigated at nonisothermal conditions in a retort. Knowledge of thermodynamics and pyrolysis kinetics are of great importance for the design and simulation of reactors in order to establish the optimum process conditions. The experimental runs were conducted at heating rates between 1 and 50 °C min^{-1} using a thermogravimetric analyzer. The activation energy values as a function of the extent of conversion for the oil shale pyrolysis process have been calculated using Friedman, KAS and Flynn procedures. A kinetic model was developed which assumed a Gaussian form. We observed a good comparison between the experimental results and the Gaussian model.

Objectives

1. To understand and predict the yield and quality of the product generated by pyrolysis of oil shale
2. To determine the activation energy using isoconversional methods
3. To determine the variability in kinetic parameters.
4. Develop unified kinetic model
5. Validate Model with Experimental data

Methods

- Oil shale samples investigated in this work were obtained from Ellajun area located in the southern region of Jordan.
- The original oil shale samples were ground in a ball mill and sieved to particle size 0.5–2.1 mm.
- The size selection was based on diffusional influence and mass transfer studies.
- All samples were dried in oven at 110 °C ± 3 for a period of 10–12 hours.
- All experiments were conducted in a stainless-steel fixed-bed retort.
- Five hundred grams of oil shale sample were electrically heated in an 800-cm3 cylindrical retort. Reactor and furnace temperatures were controlled to obtain the desired retorting temperature.
- Sweep gas was introduced from the top of the retort . Fig. 1

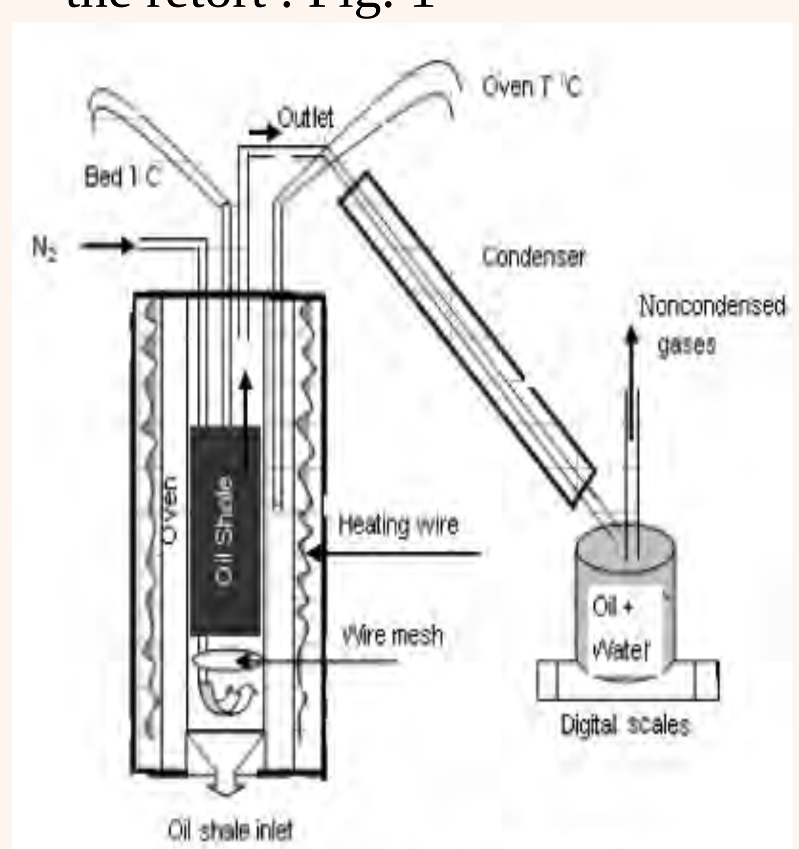
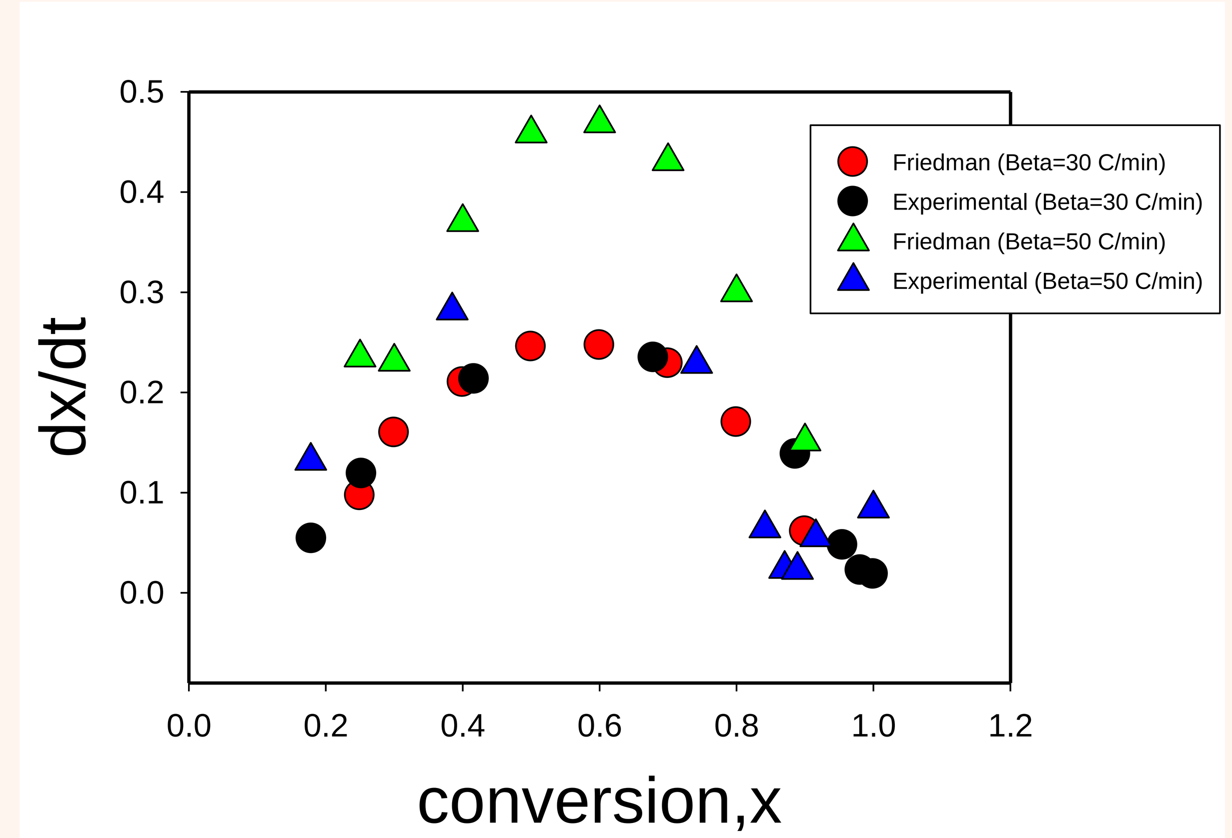


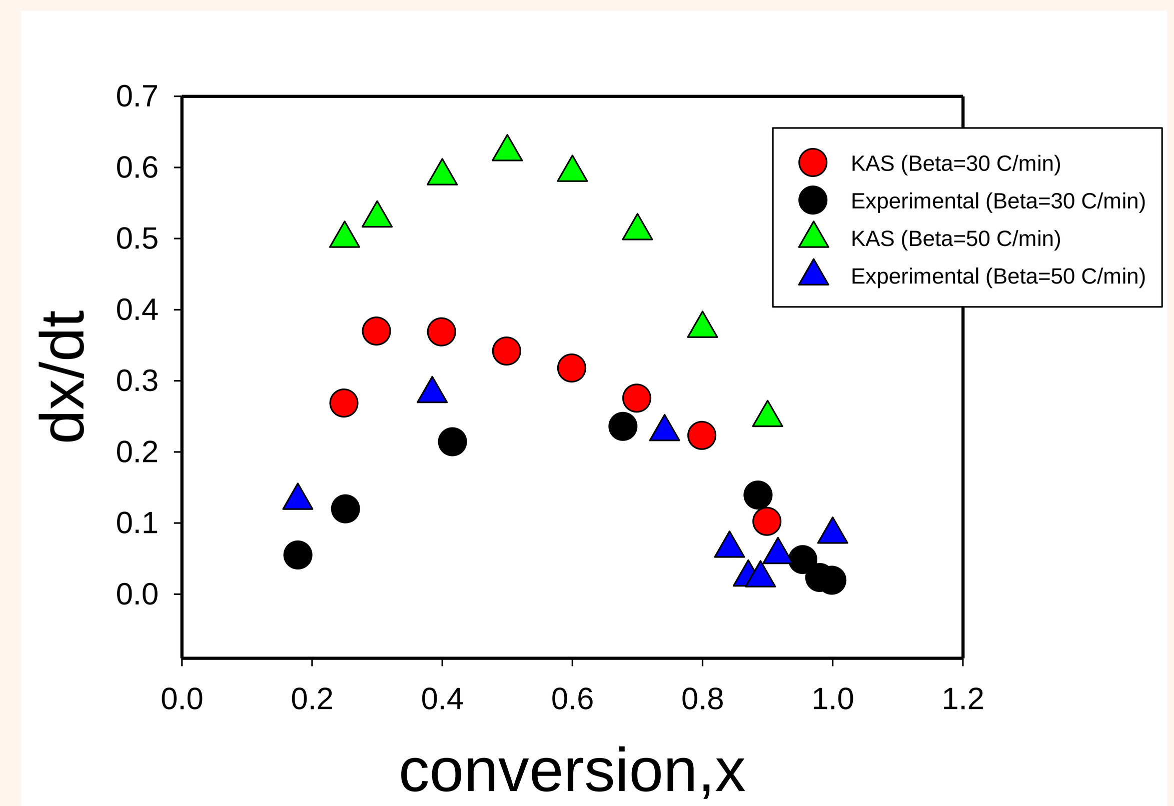
Fig. 1. Diagram of experimental setup.

Results

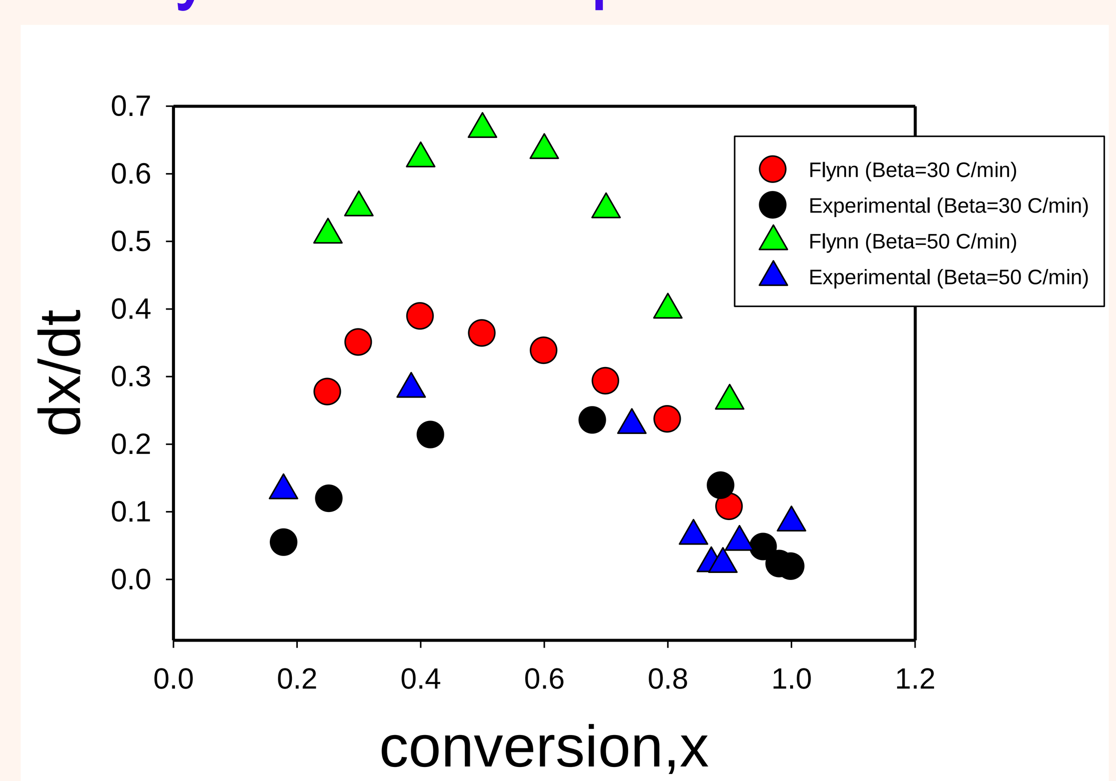
1. Friedman versus Experimental



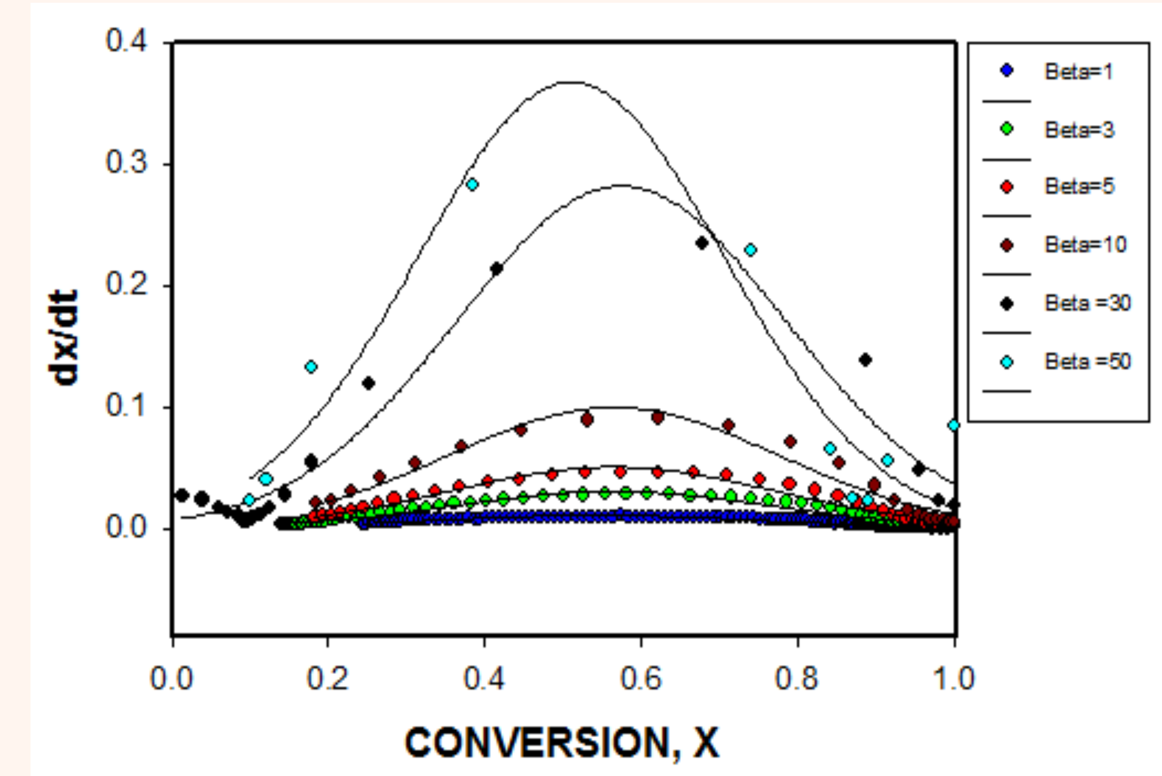
2. KAS versus Experimental

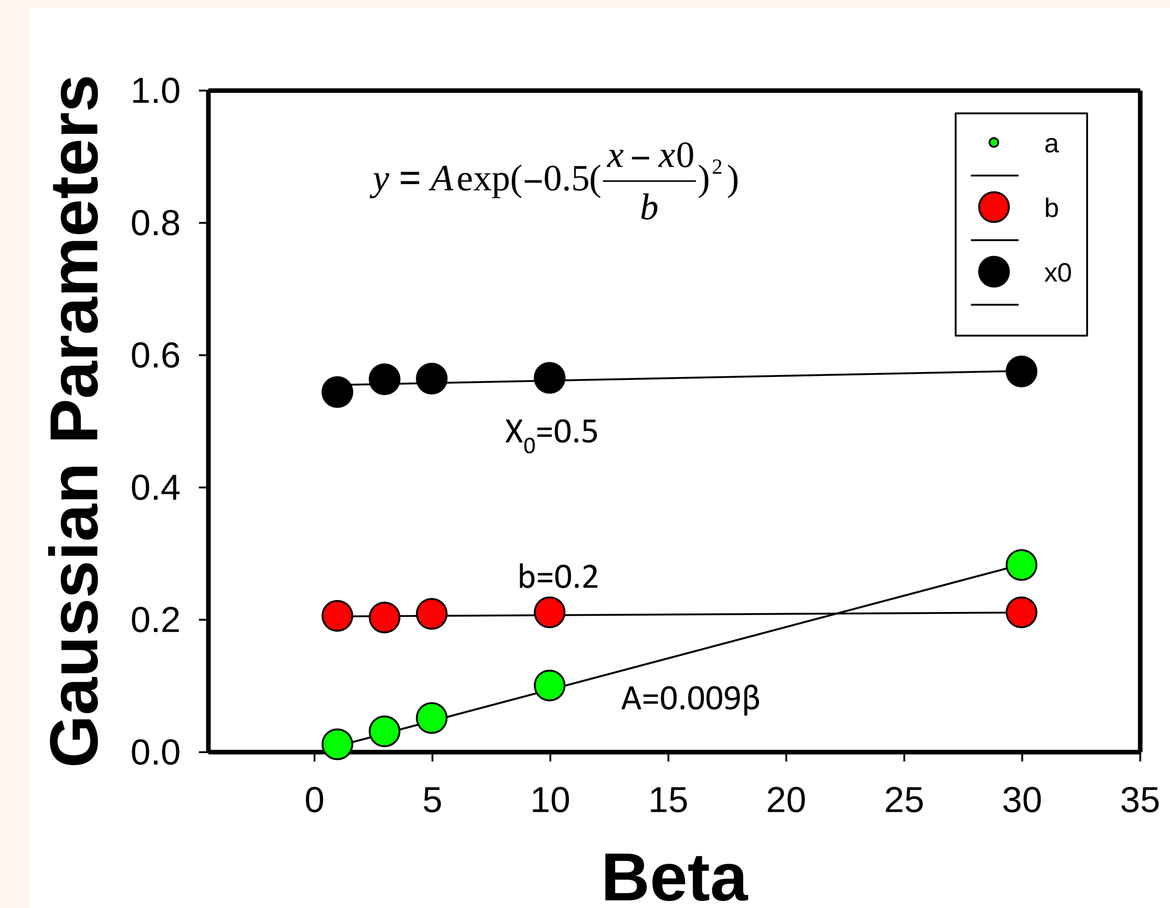


3. Flynn versus Experimental



4. Gaussian Models





Conclusion

On comparing with experimental results, We conclude that the Gaussian Model gives better agreements than other models

Acknowledgements

Special Thank go to 32nd Oil Shale Symposium