Heating Rate Effect on Shale Oil in Fixed Bed Reactor

Dr. Omar S. Al-Ayed
Al-Balqa Applied University
Faculty of Engineering Technology
Department of Chemical Engineering
P.O. Box 15008 Marka 11134
Amman Jordan
E-mails: osalayed@fet.edu.jo

INTRODUCTION

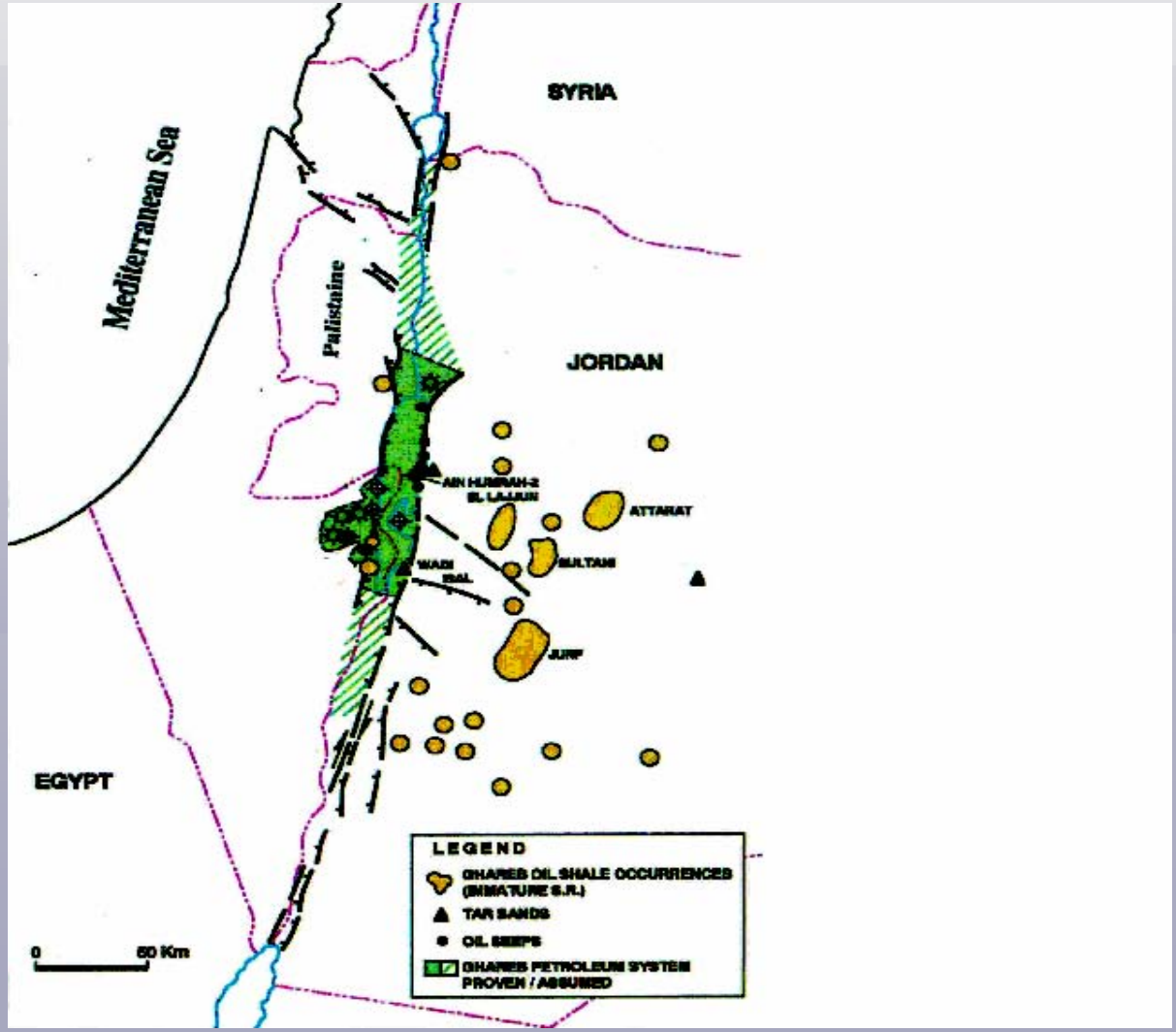
- To investigate effect of heating rate on

1. Weight loss
2. Oil yield
3. Physical property (Density) of shale oil

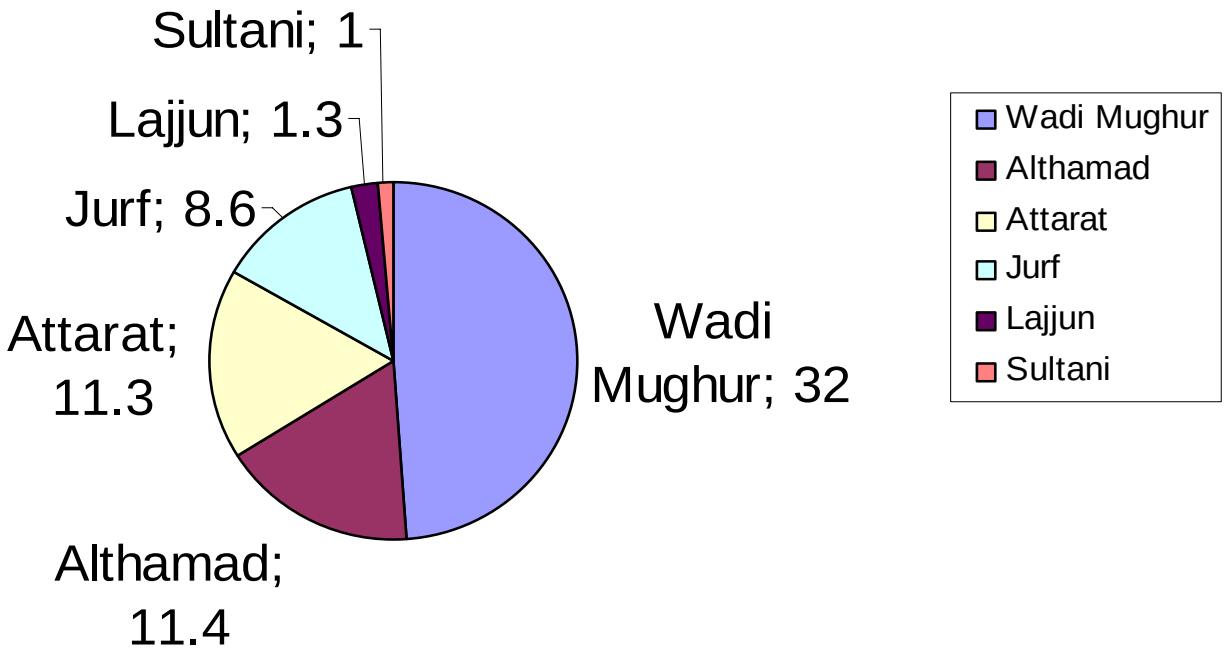
AND EFFECT OF TEMPERATURE ON

1. Sulfur content of shale oil (using XRF)

OIL SHALE LOCATIONS IN JORDAN



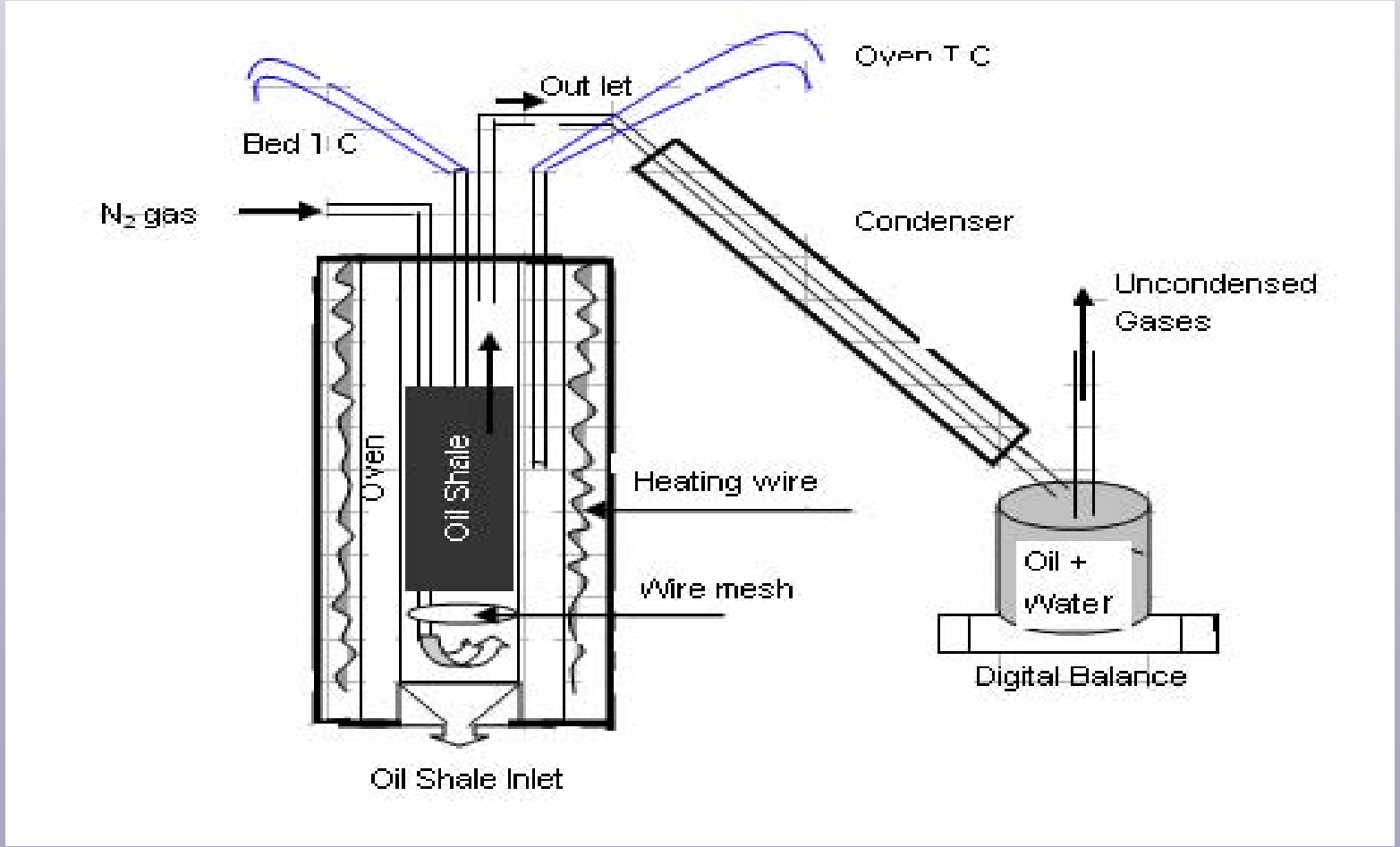
Oil Shale Deposits in Jordan (Bilion Tons)



EXPERIMENTAL

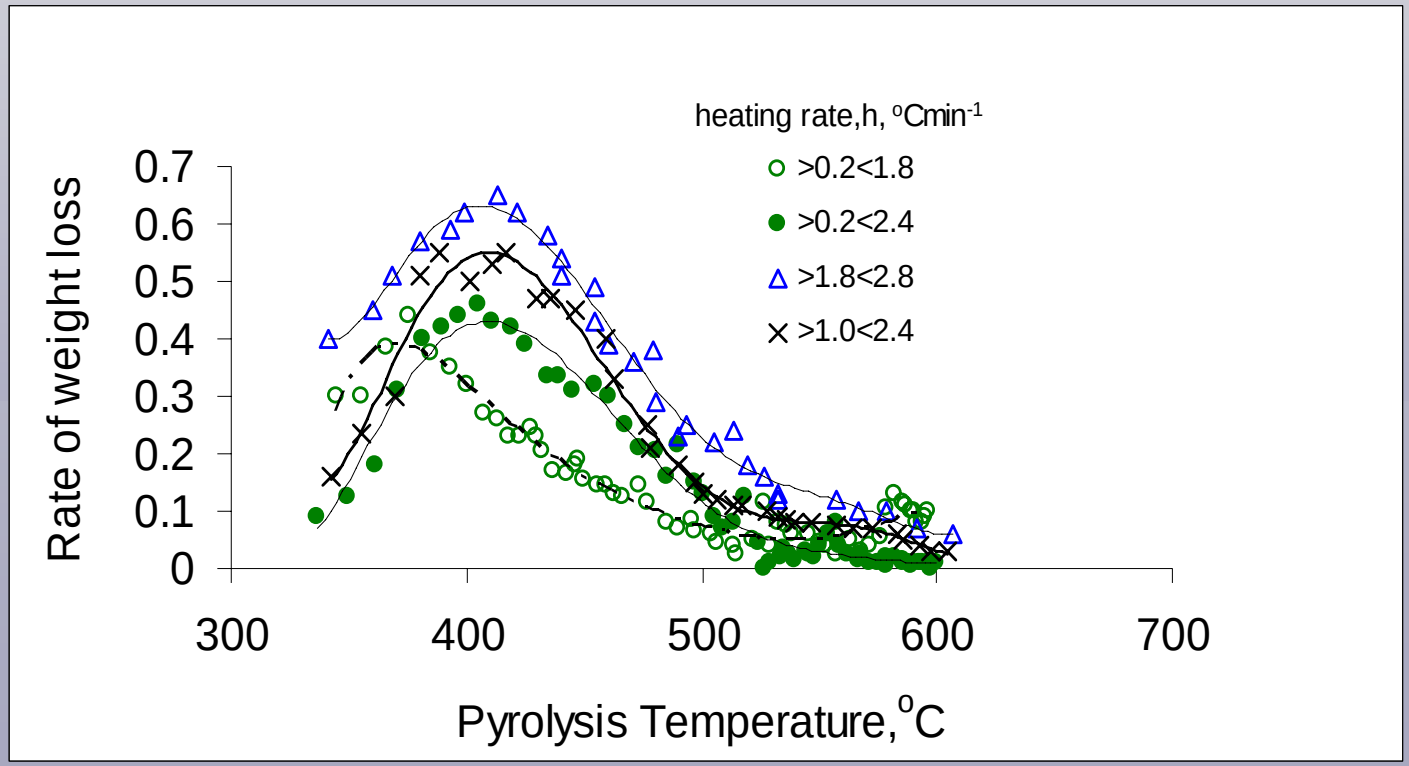
- 610 – 873 K temperature range
- 0.5 – 2.1 mm particle diameter
- Atmospheric pressure
- Nitrogen sweeping gas
- 500 gram in stainless steel retort
- Oil Shale, El-ajune site, Jordan
- 0.2- 13 $^{o}Cmin^{-1}$ (h) Heating rate

Setup

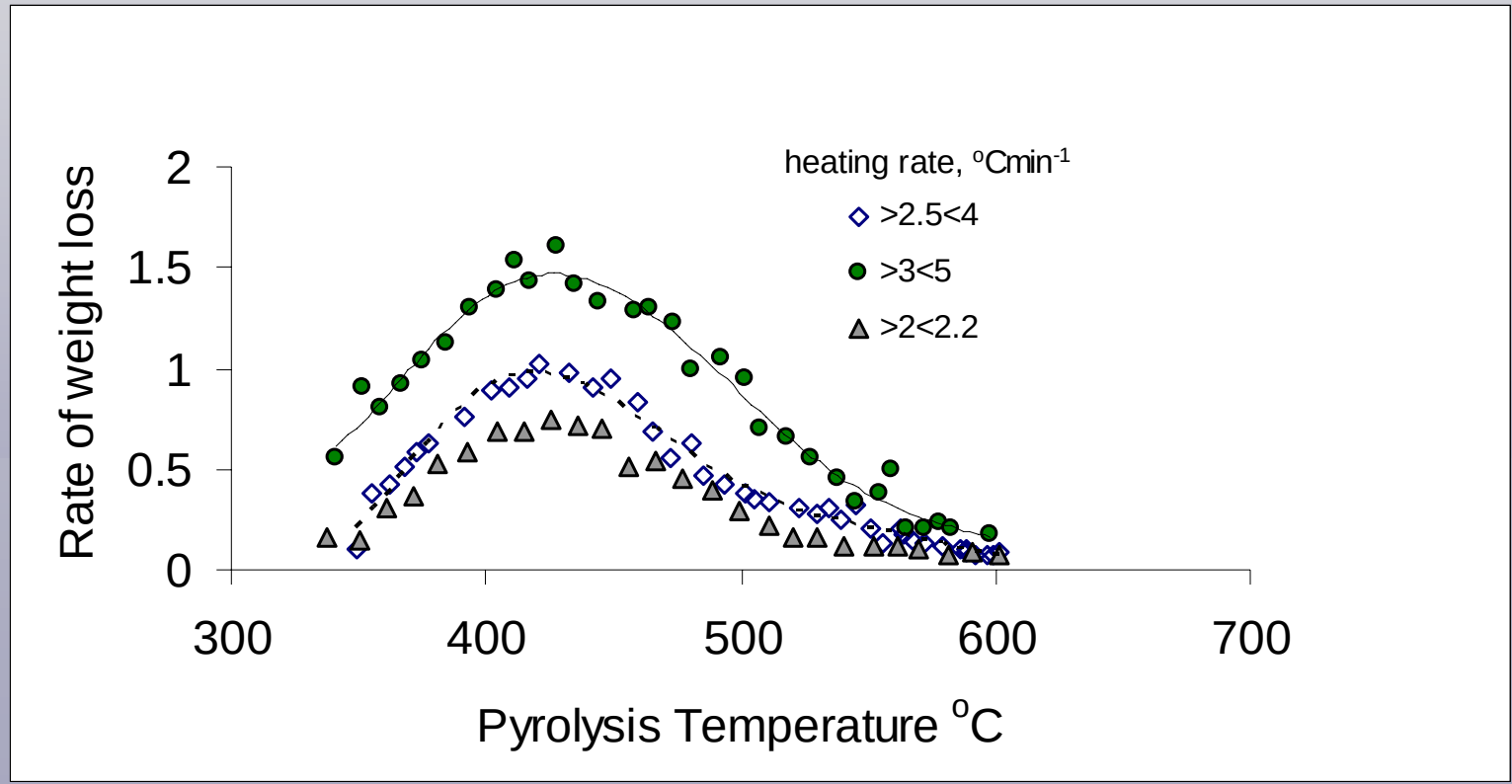

Oven T C
Out let
Bed T C
N_2 gas
Condenser
Uncondensed Gases
Oven
Oil Shale
Heating wire
Wire mesh
Oil + Water
Digital Balance
Oil Shale Inlet

Rate of Weight Loss Measurement

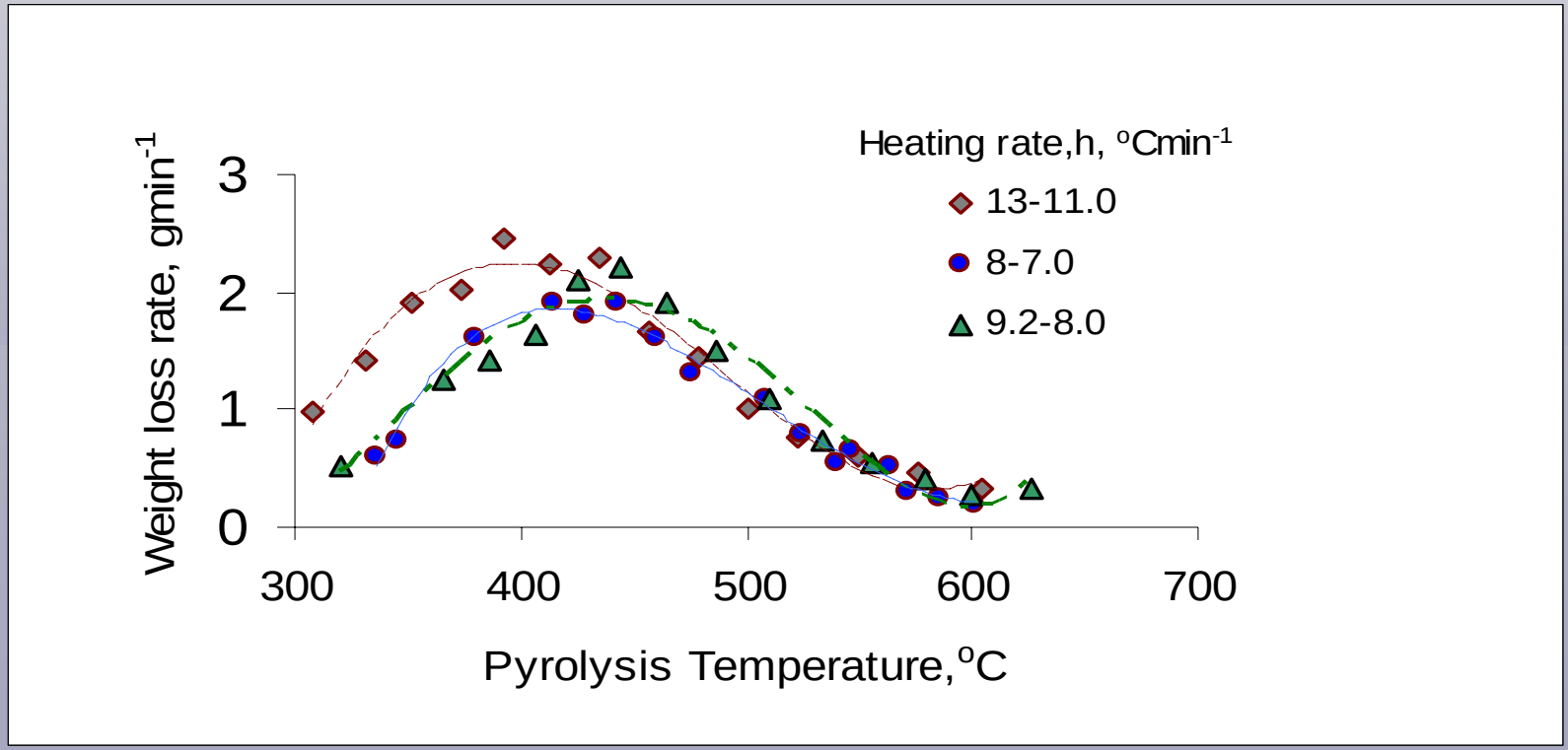
- Low heating rate : 0.1 - 2.8 $^{o}Cmin^{-1}$



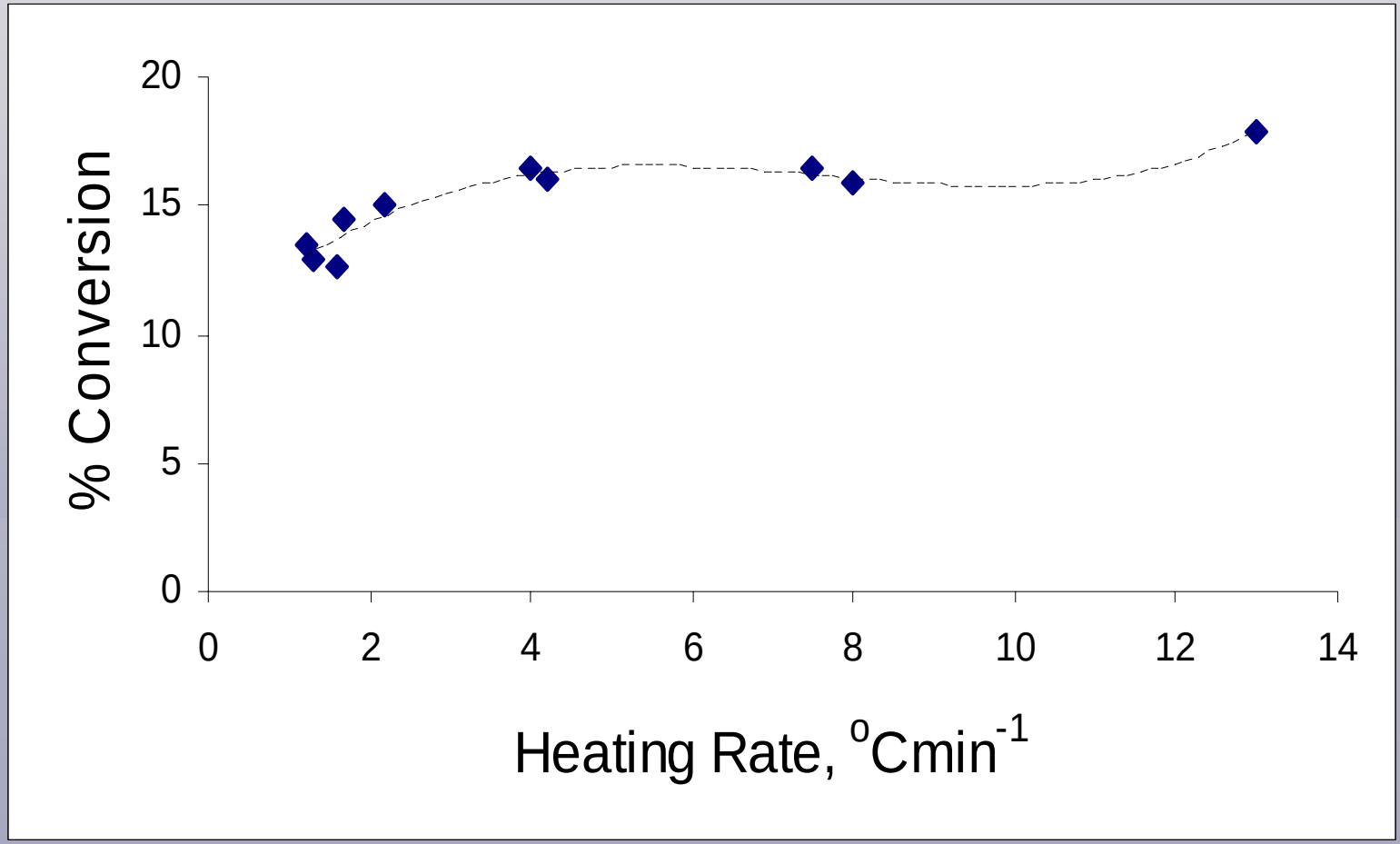
- Intermediate heating rate: 2.2 - 5 $^{o}Cmin^{-1}$



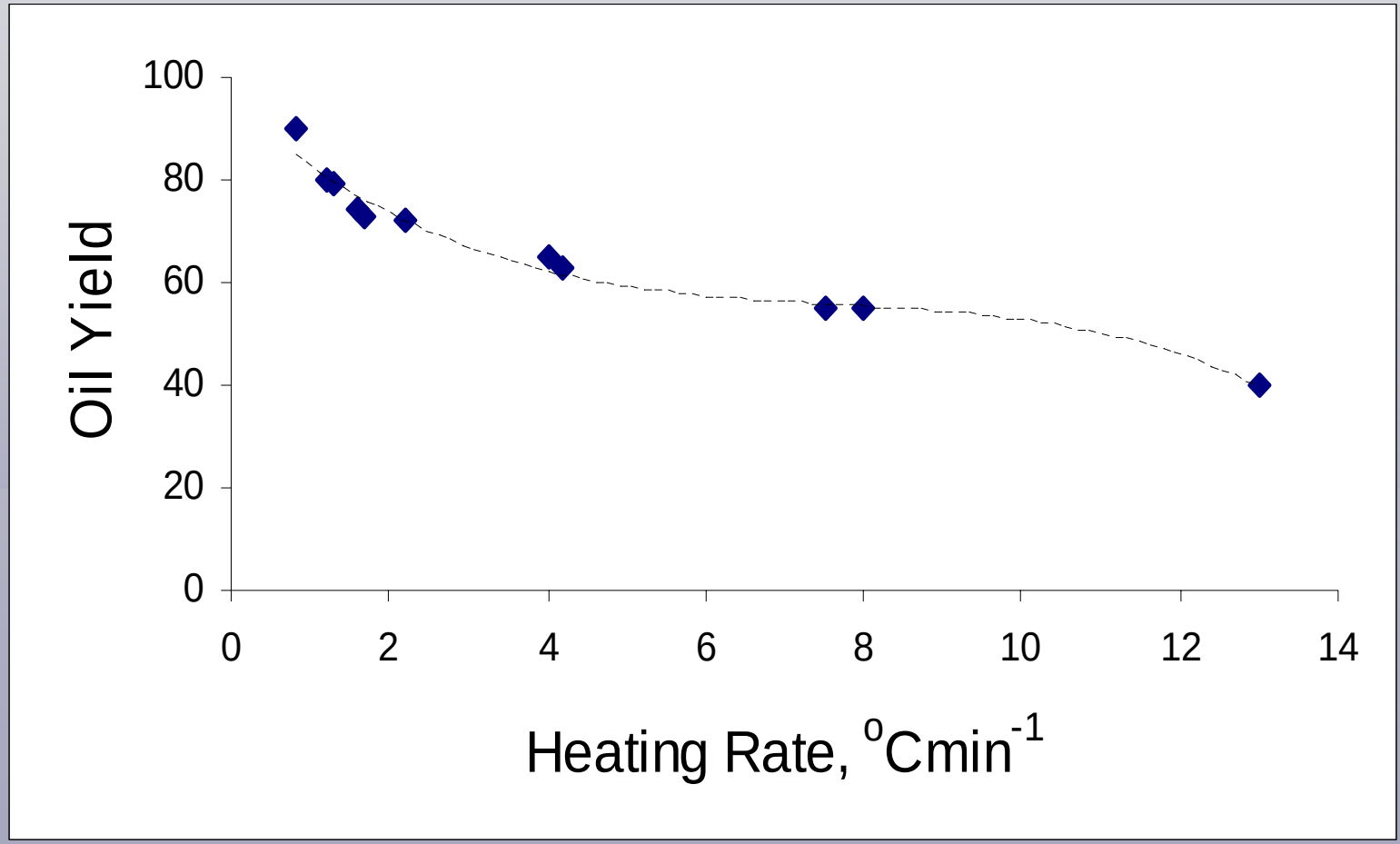
- Heating rate 7.0 ≥ ***h*** ≤ 13.0 resulted in the highest rate of weight loss



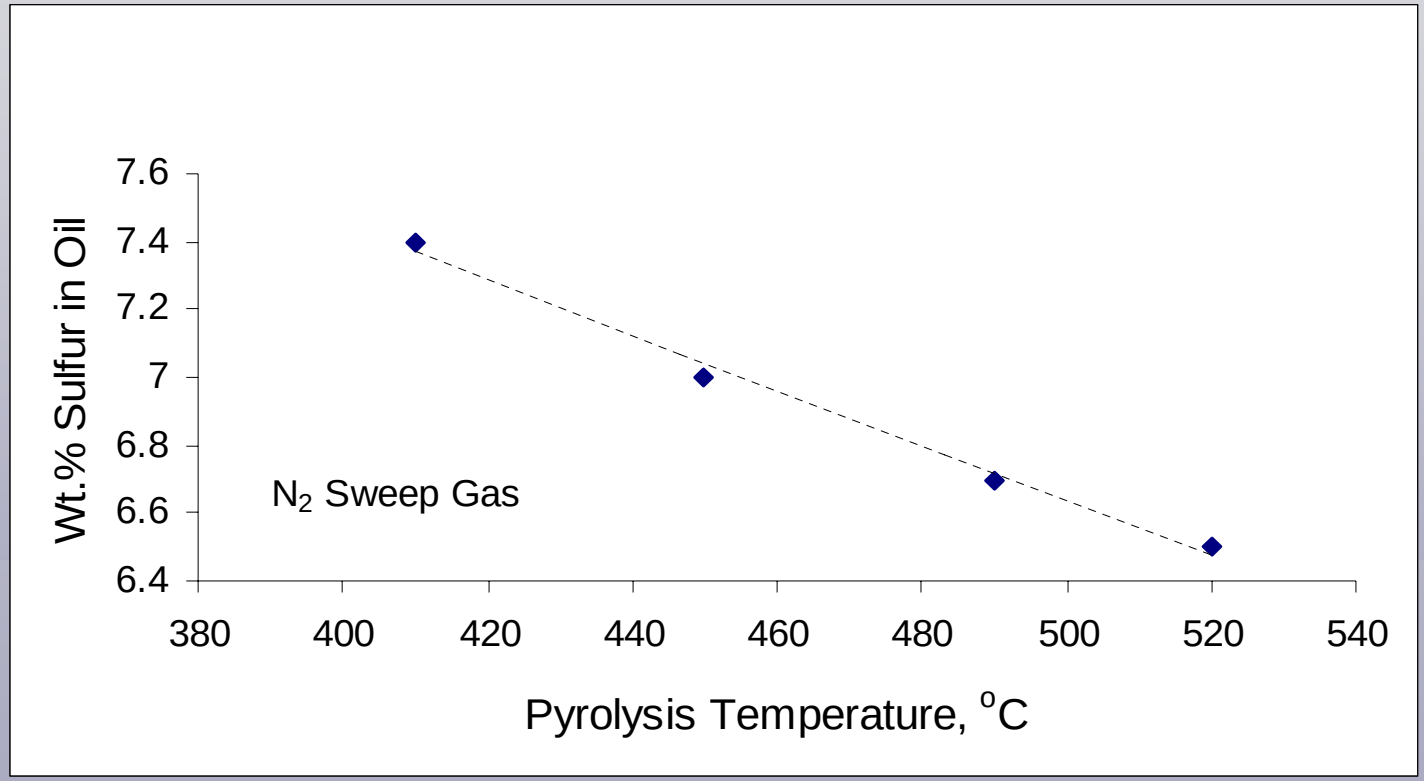
Conversion and $^{o}Cmin^{-1}$



Oil Yield and Heating Rate

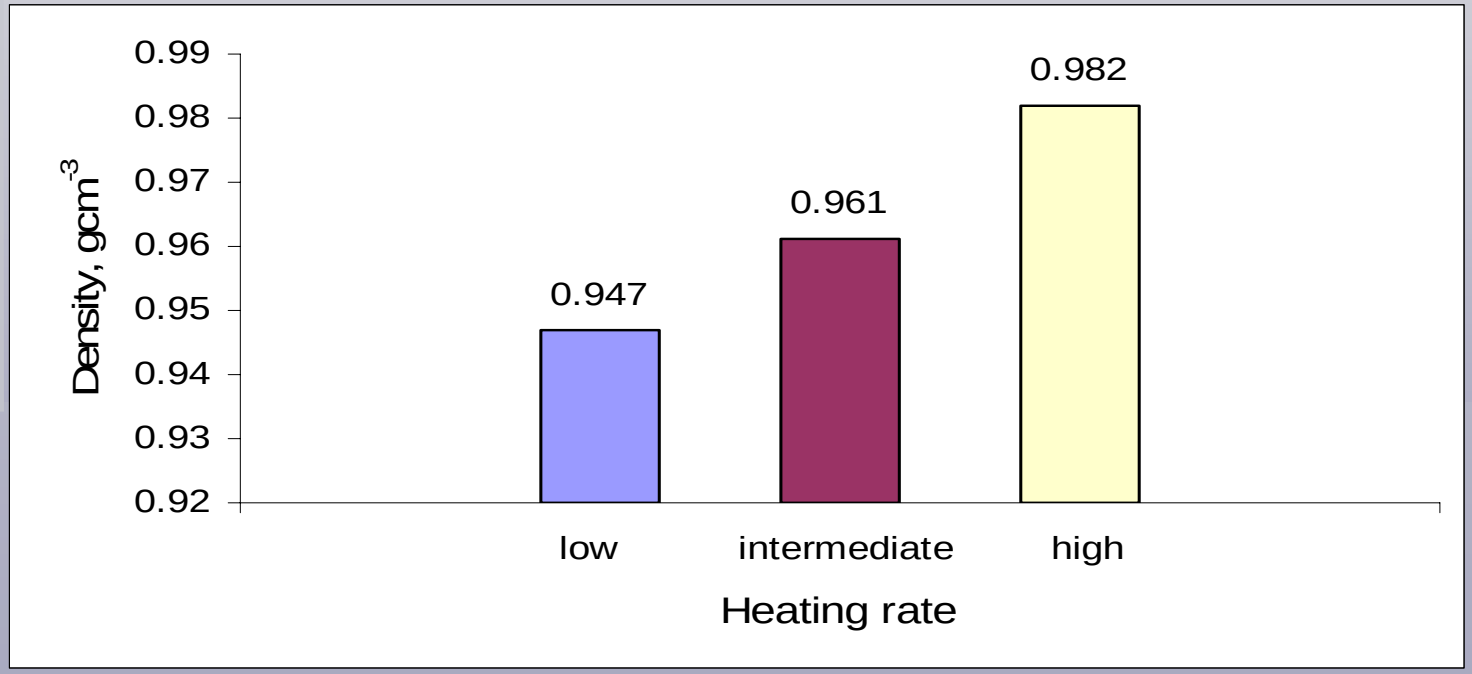


PYROLYSIS TEMPERATURE AND SULFUR



PHYSICAL PROPERTY, DENSITY

- IS A MEASURE OF NATURE OF COMPOUNDS



CONCLUSIONS

- The heating rates has shown a direct impact on the rate of weight loss of samples. The results has demonstrated unequivocally that increasing heating rate, increases the rate of weight loss in the studied range of heating rates. A maximum magnitude of the heating rate was observed for all heating rates although the corresponding pyrolysis temperature was different. Generally, higher is the heating rate, the higher is the temperature at which the maximum weight loss rate occurs. In the studied range of temperature, the maximum investigated temperature was 873 K; the effective range of hydrocarbon evolution is less than 773K. Oil yield was also a function of the heating rate. Increasing the magnitude of the heating rate decreased the oil selectivity. A steady decrease was observed for oil yield with increasing the heating rate in the studied range. On the other hand, increasing **h,** increases the density of the produced shale oil, while increasing pyrolysis temperature decreases sulfur content shale oil.

THANK YOU ALL

- GRATITUDE TO ORGANIZING COMMITTEE OF THE 26TH OIL SHALE SYMPOSIUM