

Effect of Oil Shale Particle Size on Oil Yield, Sulfur and Distillation Fractions

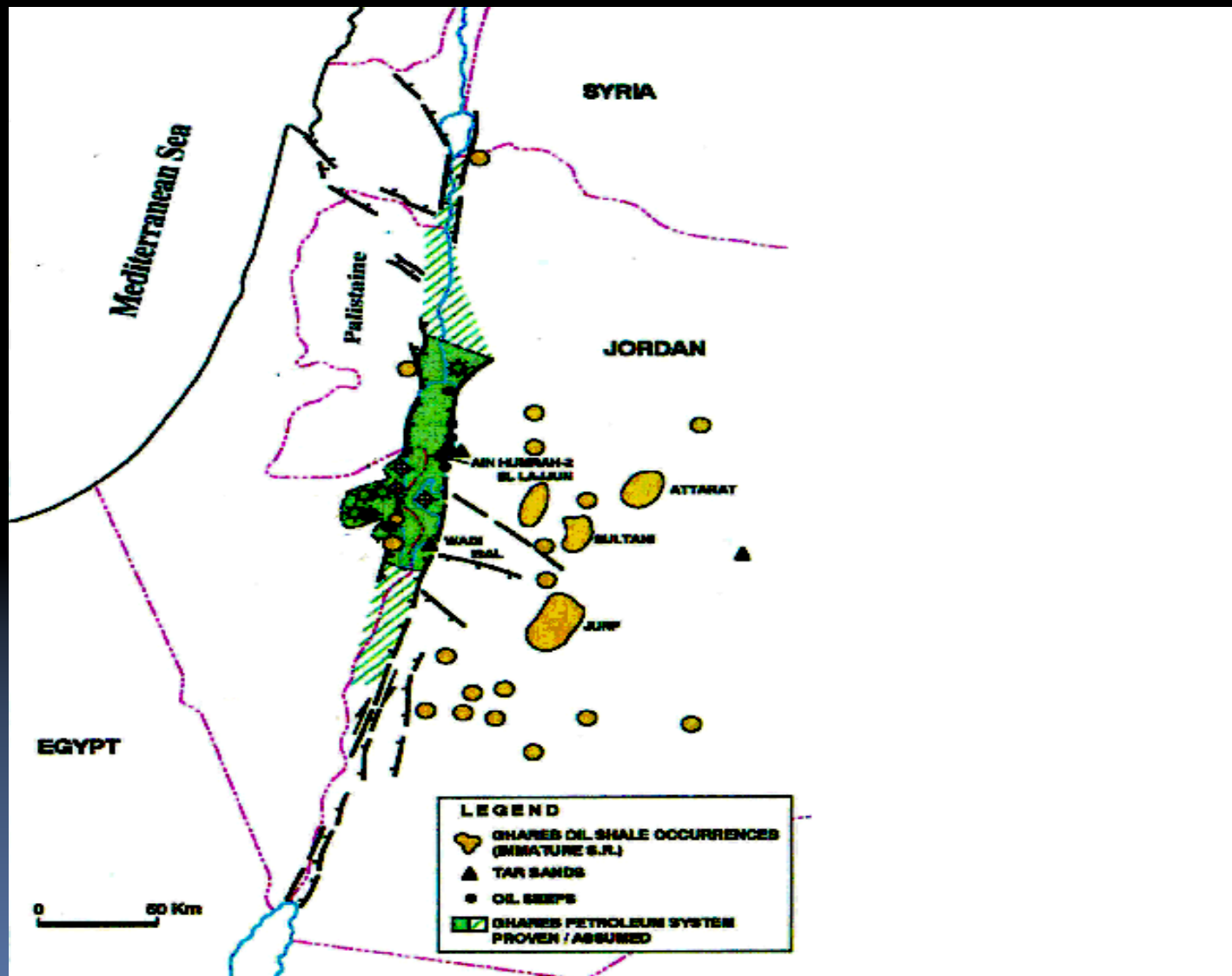
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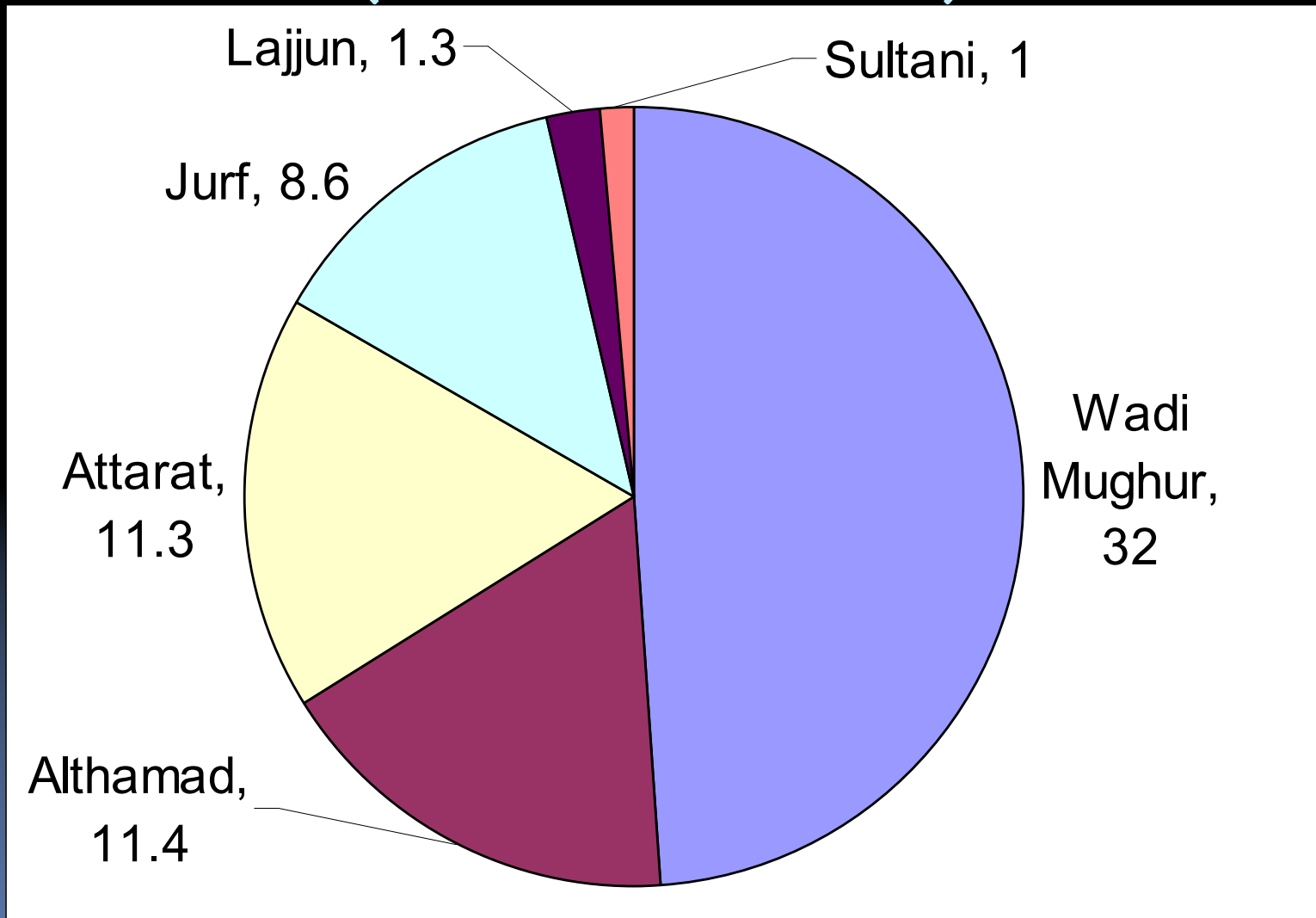
Introduction

- To investigate effect of particle size on:
 1. Weight loss
 2. Oil yield
 3. Physical property (density) of shale oil
 4. Sulfur content of shale oil (using XRF)

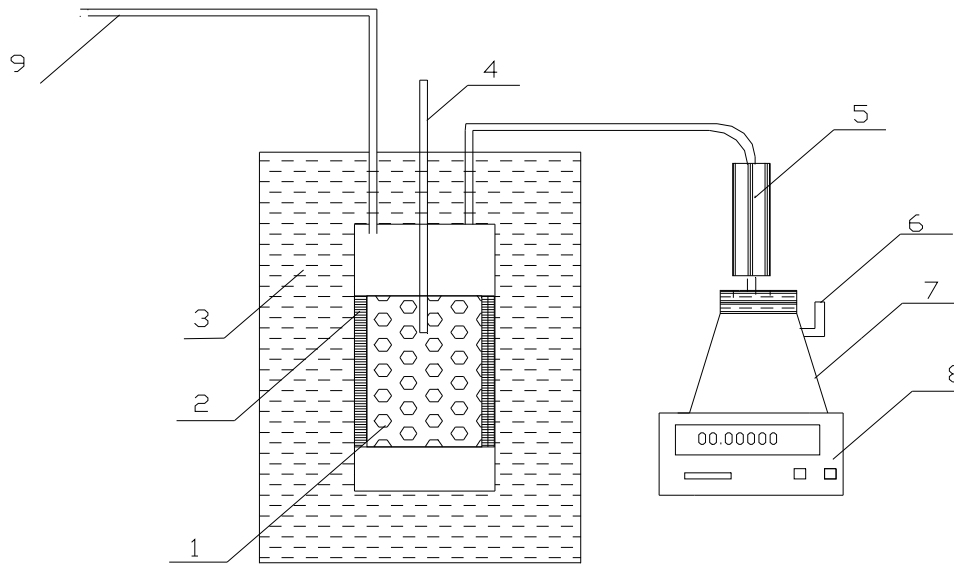
OIL SHALE LOCATIONS IN JORDAN



Oil Shale Deposits in Jordan (Billion Tons)



Experimental Setup

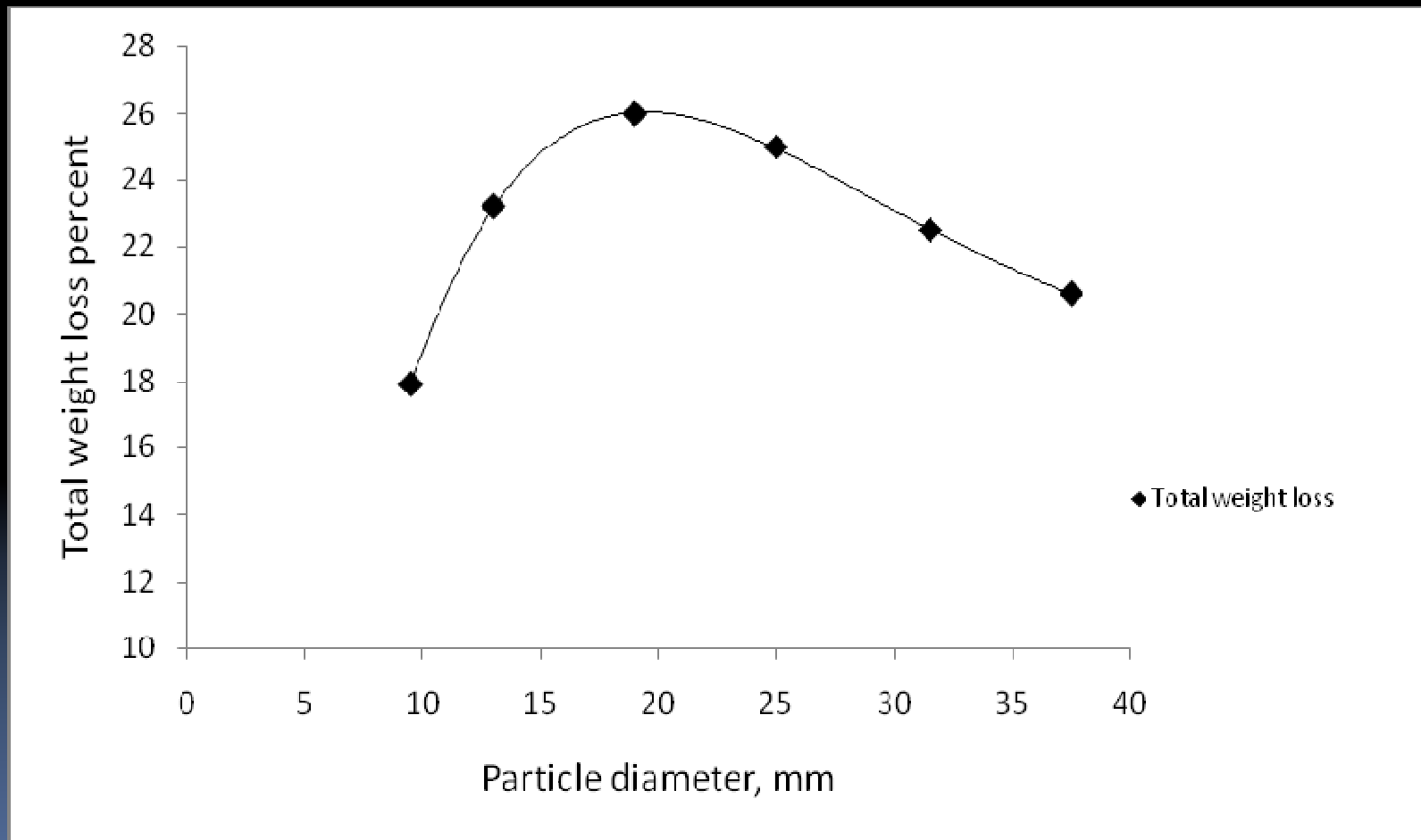


1- Sample, 2- Retort , 3- Insulation, 4-Thermocouple, 5-Condenser
6- Vent, 7- Flask, 8- Digital balance, 9- Nitrogen inlet

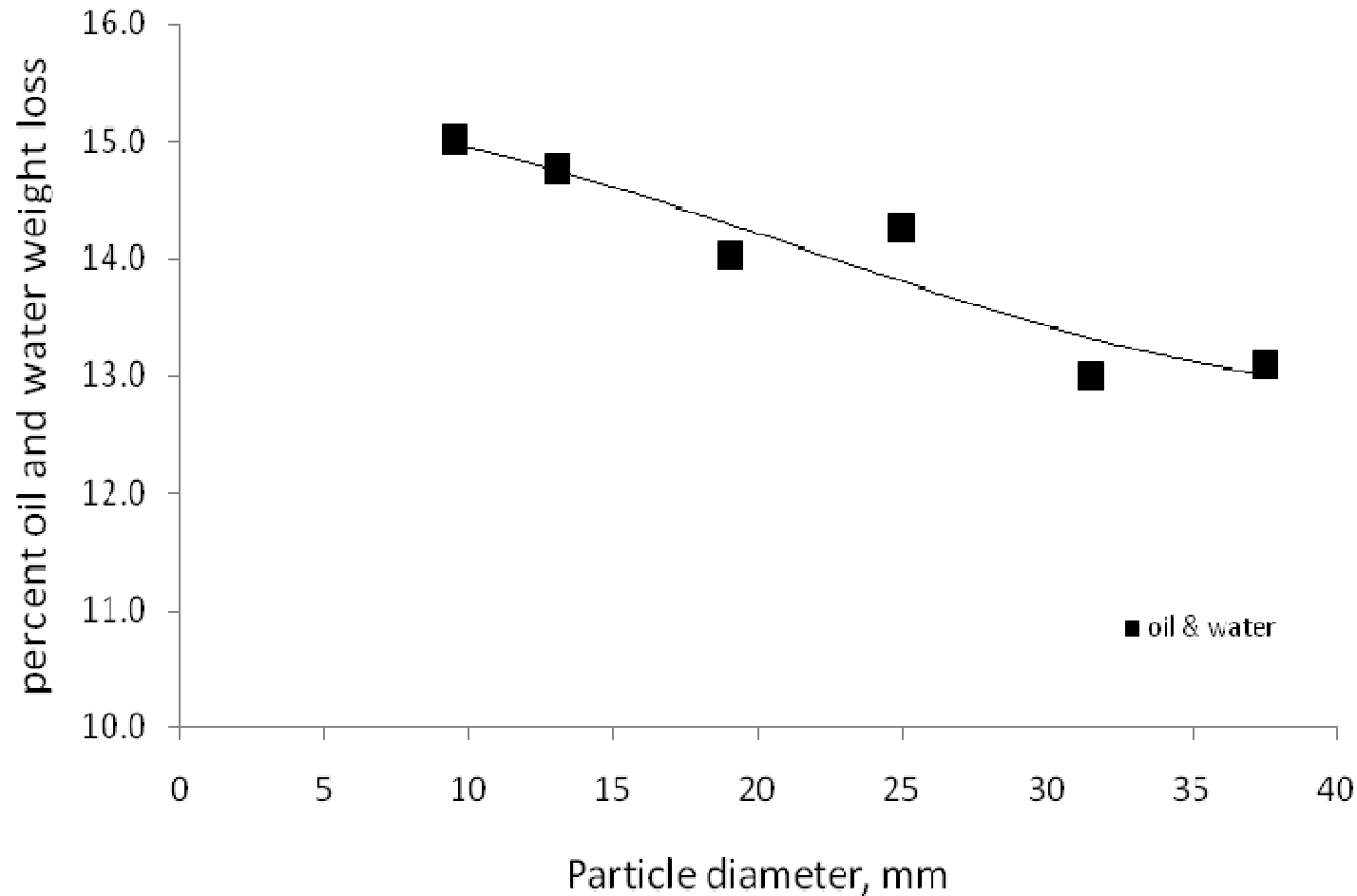
Working Conditions

- 400 gram sample in stainless steel retort.
- 823 K final pyrolysis temperature.
- Constant heating rate range 3 - 6 °Cmin⁻¹
- Atmospheric pressure.
- Nitrogen sweep gas with fixed rate.
- Particle sizes less than 37.5 mm
- Oil Shale, El-Lajjun site, Jordan
- Simple distillation unit

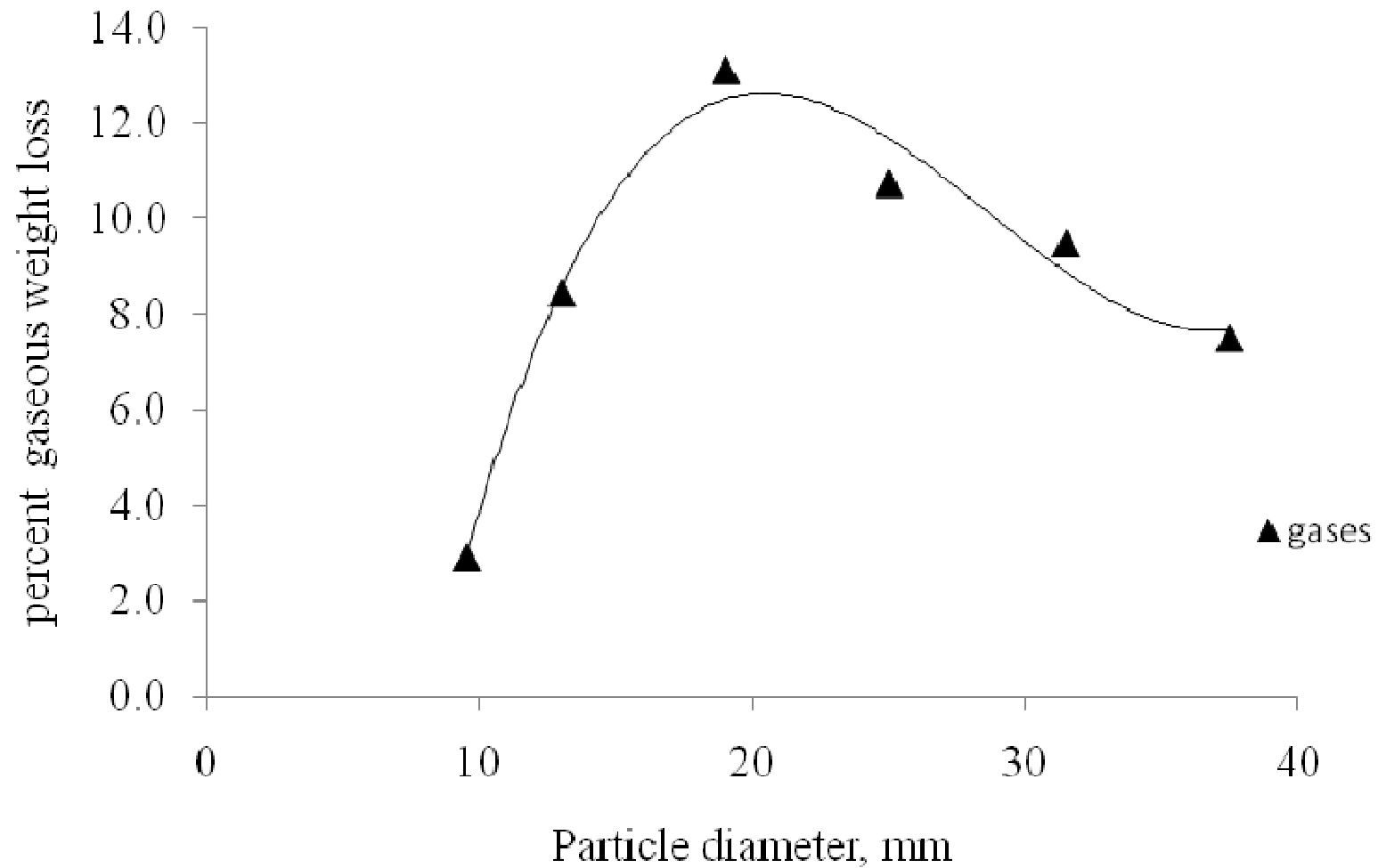
Particle diameter and total loss




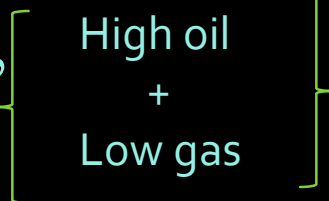


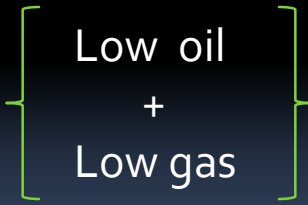


Particle size and Oil & water



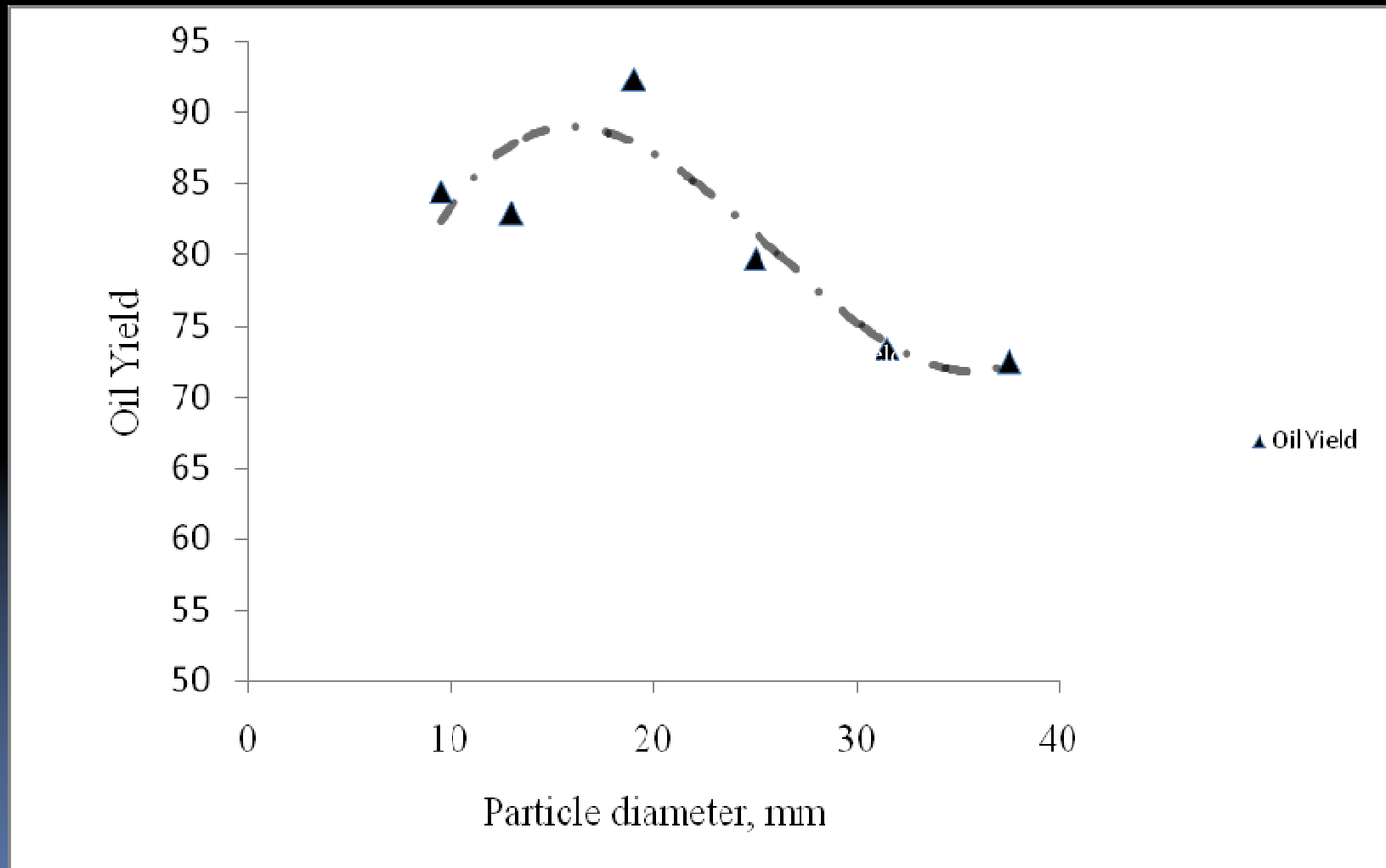
Particle size and gases loss



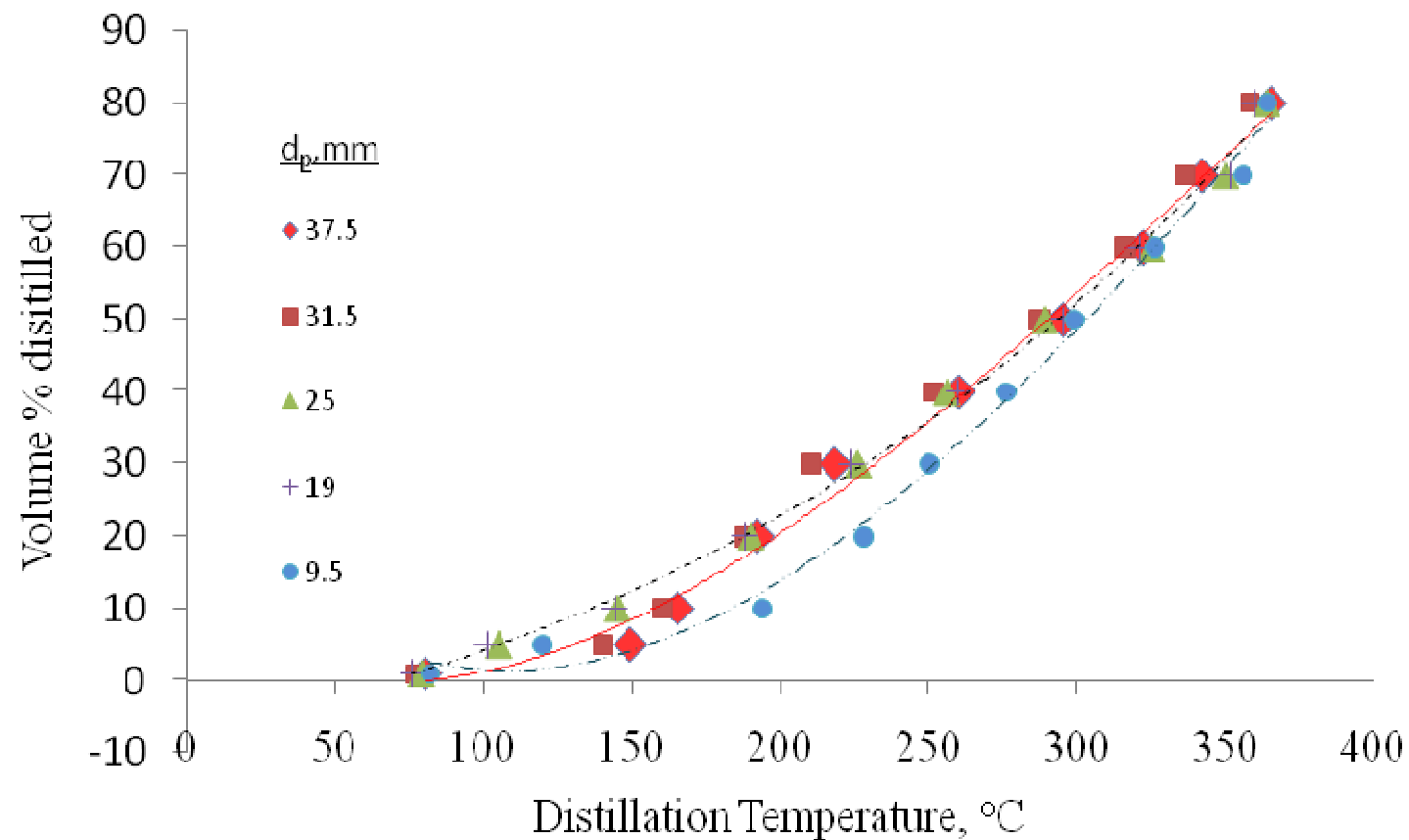
Comments on graphs

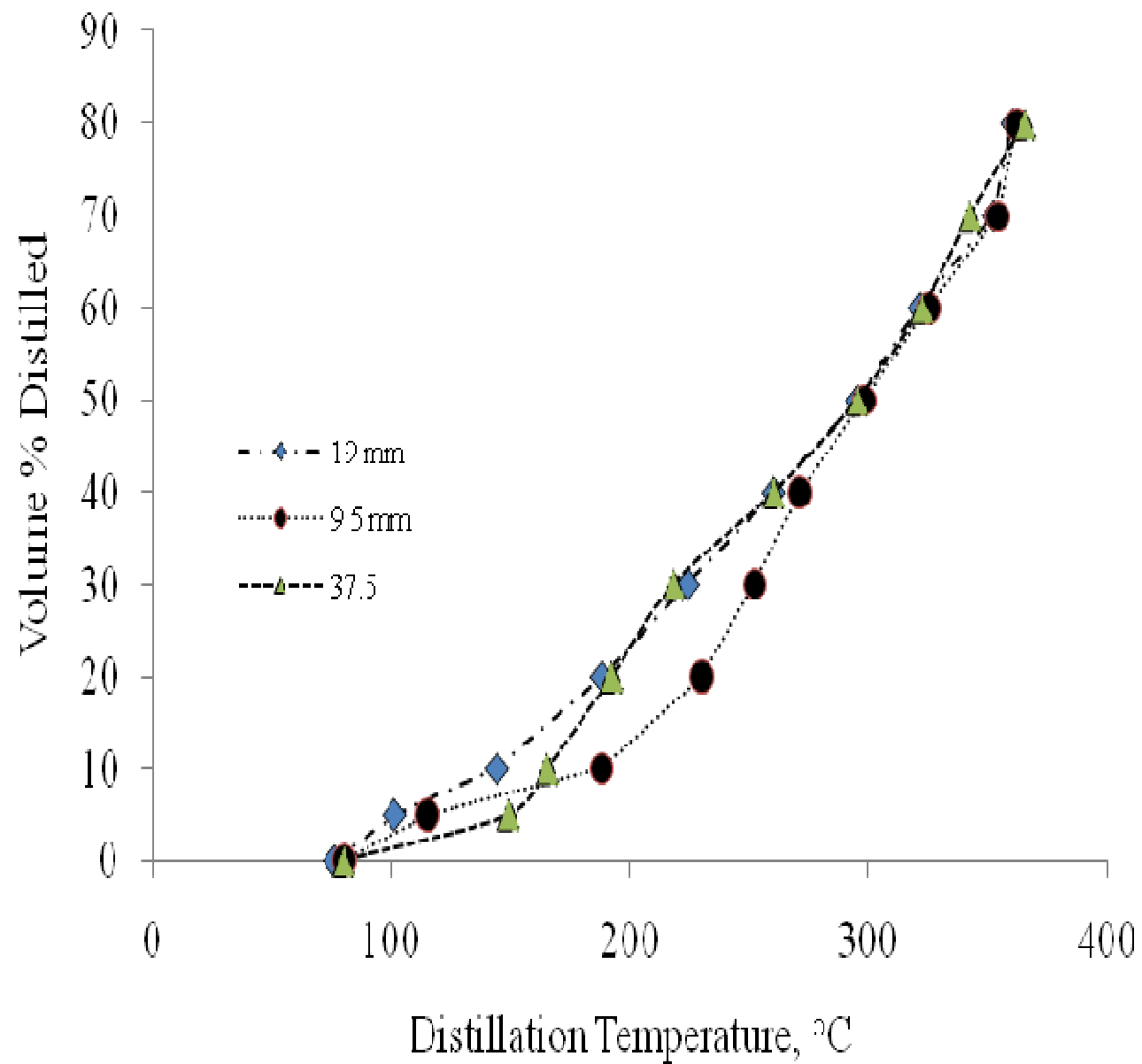
- 1- Low d_p ,  low total losses,  High oil + Low gas
-  Coking + Oil
- 2- High d_p  low total losses,  Low oil + Low gas
-  Coking
- 3 – Intermediate d_p ,  Cracking

Particle size and oil yield



Particle Size and Distillation

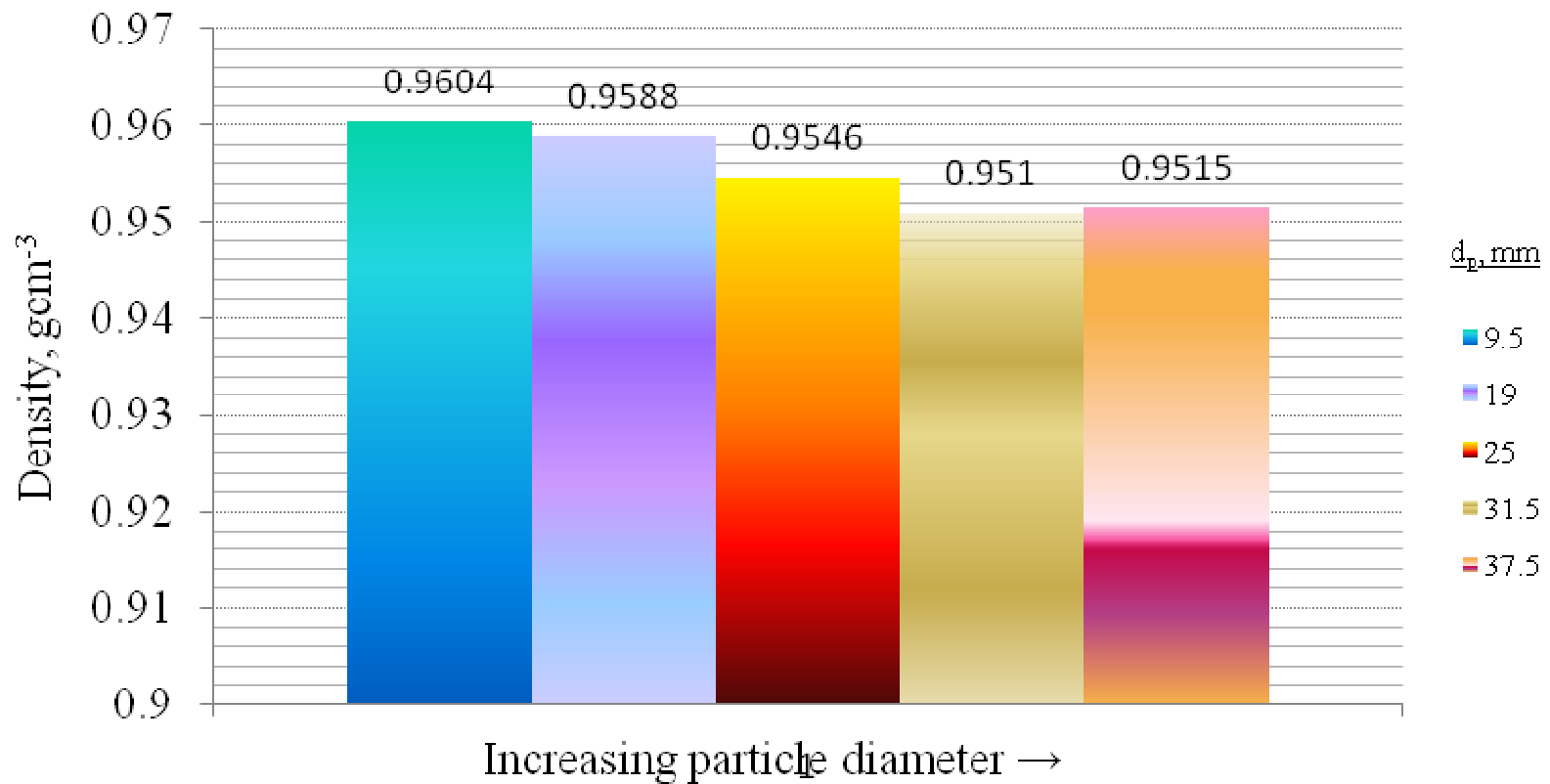




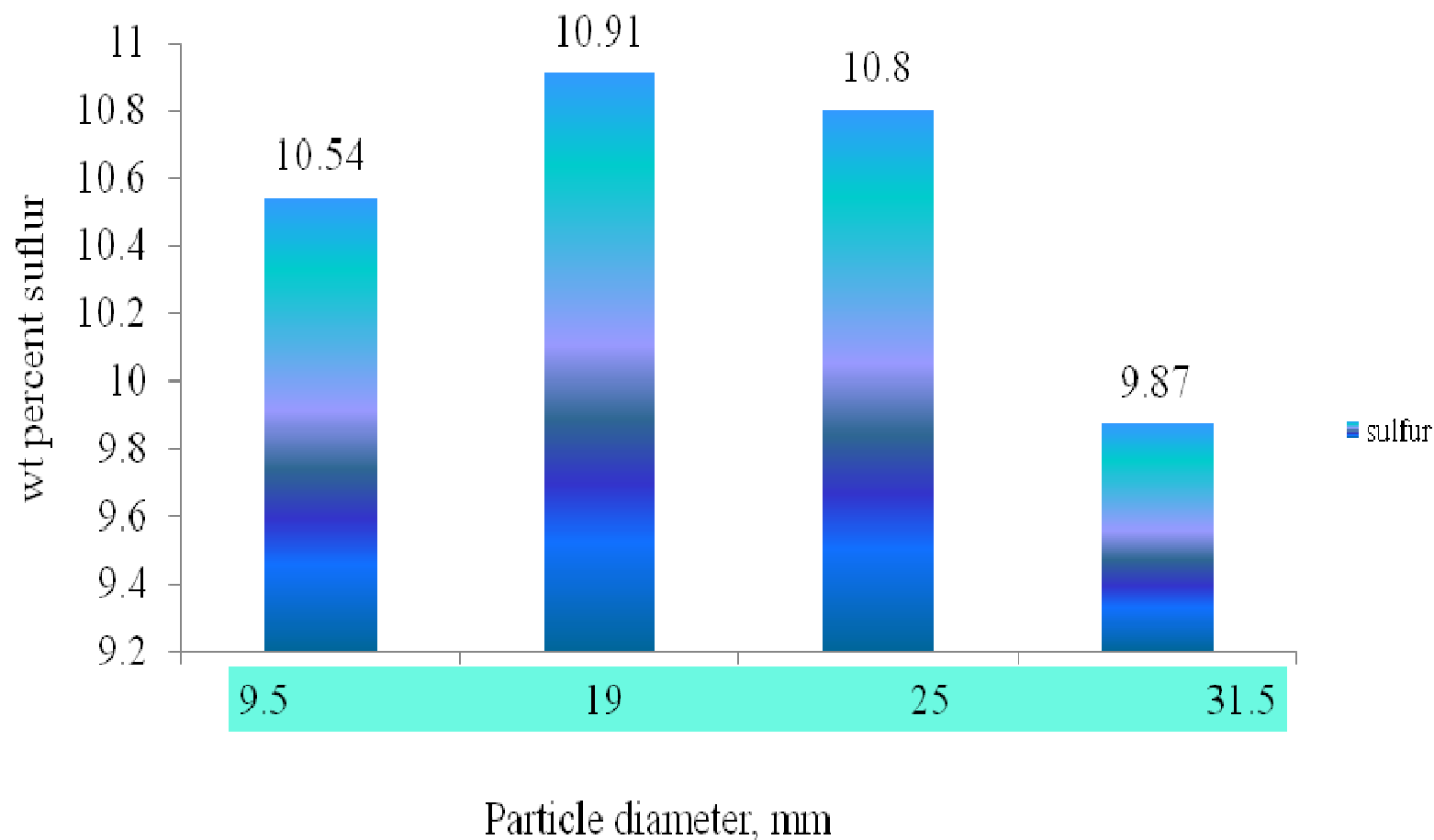
Fractionation Results

- larger size produced 20% volume of liquid hydrocarbons which boils below 190°C whereas pyrolysis of small oil shale particle size resulted in 10% volume for same distillation temperature.
- Kerosene produced during pyrolysis of large particle size was found to be 34% volume distilled while 22% volume distilled was reported for smallest size used. Diesel constituted 42% volume distilled for largest particle size whereas 50% volume distilled was reported for smallest particle size.

Particle size and Density



Particle size and Sulfur



Conclusions

- Increasing the particle size does not produce a clear trend in total weight loss; oil & water collected; and gaseous loss percent.
- Increase in particle size resulted in a **decrease** in percentage of naphtha and gasoline products, in an **increase** in kerosene production, and a **decrease** in diesel production. Product density decreased with increasing particle diameter.
- Product sulfur content decreased with increasing particle diameter.
- These changes in product composition appear to be the result of diffusional influences on the products generated by the pyrolysis process.

Thank you

