Clean, Shale Oil Surface (C-SOS) Process Pilot Plant

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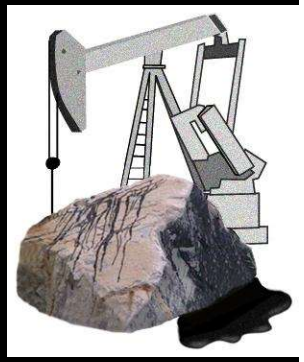
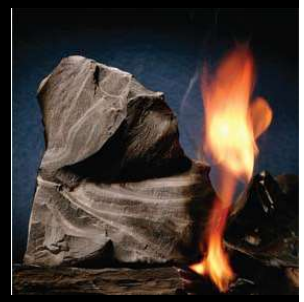
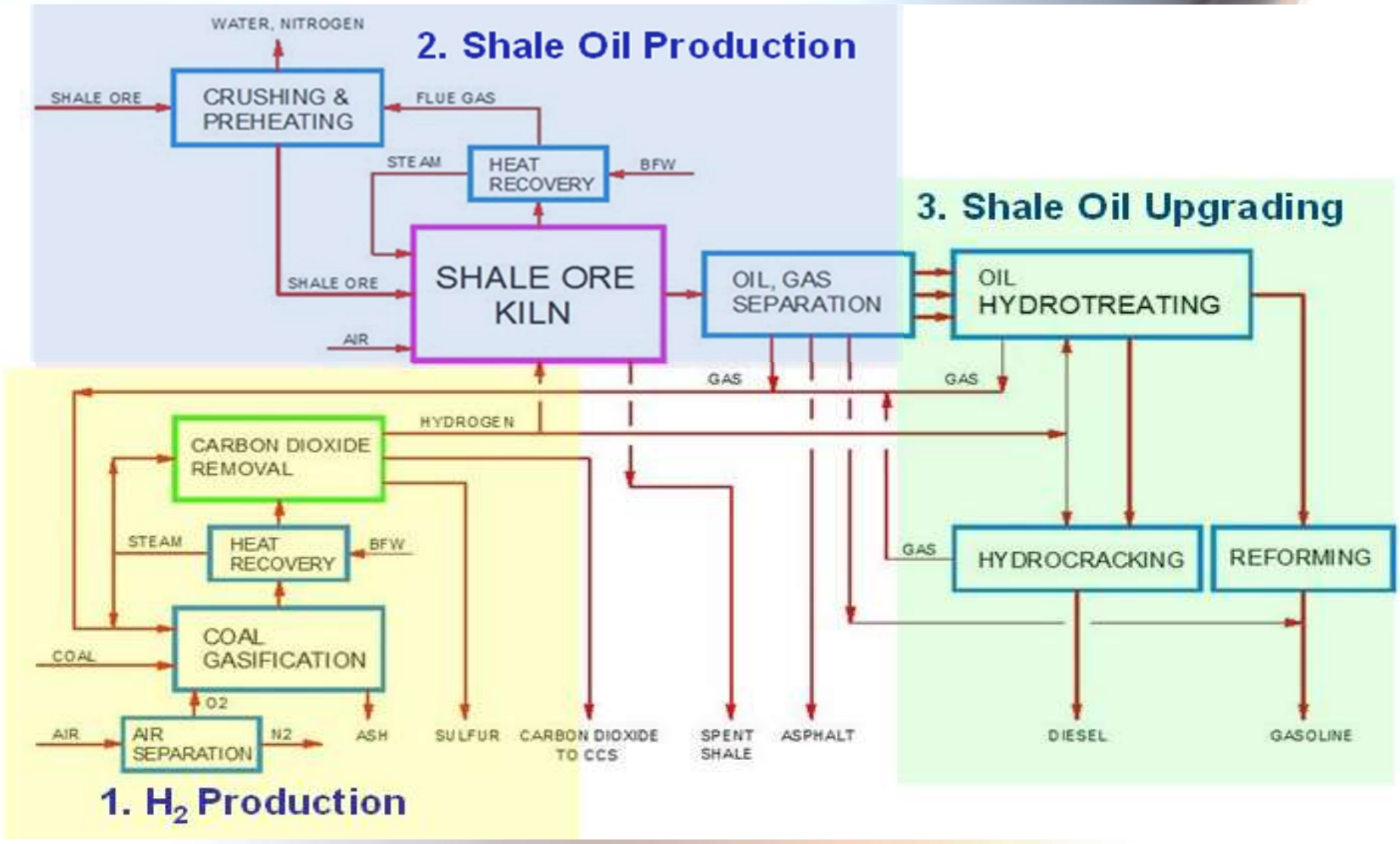




C-SOS Process Flow

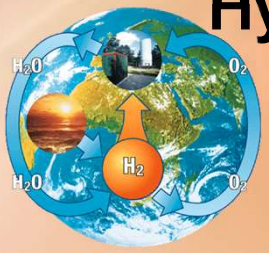


Some Features of C-SOS Process

Motor fuels can be made from oil shale with

Minimal release of CO_2 to the atmosphere

Minimal water use in processing



Hydrogen for energy and upgrading

when using the C-SOS process

C-SOS Pilot Plant

Combustion Resources, Inc. facilities in Provo, Utah, USA

Shale Kiln Heating Section of Pilot Plant

Oil Recovery and Separation Portion of Pilot Plant

Pilot Plant Control System

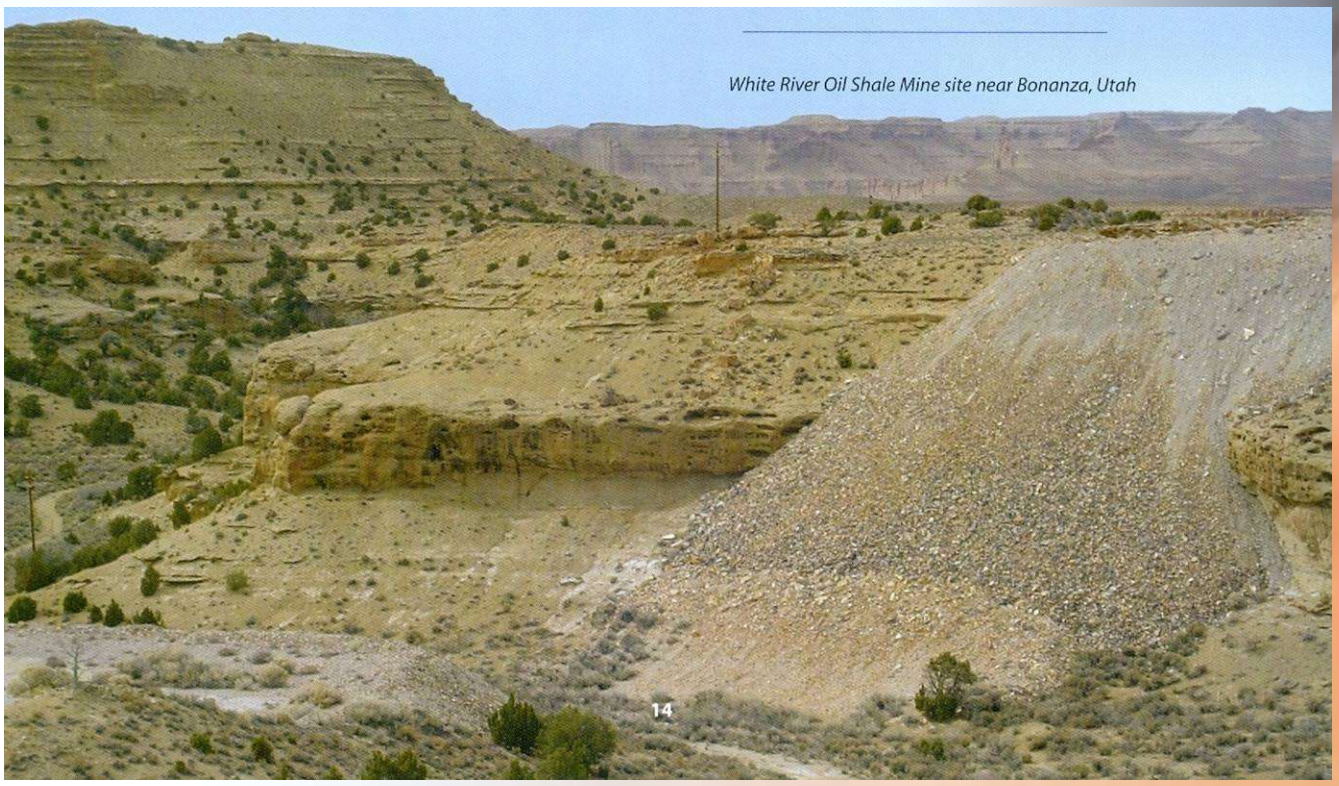
Objectives of Pilot Plant Testing

- Demonstrate kiln operation with oil shale
- Demonstrate recovery section
- Perform parametric study for optimization
- Recover shale oil fractions for upgrading testing
- Obtain operational data for scale-up and to refine economic analysis
- Demonstrate process in long-term run

Pilot Plant Test Plan

- Perform initial check-out tests
- Complete parametric test plan
  - Shale feed rate
  - Kiln temperature
  - Kiln speed
  - Particle size
  - Sweep gas rate
- Analyze oil fractions for upgrading
- Run plant for extended period

Feed Materials for Testing



- 150 tons from White River mine stockpile near Bonanza, UT
- Acquired through BLM and OSEC
- Obtained, crushed to -3/8” and shipped by Sage Geotech

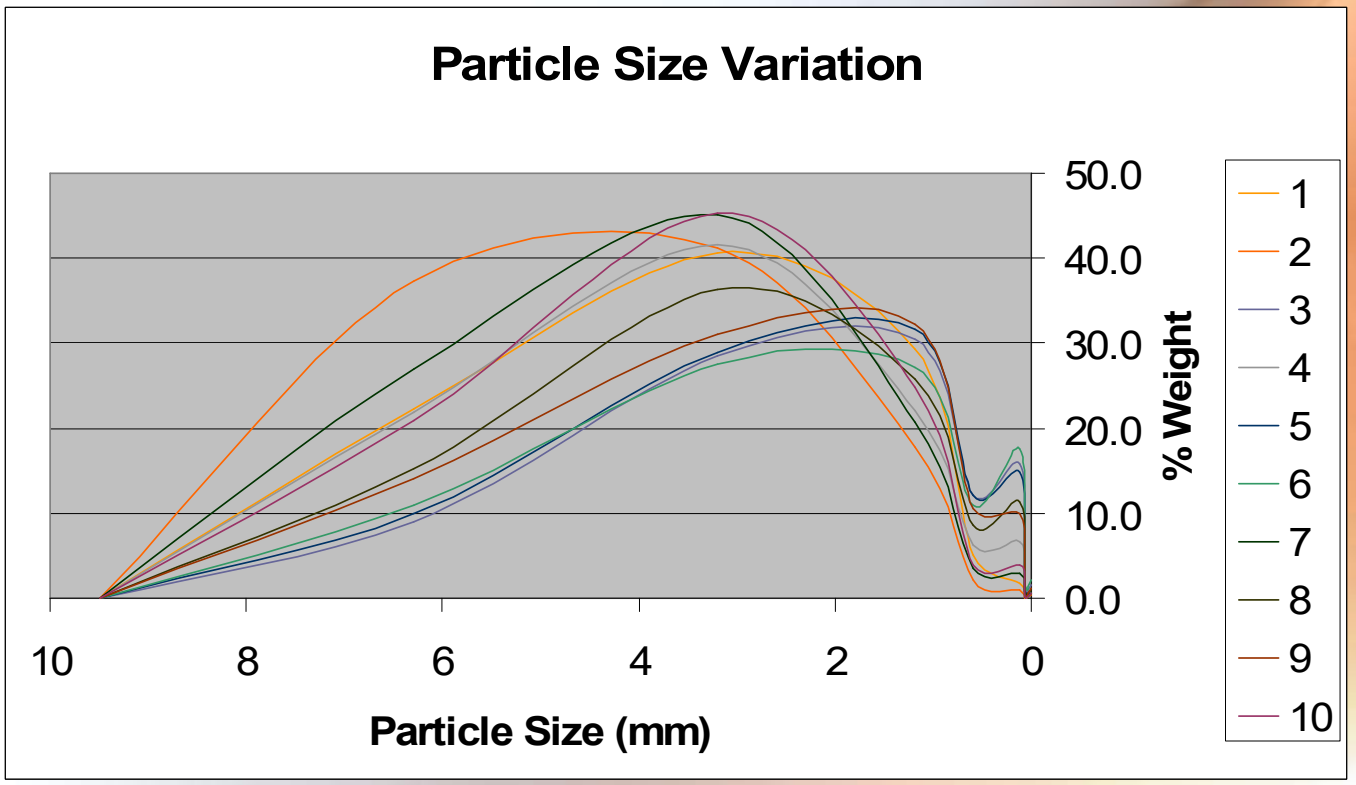
Analysis of Test Shale

White River Mine Test Shale Analysis

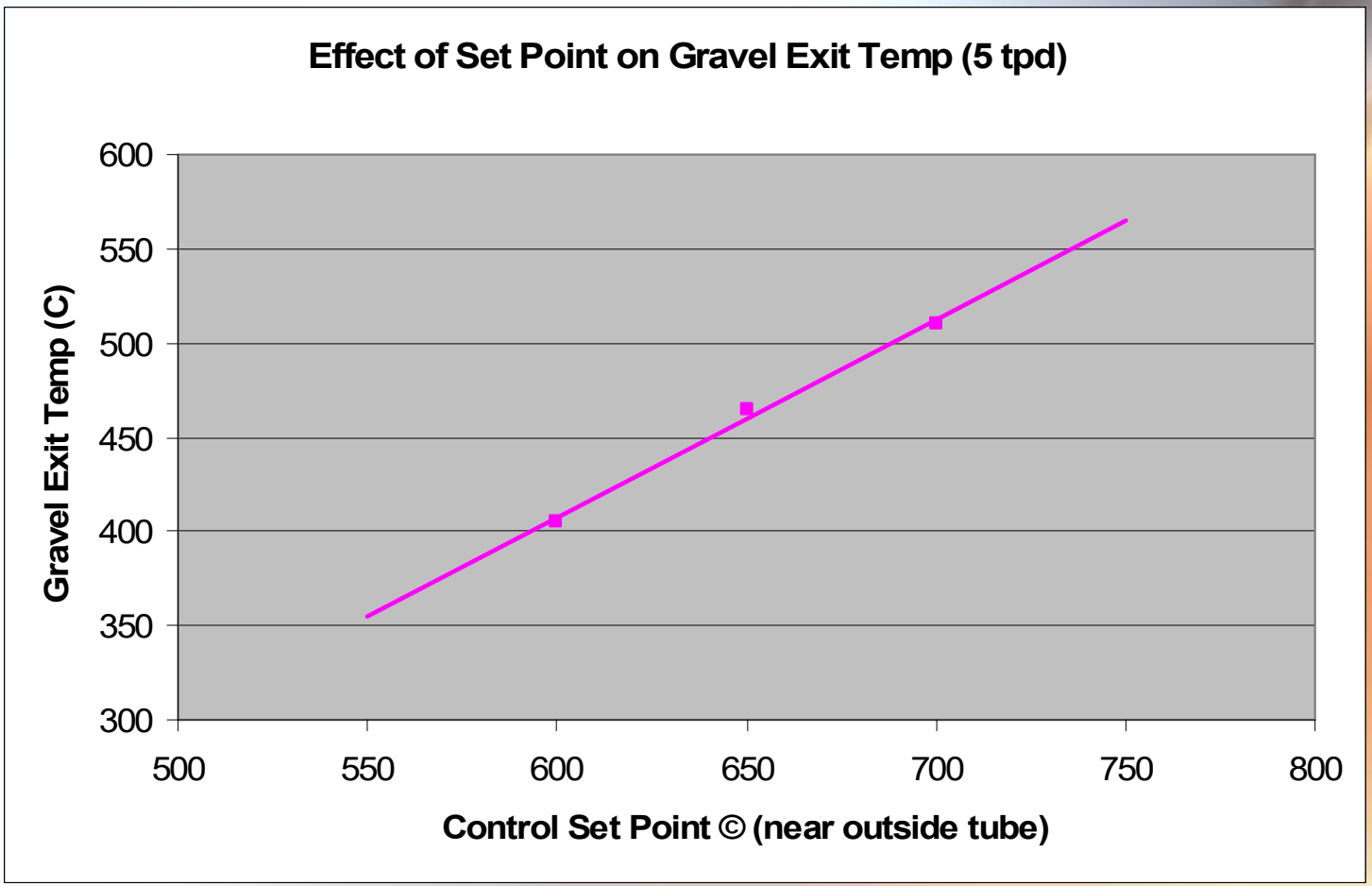
Parameter	Value	Units
Carbon	19.45	wt %
Hydrogen	2.08	wt %
Nitrogen	0.49	wt %
Oxygen	15.4	wt %
Sulfur	0.13	wt %
Moisture	0.65	wt %
Heating Value	2831	Btu/lb
Oil (Fisher Assay)	29	Gal/ton
Oil Density	0.9	g/cc

Oil Shale Particle Size

Oil Shale Particle Size Distribution



Inert Material Heat-up Testing



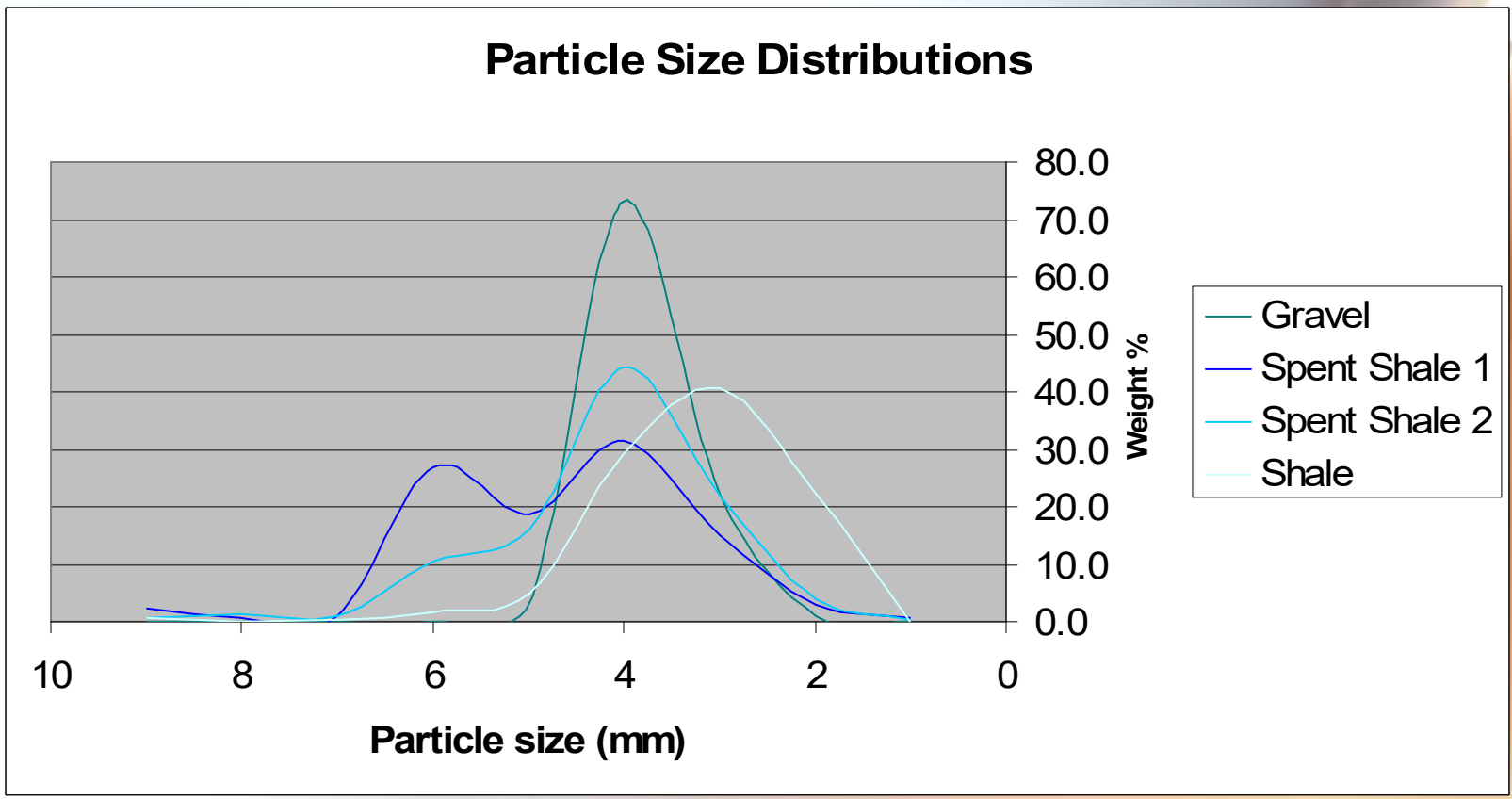
Preliminary Oil Shale Check-out Test Results

- Performed 3 check-out tests (3 tpd)
- Variation in kiln set point temperature
- Collected full system operational data using Opto 22 control system
- Collected different oil fractions
- Collected and analyzed spent shale

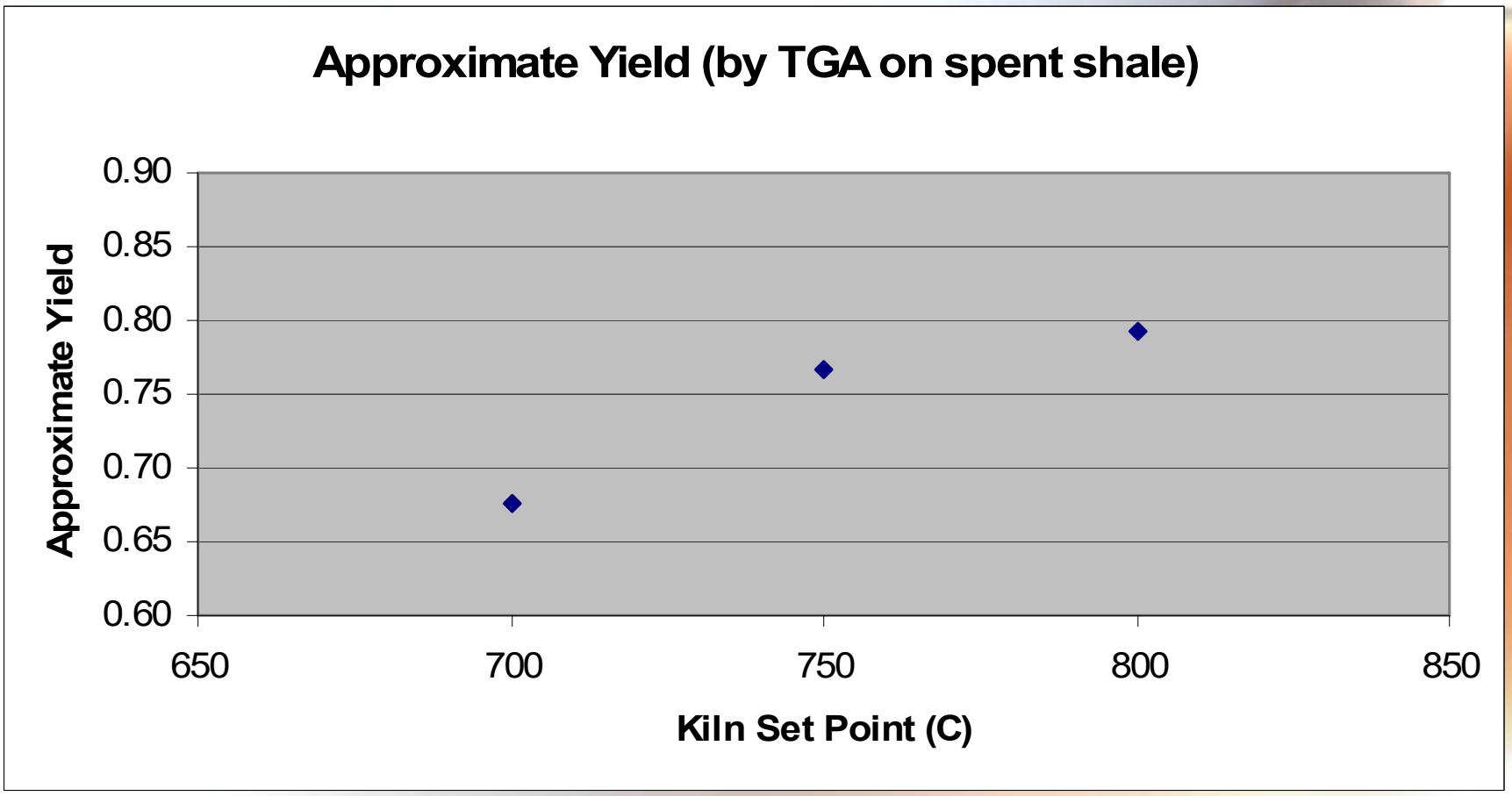
Preliminary Test Results, cont.

Collected oil from different column fractions plus product gas

Preliminary Test Results, cont.



Preliminary Test Results, cont.



Planned Oil Upgrading Tests

- Ultimate Goal: convert oil fractions to motor-ready fuels
- Hydrotreating testing to be performed by independent lab
- Collected fractions treated separately
- Trial catalysts being selected
- Current discussions with 2 catalyst suppliers

Summary

- C-SOS pilot-scale facility is complete
- Pilot-scale check-out tests are underway with very early, preliminary data
- Parametric testing is planned
- Upgrading testing will follow
- Results to aid in scale-up and refining economic analysis

Aknowledgements

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