AECOM

The Alberta Taciuk Process (ATP) Technology
- Excerpts from UMATAC Technical Paper and Presentation -

UMATAC Industrial Processes

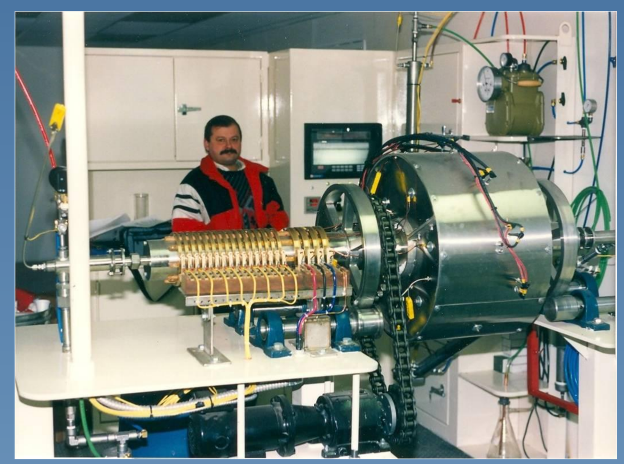
UMATAC Research Program to Study the Effect of Temperature Exposure and Variable Soak Times on Oil Yield, Gas Yield, and Product Composition for Various Oil Shale Deposits

Background of Test Program

UMATAC, as the ATP Technology developer, has concentrated testing and development efforts to obtain the highest oil yields possible in the retort zone of the ATP Processor. Assessments have also been made of the steam and gases that are produced in the preheat zone of the ATP Processor. This preheating step is a relatively short duration exposure (≈ 20 minute) of the oil shale to hot cylindrical surfaces at temperatures ranging from 400°C to 700°C.

In 2009, UMATAC conducted a series of tests to study and assess the effects of longer duration exposure of oil shales to low and intermediate temperature environments. Tests were conducted in static steel cylinders, externally heated, and with both top and bottom product vapour discharge. Tests were run using nominal 25 kg crushed shale charges and the process conditions were at atmospheric pressure, temperatures between 20 to 560°C, and soak durations from 1 to 70 days.

Equipment Used During Test Program



ATP Batch Test Unit

Insulated and Assembled Soak Test Units

Crushed Oil Shale Sample

Gas Chromatographs
No.1 Refinery Gas, No.2 Hydrogen and Methane

Tedlar Gas Bag, Pump with Gas Meter

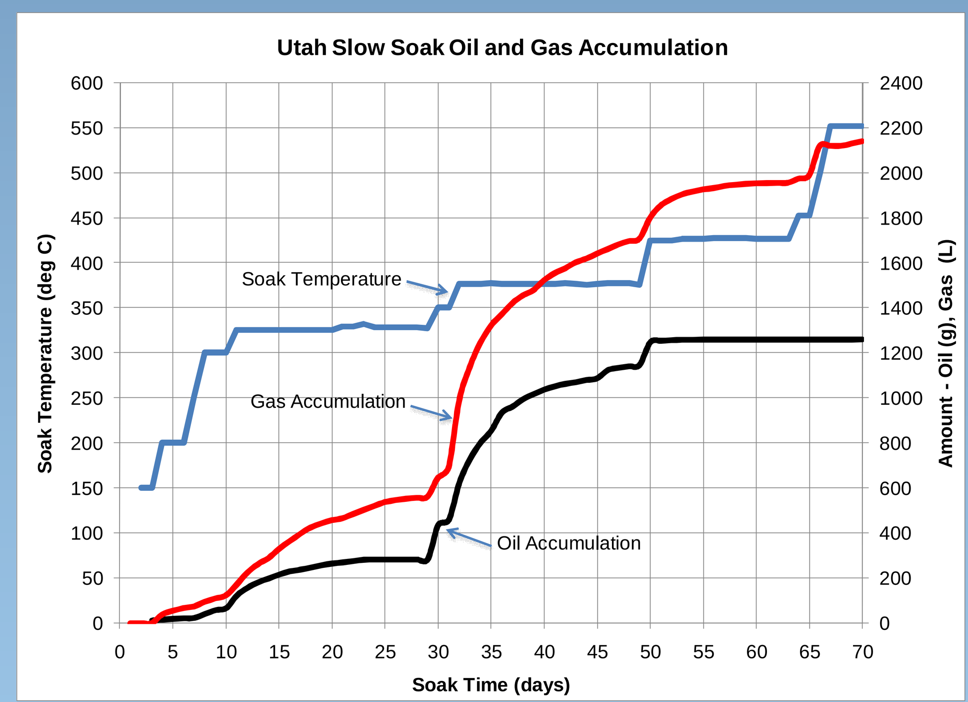
Test Results

Indications of Oil Shale Sensitivity to Temperature and Time

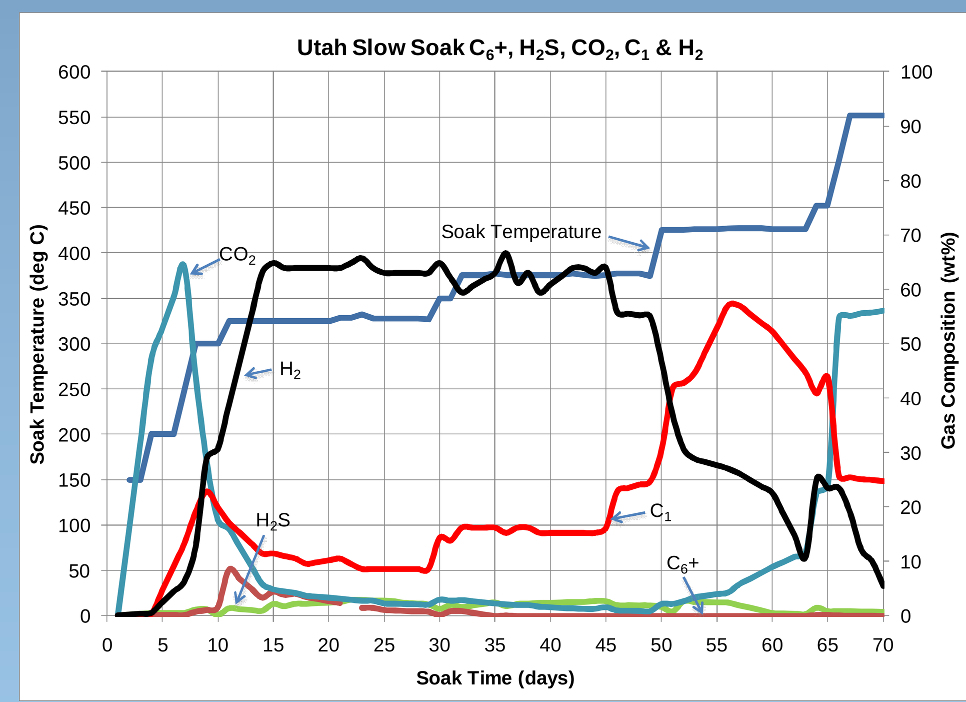
- Prolonged drying of oil shale at 150°C reduces Fischer assay oil yield.
- Prolonged drying of lignite coal at 150°C significantly reduces Fischer assay oil yield.
- Shale exposure to 200°C, as in the ATP preheat zone, results in some odorous gases.
- Shale exposure to 275°C for short periods results in condensate containing hydrocarbons.
- Certain shales have a faint bituminous smell when crushed indicating the presence of hydrocarbons.

Test Series	Apparatus Used	Vapour Discharge Orientation	Duration of Test	Temperature of Test (°C)	Sample Used
A	ATP Batch Unit	Side	Various	150, 225, 300, 350, and 400	5 Oil Shales
B	Slow Soak	Top	50 – 70 days	150 – 560	5 Oil Shales
C	ATP Batch Unit	Side	Various	400	5 Oil Shales
D-1	Slow Soak	Bottom	1 day	20 – 560	Utah and Jordan Shales
D-2	Slow Soak	Bottom	5 – 20 days	20 – 560	Utah and Jordan Shales

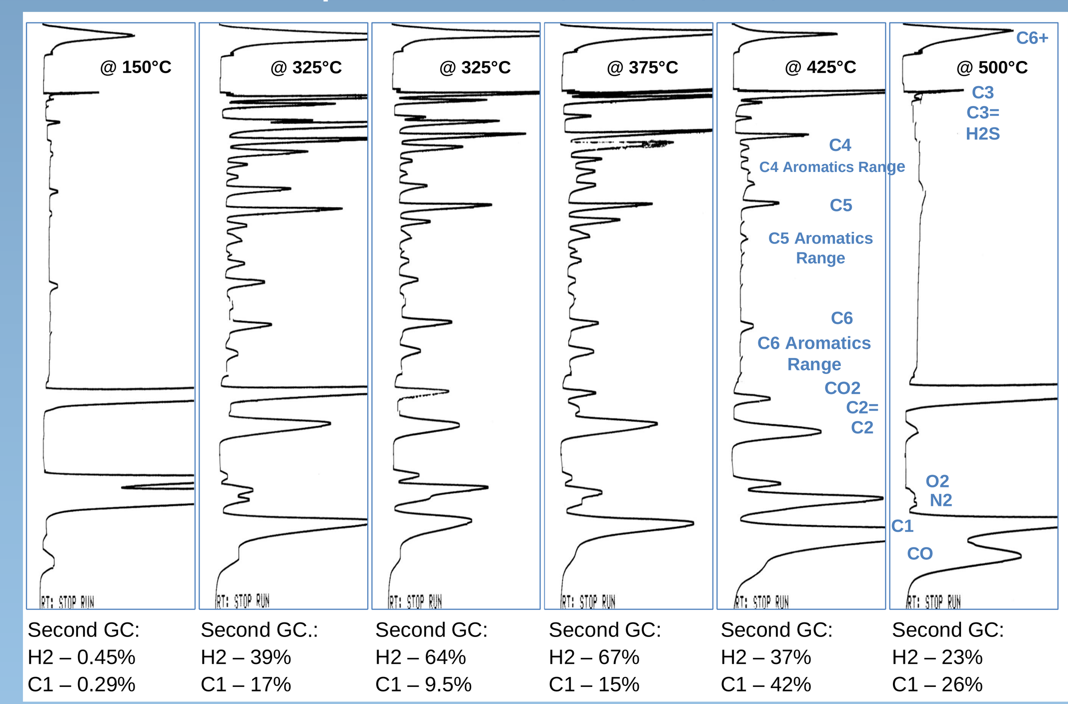
Utah – 70 Day Soak – Oil and Gas Cumulative



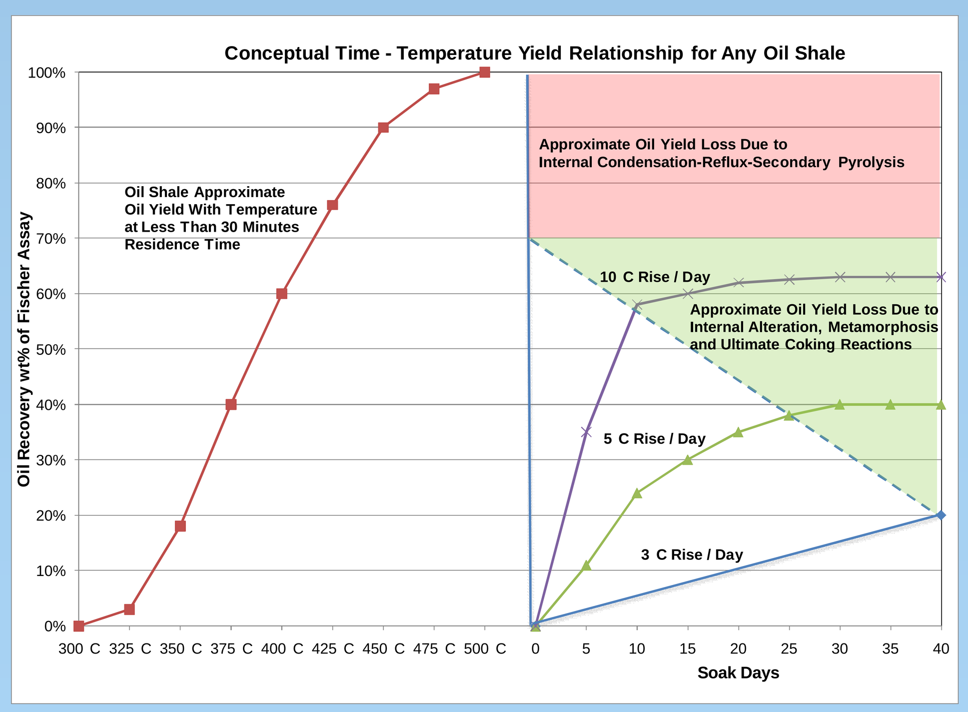
Utah – 70 Day Soak – Off Gas Compositions



Utah - Off Gas Compositions at 150, 325, 375, 425, and 500°C

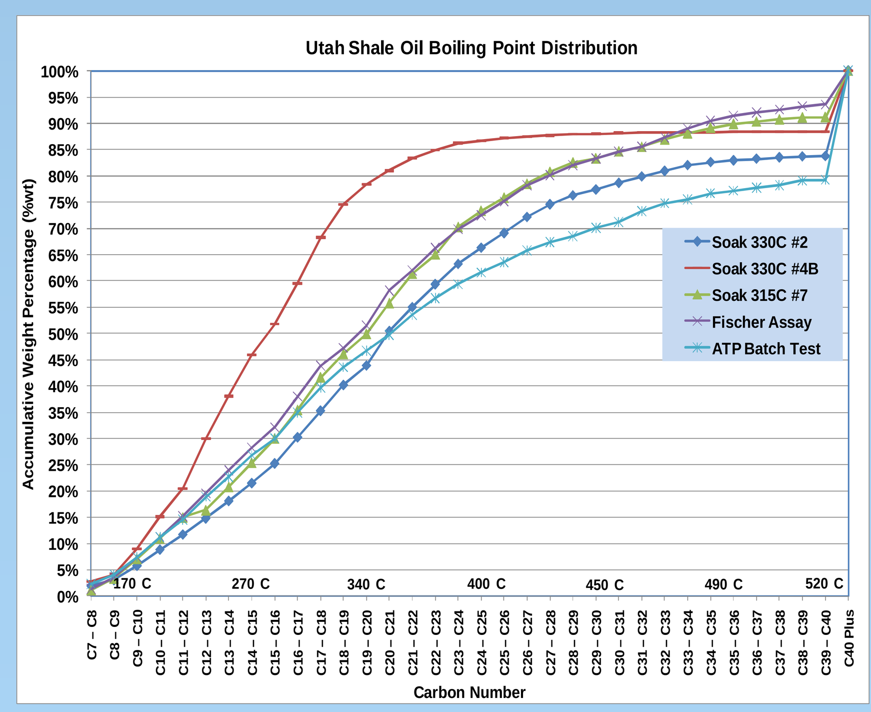


Conceptual Time – Temperature Relationship for Any Shale

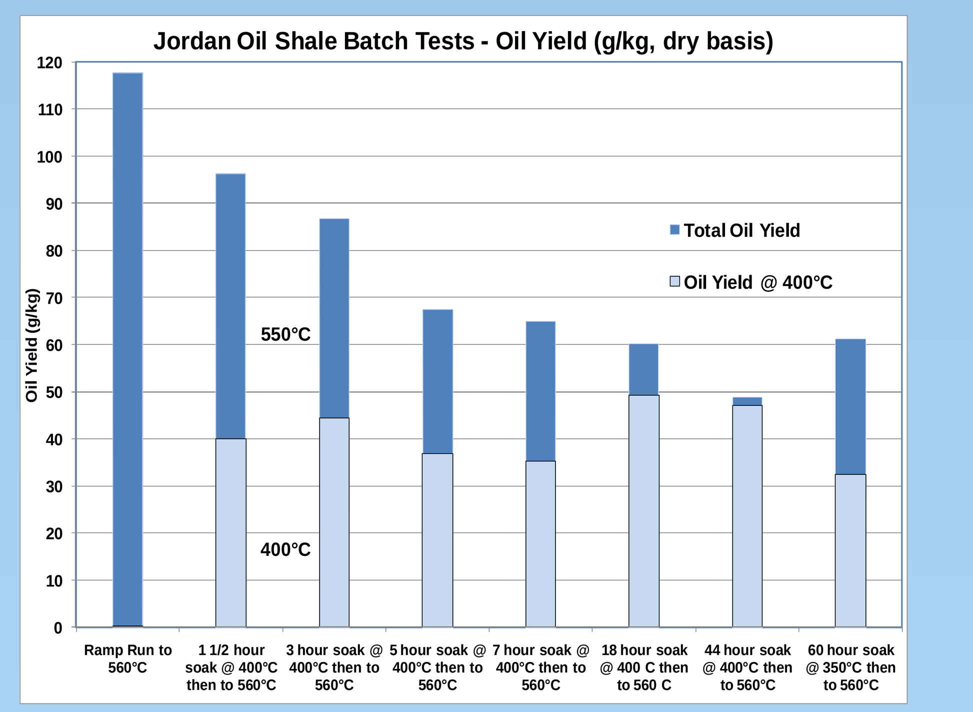


Item	Jordan	Utah	Fushun	Australia	Estonia
Sample Age (years)	11	3	5	14	8
Crushed Top Size (mm)	12	14	14	18	12
Moisture (wt%)	3-7	2-4	3-7	25-30	10-20
Modified Fischer Assay (LT0M C_4+)	135	140	90	125	110
C_6+ Oil Specific Gravity (g/mL)	0.95	0.94	0.89	0.90	0.94
Modified Fischer Assay (kg/t 0M)	125	130	80	112	103
Ultimate Analysis (dry basis)					
C (wt%)	19.60	18.90	13.60	19.24	17.14
H (wt%)	1.89	1.90	2.10	2.72	1.68
N (wt%)	0.39	0.50	0.81	0.55	0.36
S (wt%)	3.27	0.61	0.61	1.52	2.62
O (diff) (wt%)	9.85	10.9	5.76	5.27	9.75
C_6+ Oil (kg)	114	121	86	110	114
C_6- Gas (m^3)	36	33	37	32	36
Main Feature	High Sulfur Oil	High Limestone	Lowest Oil Content	High Moisture	Phenolic Oil

Utah Shale Oil Boiling Point Distribution



Jordan Oil Shale Yield Soak Variable Time at 400°C and Rapid Temperature Increase to 560°C



Utah Oil Shale Yield Soak Variable Time at 400°C and Rapid Temperature Increase to 560°C