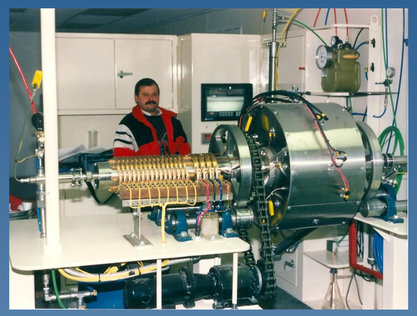
The Alberta Taciuk Process (ATP) Technology
- Projects and Performance -
UMATAC Industrial Processes

AECOM

UMATAC Oil Shale Testing Equipment and Project Development Stages

Modified Fischer Assay

- 1st stage of testing, small scale, quick, and inexpensive
- 100 g of feed per test
- Pyrolysis yield characterization
- Ore grade assessment
- Basic oil, gas, and coked solids production



Batch Retort Unit

- 2nd stage of testing
- 2,500 g of feed per test
- Pyrolysis yield sensitivity
- Combustion studies
- Drying studies
- Enables production of larger oil samples for detailed characterization and more closely simulates behavior of commercial scale equipment

UMATAC's Pilot ATP System (ATP60)

- 3rd stage of testing
- Up to 5 t/h (60 bbl/day oil sands equivalent)
- Transportable
- Used to gather final data necessary for design of commercial plant
- Produces representative oil, off gas, flue gas, water and solids products for detailed characterization
- Incorporates all parts of commercial plant ATP System:
  - Material handling
  - ATP processing / hydrocarbon extraction
  - Hydrocarbon recovery
  - Flue gas treatment

Commercial Scale ATP System

- Large unit capacities (200 to 750 t/h per ATP Processor)
- Complete utilization of oil shale resource (no need to discard fines portion)
- High oil yield and recovery efficiency
- High quality excess off gas

Typical Modified Fischer Assay Data

MFA Data	Units	China 1	China 2	Saskatchewan	Utah High Grade	Utah Med Grade	Utah Low Grade	Wyoming Low Grade	Jordan	Australia	Estonia
Feed Composition, wt% wet											
Organics (including CO/CO_2)	wt%	32.3	18.8	12.0	29.3	21.8	15.0	9.7	20.2	21.3	20.0
Free Water	wt%	4.4	5.1	15.0	1.1	1.0	0.6	9.3	2.9	25.5	6.8
HC Yield, wt% of dry feed											
$CO+CO_2$ Gas	wt%	1.7	2.0	0.8	1.0	0.6	1.0	1.1	0.8	2.1	0.9
Kerogen											
C_3&- Gas (including H_2 & H_2S)	wt%	1.3	0.7	1.4	1.5	1.2	1.0	0.4	1.1	1.0	1.2
C_4 in Gas	wt%	0.4	0.2	0.5	0.6	0.5	0.3	0.2	0.3	0.3	0.4
C_5&+ in Gas	wt%	0.3	0.3	0.3	0.5	0.3	0.2	0.1	0.3	1.2	0.5
Clean Oil	wt%	11.7	7.4	4.6	19.4	12.6	8.0	4.4	11.2	13.7	13.7
Total C_4&+	wt%	12.4	7.9	5.3	20.4	13.4	8.5	4.7	11.4	15.2	14.5
Total Coke	wt%	18.9	8.9	6.8	8.1	6.8	4.6	4.6	7.8	10.4	4.9
Total Organic Products	wt%	34.2	19.5	14.3	31.1	22.0	15.1	10.8	21.2	28.6	21.5
Total HC Products (without CO/CO_2)	wt%	32.6	17.5	13.5	30.1	21.4	14.1	9.7	20.3	26.6	20.7
Clean Oil Density (C_4+)	g/mL	0.91	0.87	0.91	0.89	0.88	0.88	0.89	0.95	0.86	0.94
Oil Yield (C_4&+)	LT0M	136.2	91.4	59.3	229.2	151.7	96.2	52.9	121.2	176.7	155.5

Typical Mineralogy Data

	China 2	Utah	Wyoming	Jordan	Australia	Estonia
Free Water (wt%)	5.72	5.23	7.40	3.76	16.62	6.14
Kaolinite	21	-	-	<1	3	<1
Smectite	31	-	-	12	38	4
Illite	1	10	11	-	3	4
Calcite	-	5	24	49	4	43
Siderite	6	<1	-	2	2	-
Dolomite		28	4	-		8
Magnesite						
Pyrite	1	<1	<1	1	2	2
Gypsum	-	-	7	-	2	-
K-feldspar	2	2	3	1		3
Na-feldspar		14	2	-		-
Quartz	17	8	12	10	10	8
Opal	-				8	
Anatase	<1				<1	
Albite	2				2	
Buddingtonite	5				-	
Analcime		1	10			
Amorphous	13	32	27	25	25	28

Worldwide Experience

UMATAC has tested oil shales from 6 out of 7 continents

- Australia
- Brazil
- Canada
- China
- Cuba
- Egypt
- Estonia
- Israel
- Jordan
- Madagascar
- Mongolia
- Morocco
- Thailand
- USA

Current Projects

Fushun, China

- Nearing completion on the construction of a 230 t/h ATP Processor, oil recovery plant, and power generation plant

Al Lajjun, Jordan

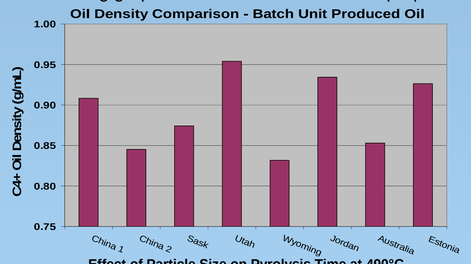
- Jordan government acceptance of a feasibility study for twin 500 t/h ATP Processors with upgrading and power generation plants
- Several large pilot plant tests were completed in summer 2009 on Jordan material and results reported

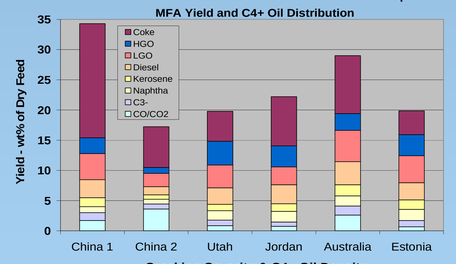
Projects in Development

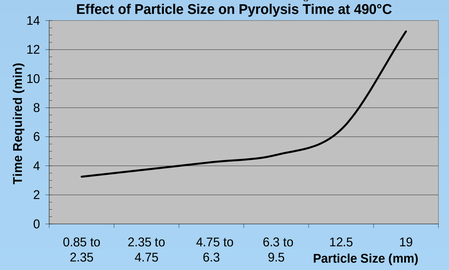
- Bench scale testing on Thailand oil shale
- Oil shale/sand resource projects – North America, Middle East, and Asia

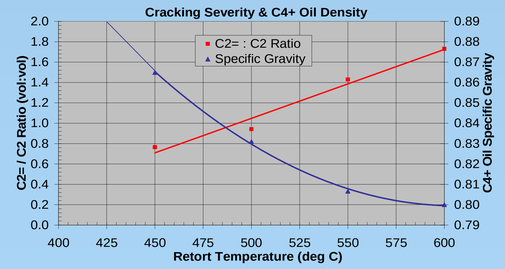
The ATP System is Capable of Processing Ores with Varied Feed Grade, Water Content, Mineralogy, Sulphur Content, and Oil Properties

The following graphs and tables show selected properties of different shales and results from UMATAC developed test equipment



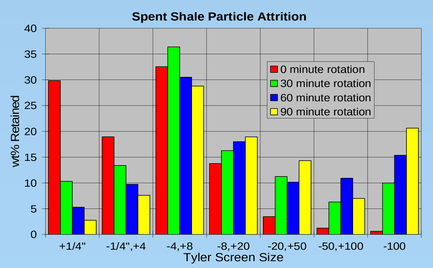






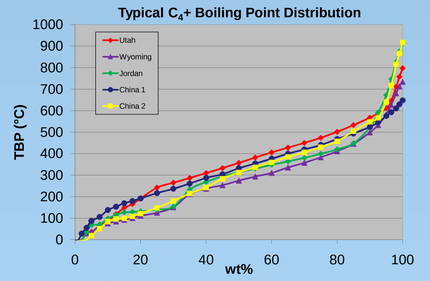
Feed Ore & Spent Shale Analysis

CHNS DATA - Feed Shale (DryBasis)	China 1	China 2	Utah	Wyoming	Jordan	Australia	Estonia
Carbon (wt%)	26.73	13.30	19.86	10.39	18.82	20.57	32.23
Hydrogen (wt%)	3.33	2.35	1.92	1.35	1.76	3.51	3.68
Nitrogen (wt%)	0.52	0.74	0.51	0.46	0.37	0.33	0.09
Sulfur (wt%)	0.62	0.64	0.66	0.55	2.91	2.00	1.91
Inerts + Oxygen (wt%)	68.80	82.97	77.05	87.26	76.13	73.59	62.08
C/H (wt%)	8.03	5.67	10.37	7.71	10.67	5.86	8.77



Complete Boiling Point Range

Hydrocarbons recovered by ATP technology comprise the full boiling point spectrum – from light gases through gasoline/diesel up to heavy gas oil



Oil Upgrading

Naphtha and Fuel Oil Fractions of Shale Oil

Hydrotreating / Upgrading Facility

Hydrotreated Naphtha Met Jet Fuel Specs
< 1 ppm Sulfur
< 4 ppm Nitrogen