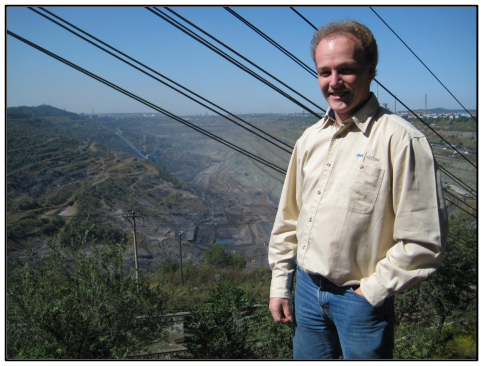
ATP Oil Shale Plant in China

UMATAC Industrial Processes Inc., a company of Polysius (Calgary, Canada)

Fushun Mining Group

The Fushun Mining Group (FMG) is a large state owned coal mining, coal processing, and manufacturing company based in the city of Fushun, Liaoning province, China. FMG has now completed construction of an oil shale processing plant that uses the Alberta Taciuk Process (ATP) technology under license from UMATAC Industrial Processes Inc., a company of Polysius.

FMG is famous in China for their West Open Pit coal mine, one of the largest mines in the world – 6 km long x 2.2 km wide x 400 m deep. Coal production capacity is 8.4 million tonnes/year.



John Barge, Senior Mechanical Engineer, in front of the Fushun West Open Pit Coal Mine, Fushun.

Oil shale lies above the coal deposit and is mined as over-burden. FMG produces oil from a portion of the oil shale using an older vertical retort technology, but the vertical retorts cannot process the fine portion of the crushed oil shale. The fines are currently being discarded. Once the ATP System is in operation, the rejected fines will be redirected to the ATP plant.

Project Highlights

- First application of the ATP Technology to Chinese oil shale.
- Design teams located in Canada, Germany, and China.
- Leading edge field machining technique was proven. This has overcome a previous equipment size limitation.
- Environmental performance has been enhanced and greenhouse gas emissions reduced.

Project Development

UMATAC, in cooperation with Polysius AG, a ThyssenKrupp company based in Germany, began discussions with FMG in 2002 to explore use of the ATP Technology with the Fushun oil shale.

UMATAC obtained small oil shale samples from FMG in 2003. These were tested in UMATAC's Calgary pilot plant facility. Based on the test results, the parties held a series of technical discussions and review meetings in China in 2003, 2004, and 2005. In 2004, FMG shipped 100 tonnes of oil shale to Calgary.

The FMG ATP Processor, shown above, is similar in size to the Processor for the Stuart Oil Shale Research and Development project, built in Gladstone, Australia in 1999.

This material was tested in 2005 in UMATAC's 5 tonne/ hour pilot plant. Following the test program, the parties held further technical discussions and review meetings, culminating in December 2005 with signing the contract for design and construction of the first ATP System for FMG.

The FMG Project, Fushun, China

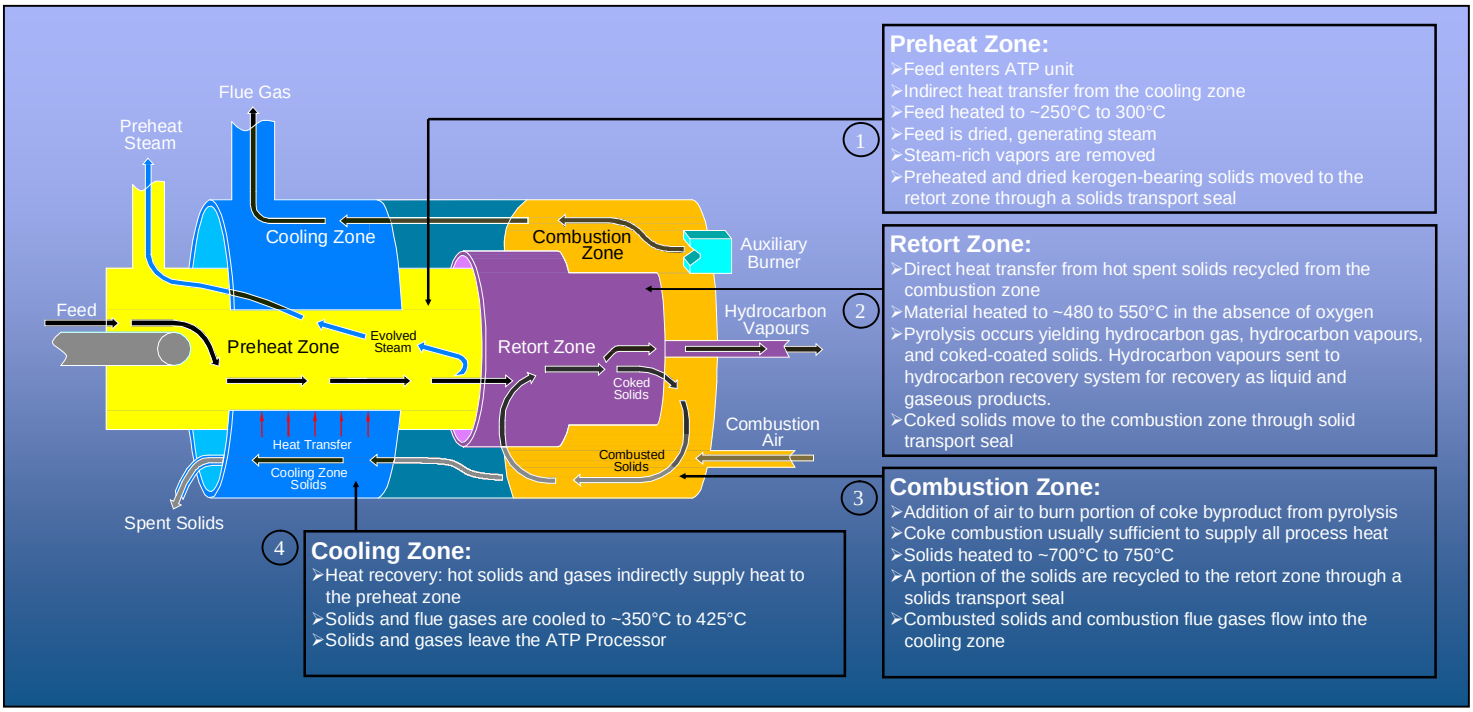
Design and construction of the first FMG ATP plant commenced in early 2006 and was originally scheduled for completion in mid to late 2008. A combination of equipment delivery delays, high demand for commodities worldwide, pressures within China due to the Olympic preparations and limited Chinese engineering availability resulted in delay of the plant completion. Plant construction is now complete and is in commissioning phase.

The FMG ATP facility has a rated oil shale processing capacity of 1,750,000 tonnes/year (230 t/h).

If operating results from the first unit meet expectations, FMG will install three to five additional ATP System trains, and opportunities for expansion into other locations in China are opened.

The ATP Processor

The ATP Technology for the FMG Project



The ATP Technology

The main component of the ATP System is the ATP Processor, which is a large diameter, horizontal, rotating cylindrical vessel. Inside the vessel are heat transfer and recovery tubes (called the preheat and cooling zones) that provide high thermal efficiency to the machine, a retorting zone where oil is extracted from the shale, and a combustion zone where all of the process heat is generated by burning the carbon by-product after extracting the oil.

When compared to the existing vertical retort technology, the ATP has the following advantages:

- Processes 100% of the mined oil shale. The existing retorts are not able to process shale smaller than 12 mm in size, and approximately 20% of the mined shale is discarded.
- Uses the by-product coke as the primary process fuel. The existing retorts burn a portion of the produced hydrocarbon gases to provide process heat. The ATP plant will use all of these gases to generate electric power, improving plant efficiency.
- The ATP System yield and recovery of oil from the shale is higher than the existing vertical retorts. Processing conditions in the vertical retorts result in incomplete extraction of oil from the shale.
- The ATP System produces a concentrated hydrocarbon stream. The vertical retorts produce a gas stream that is diluted with steam and combinations of inert gases and flue gases. This results in lower recovery of the hydrocarbon products that have been extracted from the shale.
- High capacity – the single FMG ATP Processor has the same capacity as approximately 60 of the existing vertical retorts. New ATP Processors in design will have twice the capacity of the FMG ATP.
- Environmental performance – the ATP System will emit less pollutant and recover more oil from the resource than the vertical retorts.

Environmental Performance

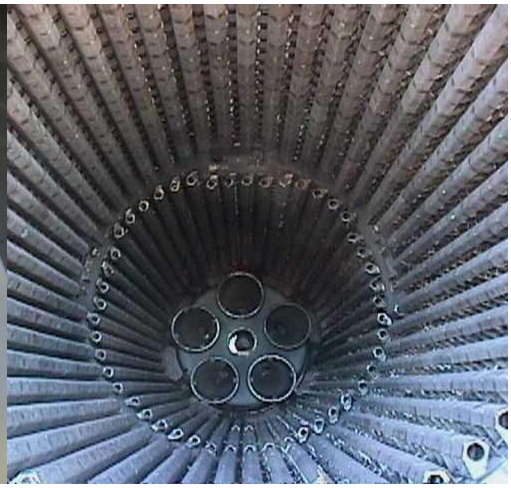
The first ATP System being constructed at FMG will be used to confirm and demonstrate the plant's ability to achieve the targets set for the project. The design teams have implemented new equipment configurations and design changes to improve environmental performance, including the following:

- Installing equipment to recover heat from the hot flue gas and spent shale leaving the ATP Processor. This equipment reduces greenhouse gas emissions by 15%.
- Including a preheat gas thermal oxidizer to destroy potentially odorous compounds.
- Scrubbing sulphur dioxide and ammonia from the flue gas to reduce pollutant emissions.
- Using high efficiency baghouse dust collectors to minimize particulate emissions.
- Improving resource utilization by making use of the 20% of the shale that is currently discarded.
- Achieving fuel self-sufficiency - no imported fuel (such as natural gas) is required to operate the ATP Processor.

Oil Shale

Light Shale Oil

Inside the ATP Processor



Project Organization

The project was organized to maximize China based engineering and equipment supply. The primary parties involved and their scopes of work are:

Fushun Mining Group – Owner

- Project management, procurement, design and supply of general infrastructure and oil shale preparation facilities, project construction, and plant operations.

Luoyang Petrochemical Engineering Company (LPEC) – Detail Engineer

- Detail engineering for plant layout, civil, structural, piping, electrical, and instrumentation. Specification of equipment for procurement.

Polysius AG – ATP Processor Mechanical Design and Supply

- Detail mechanical design and supply of key ATP Processor components, including riding rings and bearings, drive gear and pinions, supply of specialized high alloy fabrications and large castings, other specialty items, and technical assistance for field erection and quality assurance.

UMATAC Industrial Processes Inc. – a company of Polysius

- ATP technology licensor.
- ATP System basic process design, process flow and basic process instrumentation diagram generation, process equipment datasheet development, detail engineering support.
- ATP Processor detail process design, process sizing and configuration, and mechanical configuration.
- ATP System operator training and start-up assistance to FMG.
- UMATAC worked as a sub-contractor to Polysius.

Project Construction

Since the FMG plant site is located inland and approximately 450 km from the nearest port, many of the large diameter components of the ATP Processor had to be shipped in sections then welded and field machined to meet the required tolerances.

A series of pictures of the assembly and construction of the ATP Processor as well as development of the plant site follow to illustrate the equipment sizes and erection procedures that had to be practiced in order to meet the specifications set out by Polysius and UMATAC. These erection procedures included field-welding and **leading edge field-machining process** that has overcome a previous machine size limitation.

The ATP Processor has a rotating length of 63 m (206 ft), an outer shell diameter of 8.5 m (28 ft), and a support tyre diameter of 11 m (36 ft).

The empty rotating weight of the ATP Processor is 2,500 tonnes, and once operating on oil shale, the machine weight will increase to 2,800 tonnes (3,100 tons).

World-Wide Fabrication

Due to the large size of the ATP Processor components, Polysius selected shops from around the world that had the capabilities to manufacture components of this scale to the required quality requirements. Key portions of the ATP were fabricated in *Germany, Malaysia, Czech Republic, Netherlands, United States, and China*, then shipped to site for assembly.

Construction Photographs

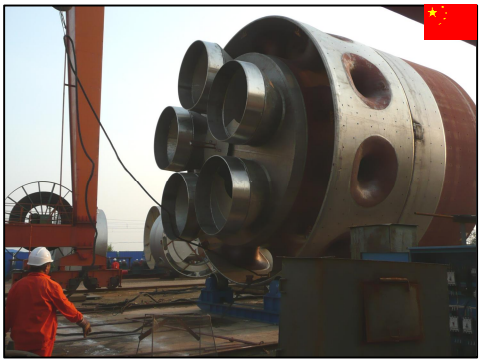
Fushun city – a major industrial centre – at night.

FMG's existing vertical retort facility.

FMG ATP System Plant Construction Photos

View of the site for the ATP System plant, showing preparations for installation of concrete pile. The pile excavations were dug by hand! The gantry crane extends the length of site for use during construction.

Casting and rough machining of the ATP support tyres was done in the ***Czech Republic***. The tyres were shipped to China in 180° segments and welded together on site. Each tyre weighs 120 tonnes (note workers in behind the tyre).

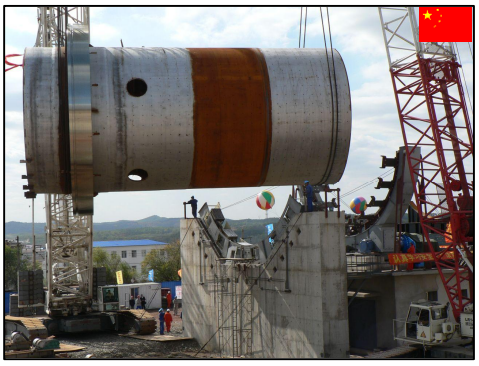


Field welding of the centre support section in ***China***. A total of fourteen 8.5 m diameter circumferential welds in steel up to 100 mm thick were required to join 15 outer shell segments together.

Design review meeting with UMATAC and Polysius engineers in ***Germany***.

Field machining of the 11 m (36') diameter support tyres on-site by Self-Levelling Machines (SLM) of ***Australia***.

This was a leading edge field-machining operation successfully completed under challenging conditions in China.



Lifting one section of the ATP Processor outer shell and one support tyre onto the foundation. Balloons and fireworks were provided by FMG to celebrate this achievement.

Design review meeting with UMATAC, Polysius, FMG, and LPEC engineers in ***China***.

Unloading the "ATP Centre Support" section of the outer shell – a high alloy fabrication manufactured in ***Malaysia***. Shipping weight was 164 tonnes.

Installing the girth gear, manufactured in the ***Netherlands***, onto the outer shell.

FMG ATP System Plant Construction Photos

View of the plant site for the ATP System, showing steel frame platforms being erected.

View of ATP Plant showing control room on right hand side and steel platforms being erected.

View of baghouse and ATP Processor preheat zone tubes.

View of ATP System plant and hydrocarbon cyclone installation.

UMATAC engineers on site in March 2010 training control room operators.

UMATAC engineers on site in March 2010 training control room operators in the field.

View of combustion zone of ATP Processor, hydrocarbon cyclone, and oil recovery system.

View of preheat zone and ATP flue gas system.

View of oil recovery system.

Future Opportunities

ATP System Plant and Upgrader in Australia

Oil Shale

Oil shale is a sedimentary rock containing a solid organic material called kerogen. Kerogen is a complex hydrocarbon molecule resulting from the gradual decomposition of organic residue from plant and animal life and can be thought of as an immature form of oil and gas. Given sufficient time, geologic forces could convert kerogen into *conventional* oil and gas. This natural process would take millions of years. Using modern processing techniques, the transformation can be rapidly accomplished and kerogen can be converted into *non-conventional* oil and gas using the *Alberta Taciuk Process*.

Oil Shale Resource and Potential

Oil shales are distributed throughout the world and differ widely in oil content and shale oil characteristics.

The largest identified oil shale deposits are located in the United States. These deposits dwarf all the others, and are estimated to contain more than two *trillion* barrels of oil, of which 560 billion barrels of this resource are considered recoverable "under present and expected local economic conditions with existing available technology" (in 2001).

For comparison, the Alberta Department of Energy estimates that the Athabasca oil sands contain 1.7 trillion barrels of oil, of which 174 billion barrels are considered proven reserves that can be recovered using current technology. Over one million barrels per day of bitumen are currently being produced from the Alberta oil sands.

The World Energy Council has prepared a 2004 survey of the shale oil potential of member countries. A summary of that survey is shown below.

By Country	Shale Oil billion bbl
United States	2,587
Jordan	34
Australia	32
Estonia	16
China	16
By Region	
North America	2,602
Europe	368
Africa	159
South America	82
Asia	46
Middle East	38
Oceania	32
World	**3,328**

Shale oil plants are currently in operation in Estonia, China, and Brazil. These plants mostly use variations of the stationary *vertical retort* technology.

The ATP Technology History

The *Alberta Taciuk Process* technology for oil extraction was developed in Alberta in the late 1970's for oil sands extraction and is equally suited to shale oil extraction.

The ATP technology is owned, developed, and licensed by UMATAC Industrial Process Inc., a company of Polysius, based in Calgary, Alberta, Canada.

The first large scale-up of the ATP System was the 250 t/h Stuart Oil Shale Demonstration facility, commissioned in Australia in 1999. ***This plant processed 2.6 million tonnes of oil shale and produced 1.65 million barrels of shale oil*** before the end of the demonstration program.

A 230 t/h ATP is currently being commissioned for FMG to supplement their existing vertical retort shale oil plant.

Future Opportunities

A 1000 t/h ATP plant is currently in preliminary design for Jordan. Two 500 t/h ATP trains will be installed in parallel to extract oil from the oil shale. A hydrotreater, sulphur recovery plant, and power plant will treat the products recovered by the ATP Processors to produce 15,000 bbl/d of synthetic crude oil, 320 t/d of sulphur, and 70 MW of electricity. The plant will be both fuel and electricity self-sufficient.

UMATAC is continually testing oil shales and oil sands from around the world. Promising oil shale prospects in the United States, Australia, Jordan, Estonia, and China have been tested and project development with the resource holders is on-going.