THE ALBERTA TACIUK PROCESS

For the Treatment and Recovery of Oil from:

- **OIL SANDS DEPOSITS**
- **OIL SHALE DEPOSITS**
- **HYDROCARBON CONTAMINATED MATERIALS**
- **SPECIALTY THERMAL RECOVERY PROJECTS**

ATP Systems Developed and Distributed by:

UMATAC Industrial Processes
A company of Polysius
Calgary, Alberta, Canada

AN INTRODUCTION TO UMATAC INDUSTRIAL PROCESSES AND THE ALBERTA TACIUK PROCESS (ATP)

The Alberta Taciuk Process (ATP) is a unique, thermal processing technology applicable to numerous industrial uses for vaporizing and recovering organic constituents that exist in a large range of feed materials. This process was originally developed and exhaustively tested for applicability to treating Alberta oil sands, commencing in 1976. It was later refined for use in oil shales and contaminated wastes treatment options. The uses which have been proven to date include:

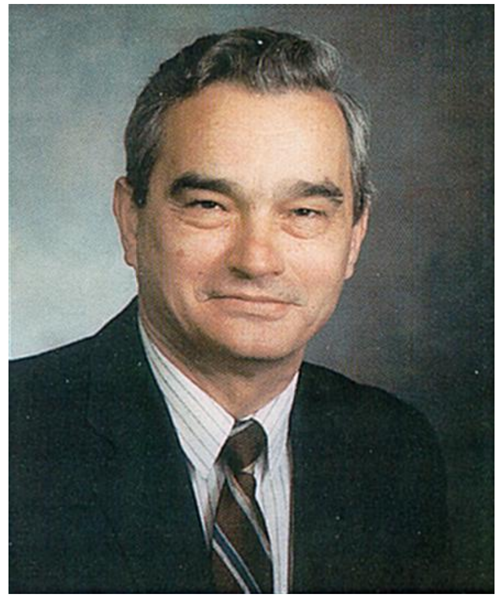
- Extraction and production of oil from oil sands.
- Extraction and production of oil from oil shales.
- Remediation of organic, hydrocarbon-bearing wastes or contaminated materials that may be present in soils, sludges and solid wastes.
- Remediation and recovery of used lubricating oils; and
- Partial upgrading of heavy oil to produce a pumpable distillate.
- Other applications that have been tested at small scale include separation of volatile metals, reduction of used rubber products and other solid wastes and reprocessing of off-specification or waste petrochemical products.

The flexibility of the ATP for treating these various materials coupled with the ability to meet processing requirements within acceptable product and environmental standards offers potential users an economic and efficient process and equipment package to be considered for industrial uses in the fields of resource development and environmental remediation. We have provided an introduction to the ***ATP System and its Developer and Supplier - UMATAC Industrial Processes*****.**

The 10 t/h Feed Capacity ATP Processor at a Superfund Site in the USA

UMATAC INDUSTRIAL PROCESSES

UMATAC Industrial Processes develops and provides the ATP technology. Located in Calgary, Alberta, UMATAC operates an engineering office, a research laboratory and pilot scale demonstrator ATP plant to support continued development of the technology as well as to investigate new applications for processing candidate feed materials.



William Taciuk, Process Inventor

UMATAC's expertise is its experienced staff of engineers and technicians, field operations experience, and the laboratory staff and facilities.

UMATAC licenses the use of the ATP. UMATAC develops custom specification, technical details, engineers, and supplies the ATP System equipment. Once the ATP System is constructed UMATAC provides technical support for start up and operation of the ATP plant.

THE ATP TECHNOLOGY

The ATP is a simultaneous extractor and primary upgrader of oil recovered from solids based feedstocks such as oil sand and oil shales. The heart of this process is a multi compartmented, rotating process unit that achieves heat exchange to preheat and dry incoming feed, thermal reactions to recover light hydrocarbons and combustion of by product carbon (coke) as the primary heat source. It is a thermal, dry processing technology that was originally developed in Alberta as an alternative to water-based systems used in oil sands. These systems employ separate process steps and technologies to extract the bitumen and upgrade it to make the synthetic crude oil.

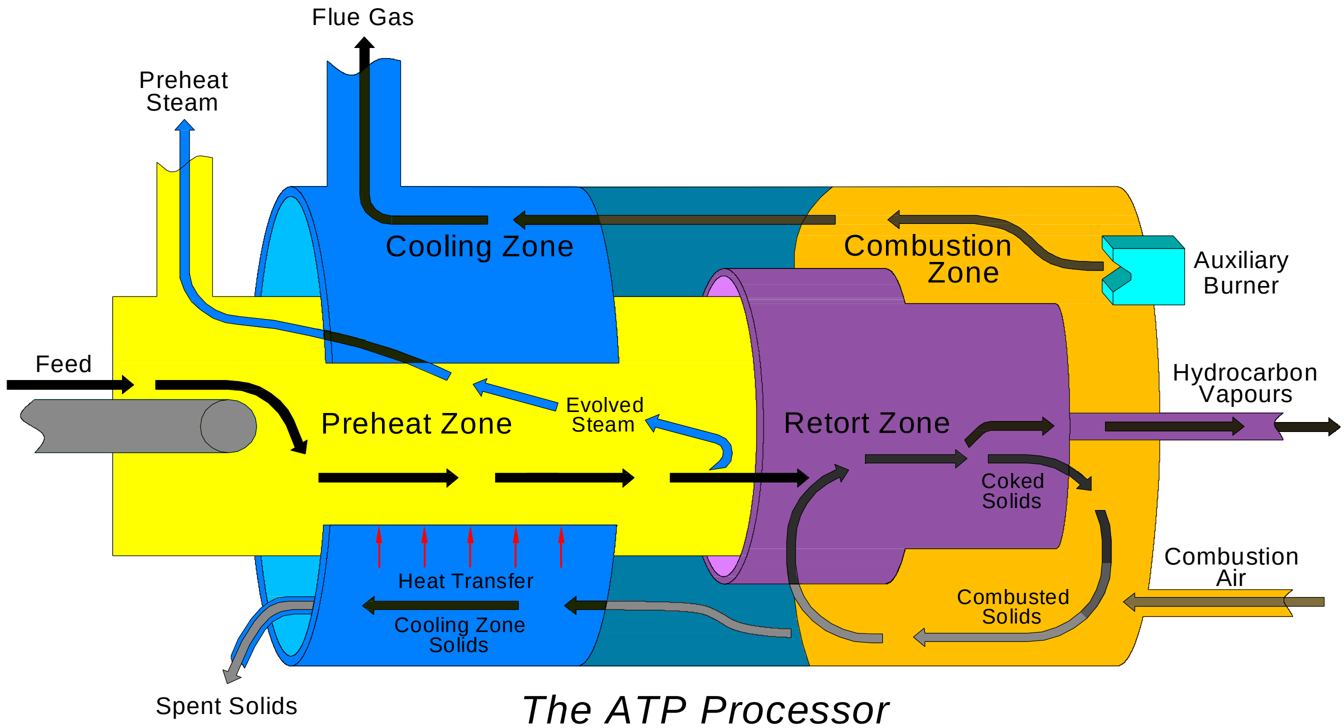
The Process is named after its inventor engineer William Taciuk of UMATAC Industrial Processes. Since 1976, under Mr. Taciuk's direction, UMATAC has developed and demonstrated the ATP at its facilities in Calgary. These facilities include a full systems pilot plant that has a production capacity of 60 barrels of oil per day from oil sands feed.

The ATP was first used commercially for remediation of hydrocarbon bearing wastes in contaminated soils. During the 1990's, an ATP System plant at several EPA Superfund sites cleaned up more than 100,000 tons of soil and sludge that contained hazardous contaminants. In the late 1990's, a semi commercial scale 250 t/h ATP plant was constructed in Australia to process oil shale at a rated capacity of 4,500 barrels of oil product per day. This ATP plant at the Stuart Oil Shale Project in Queensland operated as a demonstrator and large-scale pilot until late 2004. Technical and operational information from this demonstration has proven the capability of the ATP System to produce specified oil products and operate in a safe and environmentally friendly manner.

Currently in Fushun, China, a commercial scale ATP Plant capable of processing 230 t/h of oil shale is being commissioned by the Fushun Mining Group.

THE ATP PROCESSOR - HEART OF THE TECHNOLOGY

A horizontal, rotating vessel, the ATP Processor has individual compartments or "zones" in which the process steps occur to separate and recover the various product streams.



The ATP Processor

The Preheat Zone

- Feed material is heated and dried by transfer of heat from processed, out-going hot spent solids and combustion flue gases flowing through the Cooling Zone
- Lumpy and frozen feed materials are ablated
- Connate water is evaporated and the resulting steam prevents air from entering the Processor with the feed
- Evolved steam is cooled outside the Processor where condensed water and possibly some trace hydrocarbons are recovered
- Oversize material and rocks are removed

The Reaction Zone

- Preheated dry feed mixes with hot solids recycled from the Combustion Zone to rapidly achieve reaction temperatures
- The resulting mix temperature volatilizes or thermally cracks the feed organics in an oxygen deficient atmosphere, yielding hydrocarbon vapour, and coke-coated solid particles

- A concentrated stream of hot hydrocarbon vapours at reaction zone temperature is extracted from the Processor and processed externally
- Spent solids and coke are discharged to the combustion zone

Note – The hydrocarbon vapour is cooled outside the Processor; condensed product oil is recovered and may be directly fed to secondary treatment (hydrotreated) or pipelined. Concentrated light hydrocarbon gases are available for further processing and sold as products.

The Combustion Zone

- Air is added to burn the coke-coated solids entering from the reaction zone, thus heating the solids in the combustion zone
- Auxiliary burners supply additional heat if required, such as for start up
- The hot solids in the Combustion Zone are recycled to the Reaction Zone
- The balance of the solids and the combustion flue gases flow to the Cooling Zone

Note – The combustion of coke usually provides the necessary heat required for the process.

The Cooling Zone

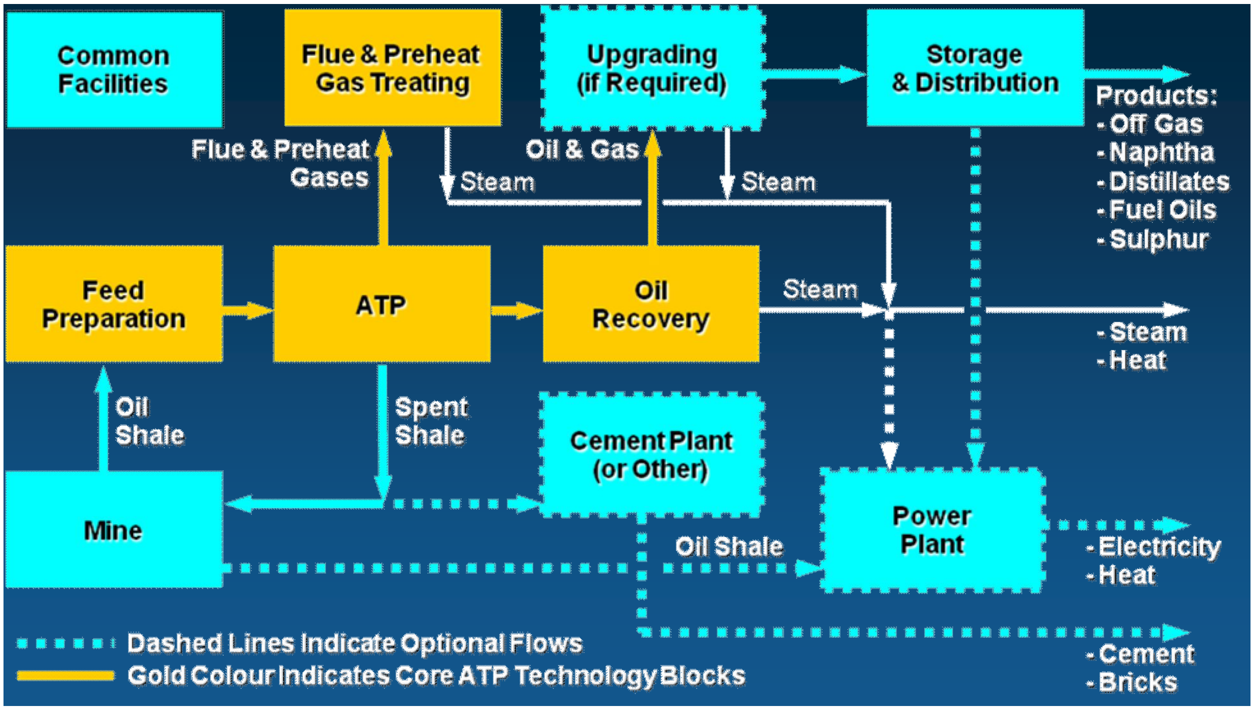
- The entering hot solids and flue gases are cooled by indirect heat transfer to the incoming fresh feed in the Preheat Zone
- The hydrocarbon-free solids are discharged and transported for disposal to mined out pit areas or other landfill
- Flue gases are discharged via a treatment system for removal of fine solids, acid gases, and other contaminants as required to meet environmental criteria

The Hot Solids Recycle System

A unique feature of the ATP Processor is the use of a recycling charge of hot solids to provide the primary heat input to the reactor. This recycling system achieves the following:

- Provides controlled heat input to the reactor by direct solids to solids contact.
- Provides seals at both ends of the reactor to maintain a vapor seal while allowing free passage of solids into and out of the reactor; and
- Provides a volumetric "locked in" solids charge to ensure seals are maintained under a wide range of operating conditions.

THE TECHNOLOGY - THE ATP SYSTEM



The Processor is the heart of an ATP System that has the following other major components:

- The Feed System feeds material directly into the Processor. Separate systems may be required to supply coarse feed to a preparation (sizing) plant that reduces particle size for feed to the ATP Processor. Standby and surge capacity are other usual systems and facilities.
- The Steam Condensation System comprises a cooler/condenser and phase separator for water recovery and the recovery of trace oil.
- The Oil Recovery System consists of a combination of cyclones, contacting towers, heat exchangers, pumps, separators, etc. as required to remove fine solids, stage condense the required oil products, and to treat the noncondensible gases as necessary for the desired usage of the C_1 to C_8 light hydrocarbons.
- The Flue Gas Treatment System - removes the fine solids (dust) and acid gases from the exhaust gas of the Combustion Zone suitable for emission to atmosphere.
- The Tailings System - receives, cools, moistens, and transports the spent solids that exit the Cooling Zone.
- Produced water treatment as required for plant reuse or disposal purposes.

RESEARCH & DEVELOPMENT

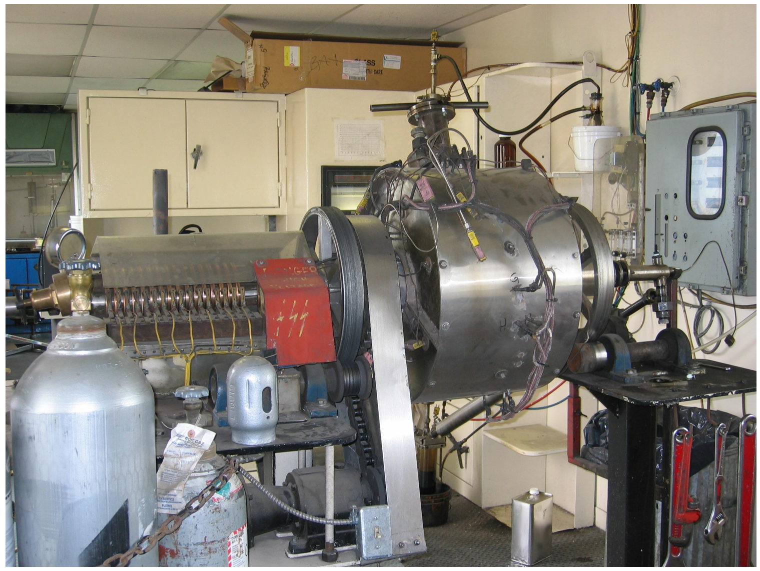
Treatability Testing

UMATAC's laboratory and pilot plant in Calgary, Alberta is equipped with bench scale test equipment that can simulate specific parts of the process conditions of the ATP Processor.

These facilities and equipment are used to carry out preliminary assessments, followed by progressively more detailed and focused test work once the ATP Technology potential is established.

With this and other lab facilities, UMATAC performs treatability tests on candidate feed stocks for treatment by the ATP System.

Products from these tests are analyzed for quality and environmental characterizations to assess the potential use of the ATP System.



UMATAC Batch Unit

100 kg/h Continuous Flow ATP Test Units

These units are located at UMATAC's R&D facility and are used to study processing characteristics of candidate feedstocks at an intermediate scale between the batch ATP retort and the 5 tonne/hour feed capacity pilot plant.

Continuous Flow ATP Test Units

UMATAC Laboratory

UMATAC operates its own laboratory to carry out internal analyses and testing. A few of these tests include and are not limited to: Modified Fischer Assays for oil shales, Dean Stark assays for oil sands, and gas chromatography for analyses of light hydrocarbons and flue gases.

Modified Fischer Assay Test Apparatus

UMATAC has tested a variety of candidate feed materials from many locations in the world including resource materials (oil sands, oil shales, peat moss, etc.) and wastes. Some of these are listed in following sections that describe ATP applications.

5 t/h Portable ATP Demonstration Plant

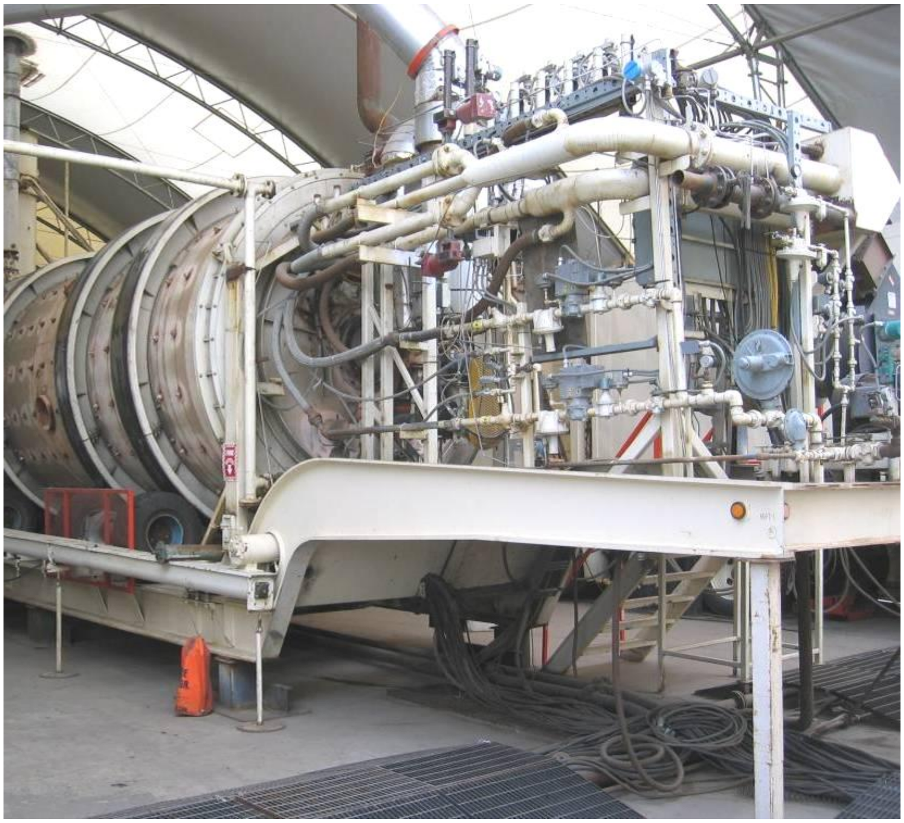
In 1978, UMATAC designed and constructed its original ATP process plant. The plant was used for all test programs until 1991 when a new 5 t/h transportable plant was constructed. The new unit was commissioned in 1992 and is suitable for:

- Demonstrating the Process at any location accessible by road or rail.
- Testing treatability of candidate feedstocks at pilot scale; and
- Commercial operations to treat wastes or contaminated materials.

This plant has been used as required to process 5,000 tons of oil sands, oil shales from Australia and Jordan as well as oily soils, sludges, styrene, used tires, and solid wastes.

One project, executed under the DESRT Program of the National Contaminated Sites Clean Up Program of Canada, demonstrated ATP remediation of wastes from oil refinery operations. The waste feed consisted of soils and sludges containing various oil and petrochemical compounds, including PCBs.

The plant is available to demonstrate and pilot test bulk samples of candidate feedstocks at the Calgary location or, alternatively, at the site(s) of the feedstocks.



The 5 t/h ATP60 Pilot Processor

Feed Materials Assessed by UMATAC for the ATP System Potential

For the oil sands application, UMATAC has process tested and assessed ore grades ranging from low through average to high-grade ore from Alberta, the United States, and a bulk sample from Malagasy.

UMATAC has tested and studied the ATP potential for a variety of oil shales that includes samples from the United States, Australia, Brazil, Israel, Canada (New Brunswick and Saskatchewan), China, Thailand, Estonia, and Jordan. Other resource materials tested for oil production or upgrading include Lloydminster (Canada) heavy oil and New Zealand peat moss.

For waste treatment applications, the range of contaminated materials and wastes tested and studied for potential treatment by the ATP System includes oil refinery wastes (sludges, tank bottoms, etc.); coal tar residues; wood preservatives (PCP, etc.); invert drilling mud cuttings; oil field desand sludges, tank sediments, emulsions, etc.; PCB contaminated soil & waste; waste rubber (tires, etc.) and off specification styrofoam.

Development of the ATP for Oil Sands Processing

1974-1975	Original research and conceptual design.
1977	AOSTRA-UMATAC agreement signed for ATP development.
1978	Construction of pilot plant completed.
1978-1980	Pilot plant operations on oil sands and other feeds.
1980-1982	Continued engineering development and piloting operations.
1982-1985	Extended test runs on oil sand feed, analyses of the ATP oil product by the Gulf Oil laboratory in Sheridan Park, batch tests on other feed stocks - oil shales, oil sands from other locations, wastes, contaminated materials, etc.
1982-1988	Proposals for a large-scale field demonstration of the ATP in the Athabasca oil sands region of Alberta.
1982	Engineering study of the ATP by Dynawest for the ERCB and engineering comparison study by Partec Lavalin - ATP vs. HWE (hot water extraction) at commercial scale.
1984	Design of the 1,200 bbl/day demonstration Processor for the OSDC & design of a 12,000 bbl/day commercial scale Processor. The Demonstrator project was deferred as a result of extremely low oil prices.
1985	Study by Bantrel Group Engineers for Canterra Energy of the 1,200 bbl/day ATP Demonstration Project.
1986	Study (conceptual design and cost estimate) of a 12,000 bbl/day capacity single Processor ATP plant for Canterra Energy (Athabasca Tenneco Lease).
1987-1992	Preliminary design and cost estimate of a 16,250 bbl/day ATP plant in oil sands, ATP evaluation of a 75,000 bbl/day capacity ATP plant and production facility to produce distillate from oil sands, ATP evaluation of a 72,000 bbl/day capacity ATP plant.
1992-1993	Operation of the ATP 60 at the Calgary plant for further testing and demonstration of the ATP on oil sands for the ADOE/Industry Task Force program. A bulk sample of ATP distillate from the above operation was supplied to independent evaluation and study of hydrotreating upgrading at CANMET.
1993-1994	Joint ADOE/INDUSTRY TASK FORCE - design, evaluation and cost estimate of a 60,000 bbl/day ATP plant by Fluor Daniel, and comparison by ADOE (Alberta Department of Energy) with an equivalent HWE (hot water extraction) plant.
1994	The ATP 60 plant was proposed for an extended operational demonstration in the Athabasca oil sands field. This project was deferred because of reduced oil prices.

Oil Shales Processing Development of the ATP

1980-1985	Batch retort tests were performed on various oil shales
1985 -1987	Australian Oil Shale Project (SPP) - ATP testing and development.
1990 -1992	Design and cost estimate for a 4,200 bbl/day capacity ATP unit for Australian oil shale. This is a semi-commercial demonstration scale project to be undertaken by the project developer, SPP.
1990-1998	Examined numerous oil shales from various locations in the world as candidates for processing by the ATP System.
1993	Visited Estonia to investigate the oil shale processing industry for potential improvement by use of the ATP Technology.
1996	Suncor Energy Inc. joined the Australian Oil Shale Project, later called the Stuart Energy Development Pty Ltd. (SED) Project. The 4,500 bbl/day capacity shale oil project was announced.
1996-1999	Participated in the design and construction of the ATP Processor for SED. This new plant is located at Gladstone, Queensland and was commissioned in 2000.
2000-2004	Participated in start up and operations of the Stuart 250 t/h R&D oil shale plant. Evaluated plant performance and carried out design and implementation of plant modifications to improve efficiency.
1998-2007	Test programs and studies carried out on oil shales from Jordan, Estonia, China, and USA.
2006-present	FMG Project (China) Stage I ATP System 230 t/h design and construction.
2008-present	JEML Project (Jordan) ATP System 500 t/h preliminary design.

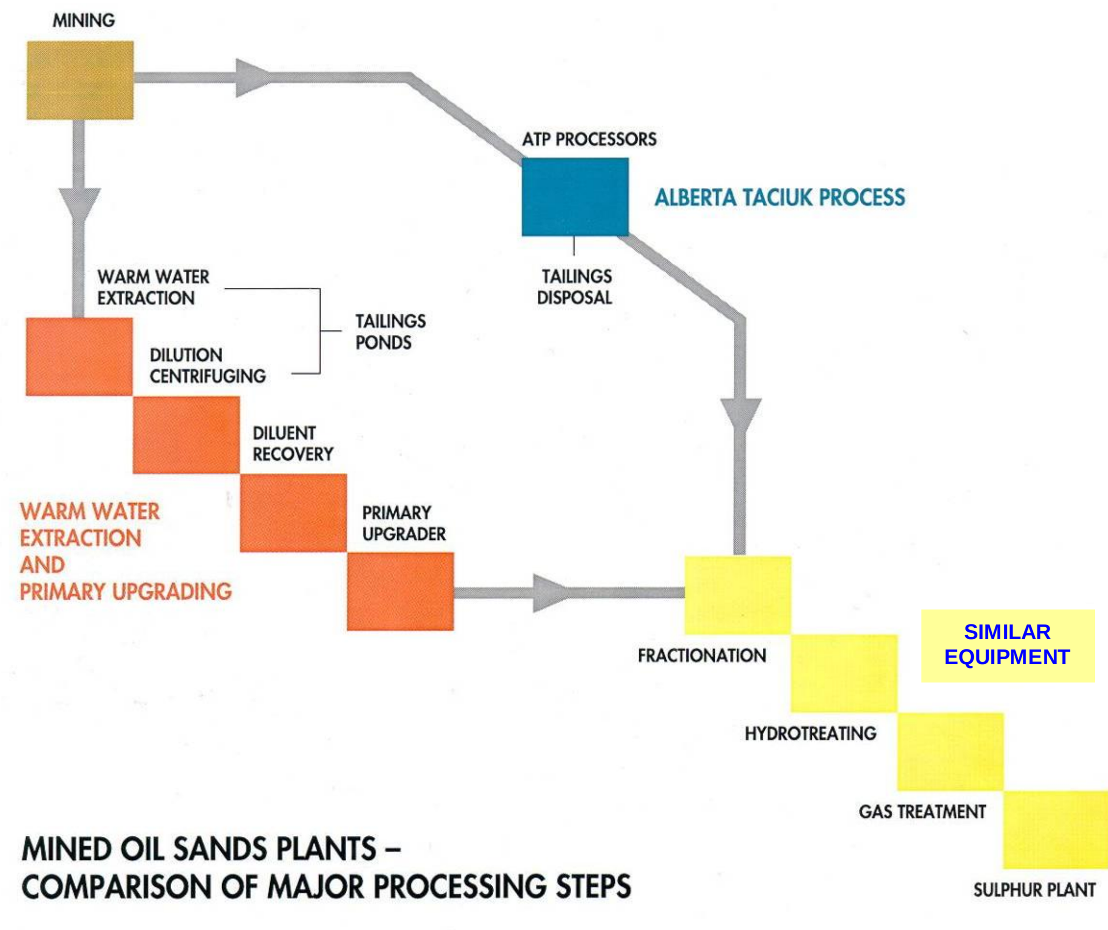
Wastes Treatment Processing Development

1985 -1998	Batch and pilot scale testing of numerous contaminated and waste materials for remediation/recovery treatment potential.
1988-1996	UMATAC partnered with U.S. licensee owner of first commercial ATP plant that was applied in waste treatment/environmental market.
1989	UMATAC built and supplied a 10 t/h capacity ATP plant to SoilTech ATP Systems Inc. for use in environmental clean-up projects in the United States.
1990-1995	SoilTech successfully completed 4 U.S. EPA Superfund Projects.
1997	The SoilTech operation was discontinued due to lack of funding for the U.S. EPA Superfund Program.

THE OIL SANDS APPLICATION

Simplify the process, reduce water consumption and tailings ponds, and save money.

It's an industrial maxim that clearly applies to the oil sands. The ATP replaces at least four major steps required in the hot water extraction and primary upgrading processes that are currently used. Project and plant design concepts can range from the simple production of ATP distillate; to a partially upgraded, stabilized crude oil; to a fully upgraded, widely marketable sweet crude oil.



The Oil Sands Advantage

Test results demonstrate that compared to current commercial methods for oil sands extraction and primary upgrading of bitumen, the ATP:

- Increases yield of product oil.
- Readily processed lower grade oil sands.
- Eliminates hydrocarbon loss to tailings.
- Eliminates large slurried tailing ponds.
- Increases energy efficiency; and
- Reduces water consumption.

The simplified design and streamlined technology of the ATP plant offers attractive economic benefit for its users. By modest estimates, the Alberta Taciuk Process offers the potential to meet or reduce the current cost of producing oil from oil sands.

These cost estimates were based on comprehensive evaluations by independent engineering consultants. In comparisons with then current commercial and developing methods for oil sands bitumen recovery and primary upgrading, the ATP was shown to:

- Reduce capital and operating costs.
- Provide higher net revenues through increased oil yield; and
- Enable improved rates of return on capital investments for an integrated mineable oil sands plant producing Athabasca light sweet crude oil.

THE OIL SHALE APPLICATION

Compared with other oil shale processing options, the ATP offers the unique features of:

- Simplicity of design for the System and equipment.
- Consistent operation over a wide range of feed characteristics.
- Large throughput in a single rotating processing vessel.
- Demonstrated capability for efficient solids-to-solids heat transfer.
- Production of a full range of high value oil products (no dilution of off-gases with flue gases).
- Utilization by product coke by combustion to provide the process heat requirements; and
- High recovery efficiency of hydrocarbons based on Fischer Assay.

When coupled with lower capital cost, these advantages make the Processor particularly attractive for the production of oil from oil shale. The ATP has been tested on many oil shales from around the world.

The Stuart Semi Commercial Demonstrator

In 1987, 1,600 tonnes of oil shale from the Stuart Deposit in Queensland, Australia, were successfully processed at the Calgary pilot plant in tests that confirmed the processing capabilities of the ATP and provided a reliable base for comparison of ATP performance with that of other technologies. This work led to an agreement with an Australian oil shale developer for a semi commercial plant that was used to confirm process performance for design of larger scale commercial ATP plants.

Commencing in 1996, UMATAC was closely involved in the design, construction, start-up, and operation of a 6,000 t/d (4,500 bbl/day) demonstration ATP plant for Stage 1 of the Stuart Project. This plant was commissioned in 2000 and, by 2002, operated at 60% to 80% of design capacity. It operated intermittently until late 2004 and prior to being shutdown in October 2004 it achieved 105% of the design feed rate.

At the completion of the Stuart Stage 1 operation, the Owner's Chief Operating Officer reported that "Initial results from a series of final plant trials conducted over the last two months have been positive. Notable achievements include stable production runs at over

100% of design capacity solid feed rates and oil yield while maintaining product quality and adhering to EPA emissions limits. These plant trials were conducted using existing equipment and known proven technology on-site at Stuart."

Stuart Project Alberta Taciuk Processor, 8.2m diameter x 63 m long

The Stage 1 ATP Demonstration Plant at the Stuart Project in Australia (Processor at lower left)

ATP FOR REMEDIATION OF WASTES AND CONTAMINATED SOILS

UMATAC's extensive research has also developed the capabilities of the ATP for remediation of wastes and other materials containing organic contaminants. Commercial use of the ATP for waste remediation began in 1989, and several clean up projects for the U.S. EPA Superfund program have been successfully completed to date. Waste contaminants in these projects have included PCBs, PAHs and pesticides.

Oil production and refinery wastes can be treated by the ATP to yield hydrocarbon free solids that may be disposed as landfill. Light, clean, oil may also be produced as a by-product.

In 1996, UMATAC carried out the R&D related to use of a modified ATP System for treating used lube oil to produce metals-free oil suitable for recycling to a refinery. A 400 bbl/day plant for this purpose was commissioned in 1996. The plant was shut down in 2000 due to poor economics.

ATP plant performance conforms to regulatory criteria for all effluents. Commercial and demonstration ATP plant performance were extensively monitored during the U.S EPA Superfund and the Canada DESRT programs. These projects were successful demonstrations of this innovative technology in waste remediation.

Provided below are reference projects completed in commercial operations of the ATP Technology and 10 tph waste treatment plant:

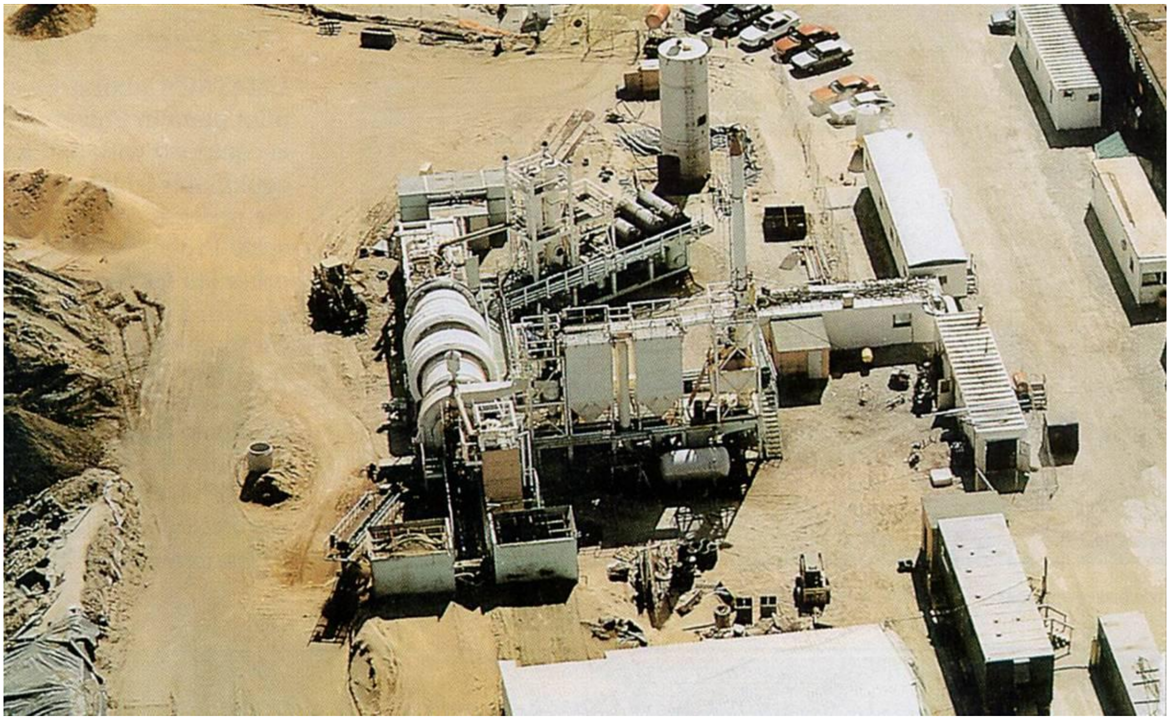
- **Wide Beach Superfund Site, Buffalo, N.Y., 1990/1991**
  - 42,000 tons of wet clay/silt soil contaminated with PCBs and road oil. The Project was evaluated and reported by the EPA SITE program.

- **Waukegan Harbour Superfund Site, Waukegan, Illinois, 1991/1992**
  - 13,000 tons of sediments from ditches and harbour bottoms contaminated with PCBs and heavy oil. The Project was evaluated and reported by the EPA SITE program.

- **Pristine Superfund Site, Cincinnati, Ohio, 1993/1994**
  - 12,800 tons of wet silty clay soil contaminated with SVOCs (PAHs), pesticides, sulphur, and some VOCs.

- **Smith's Farm Superfund Site, Bullitt County, Kentucky, 1994**
  35,000 tons of shale soil from a chemicals dump that was contaminated with PCBs and VOCs.

The 10 t/h ATP Plant at a U.S. EPA Superfund Site in New York



The 10 t/h ATP Plant at a U.S. EPA Superfund Site in Michigan

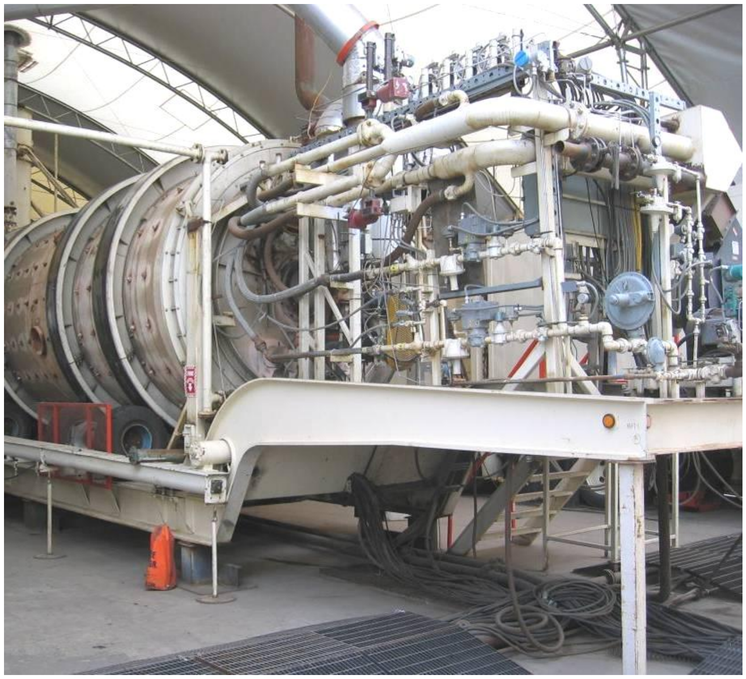
TOWARDS A COMMERCIAL FUTURE

The ATP has been clearly established as a viable system for successfully processing solids materials to extract constituents and recover and/or treat recovered products. This was achieved through the extensive research and development over the past 30 years at UMATAC's ATP pilot plant in Calgary, Alberta, by the proven commercial operation in the waste remediation industry and by the project operation in Australia of the demonstration scale ATP plant. Applications and materials on which the ATP has been proven are:

- More than 20,000 tonnes of oil sands of various grades.
- 5,000 tonnes of oil shales at the pilot plant.
- 2.4 million tonnes of oil shale at the Stuart Project demonstrator and 1.5 million barrels of shale oil produced; and
- More than 100,000 tons of hydrocarbon-bearing wastes.

UMATAC seeks opportunities to apply the ATP and plant equipment to the primary resource fields of oil sands, oil shales, heavy oil, and to the environmental field. UMATAC offers its laboratory and demonstration facilities to test and demonstrate the treatability of potential feed materials with the ATP System, which is available via technology licenses.

Once a commercial project is approved, UMATAC, with the assistance of contributing suppliers, provides the required engineering, procurement, construction management for plant erection and assistance for start up and ongoing plant operations.



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