Oil Shale Potential

ATP Oil Shale Plant in Australia

Oil Shale and Shale Oil

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 a very 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 trans-formation can be rapidly accomplished and kerogen can be converted into *non-conventional* oil and gas.

The first step in recovering oil from oil shale or oil sand is called *extraction*. The most common extraction technique for oil shale, and the only method used commercially, is to convert the kerogen to oil, gas, and coke using heat.

Kerogen molecules are very large and complicated. When the kerogen is heated to temperatures greater than 425 to 500°C (800 to 930°F), the large kerogen molecules are broken into smaller pieces, similar in properties and distribution to conventional oil and gas. This heating and decomposition process is called *pyrolysis.*

Oil recovered from the processing of the kerogen rich oil shale is called *shale oil*. Shale oil is similar in many ways to conventional oil, but does have some differences. Shale oil tends to contain higher concentrations of impurities such as sulphur and nitrogen than does conventional oil. Shale oil produced via pyrolysis also tends to be unsaturated and deficient in hydrogen.

These impurities can be removed, and the hydrogen deficiency eliminated, using standard refining practices such as hydrotreating. The process of improving non-conventional oil quality is generally referred to as *upgrading*. The upgraded oil product could be sold as a synthetic crude oil or as finished products such as gasoline or diesel.

An oil shale facility therefore typically consists of a mine, an extraction plant, and an upgrading plant. Refining of the upgraded oil can be done on-site or the upgraded products can be sold to an existing refinery.

Some technologies perform the extraction stage via mining and surface processing (*ex-situ* processing), while others perform the extraction step underground (*in-situ* processing).

Oil shale of sufficient quality may also be directly burned in specially designed power plants to produce electricity.

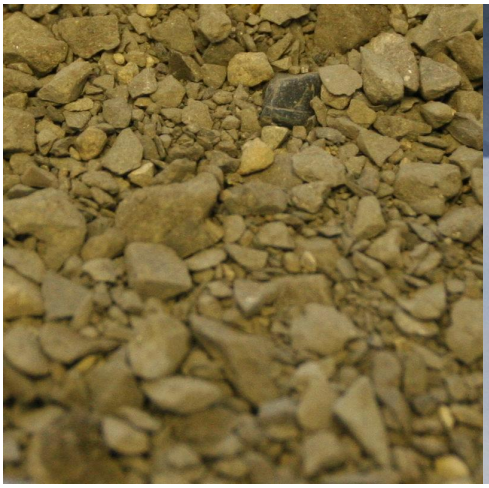
Oil Shale Reserves and Potential

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

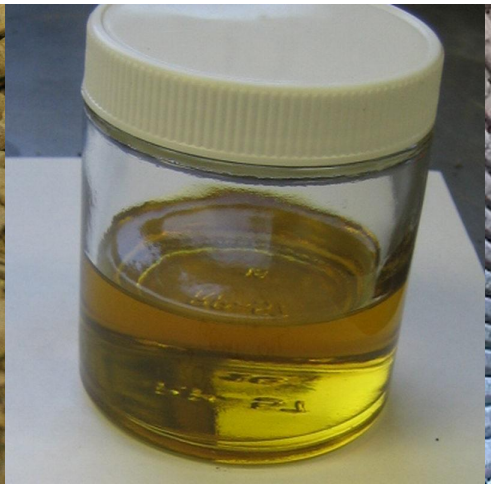
The largest identified oil shale deposits, by far, are located in the United States. These deposits dwarf all the others, and are estimated to contain more than two *trillion* barrels of oil, of which 560 billion barrels of this reserve are considered recoverable “under present and expected local economic 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.

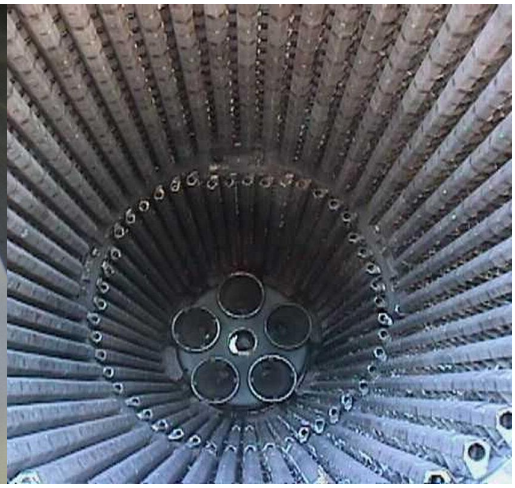
Oil Shale



Light Shale Oil



Inside the ATP



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. Many other deposits have not been fully explored, so the full extent of the deposits is unknown.

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 all use a variation of the stationary *vertical retort* technology. Estonia also has an oil shale combustion power plant in operation.

The ATP Technology

The *Alberta Taciuk Process* (ATP) technology for oil extraction was developed in Alberta in the early 1980's and is continually being improved. The technology was originally developed for oil sands, but is equally suited to shale oil extraction.

The ATP technology is owned, developed, and licensed by UMATAC Industrial Processes based in Calgary, Alberta, Canada.

After extensive research and development spanning 30 years on oil sands, oil shales, and hazardous wastes, the ATP was commercialized in the early 1990's at four Super-fund hazardous waste clean-up sites in the United States using a 10 t/h ATP.

The first ATP oil shale project, and the first large ATP scale-up to 250 t/h was achieved at the Stuart Oil Shale Demonstration facility in Australia. This plant was built in the late 1990's to demonstrate the ATP technology at an intermediate size before scale-up to the final commercial scale of 800 to 1,000 t/h. 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 built in Fushun, China to supplement their existing vertical retort shale oil plant. The existing vertical retorts exhibit low oil yield and are unable to process the fines portion of the ore, resulting in low utilization of the resource.

The advantages of the ATP technology compared to the vertical retort technologies are that:

- The ATP is able to achieve higher oil yields and process all of the crushed feed ore (the vertical retorts discard the -12mm fine size fraction).
- The ATP combines multiple process steps into a single rotating machine that is thermally efficient and mechanically robust.
- The ATP rotating kiln technology uses solids heat transfer to reduce equipment size and avoid gas to solids heat transfer which is characteristic of vertical retorts. These advantages result in a single ATP having much higher capacity than multiple vertical retort units.
- The ATP uses internally produced fuel to supply process heat and recovers heat from waste streams.
- The ATP produces a full boiling point range oil and a high heating value off gas which are both valuable products.

Future Opportunities

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