WORLD HISTORY AND RESOURCES OF OIL SHALE

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INTRODUCTION

This paper will cover briefly a little of the information that will be presented in the book I am now preparing under the same name as this paper.

Oil shale under one name or another is found all over the world.

Total world resources in place probably contain hundreds of trillion barrels of oil if all grades are considered, but only rough estimates of reserves are available since exploration and definitive evaluation has, for the most part, been extremely limited.

Based upon todays technology and economics,only a very small percentage of these world oil shale resources can be considered recoverable. Oil shale, even at 25 gallons per ton, is a fairly low-grade ore, and it appears that about 85% of the world oil shale resources are contained in shales averaging less than 10 gallons per ton.

WORLD DEVELOPMENT HISTORY

With the widespread occurrences of oil shale it is reasonable to expect that attempts have been made to utilize this resource, and indeed they have. Historically there is evidence that oil from oil shale was known at least as early as 800 AD, and the oil shales of England were worked in Phoenician times for some constituent not now known. In more modern times the use of shale oil was recorded in Austria in 1350. The first oil shale patent was issued to Martin Eele in England on 1694. Oil shale was officially recognized in Australia in 1802. The first recognized commercial production of shale oil started in France in 1838. About 1850, there were at least 60 companies operating in the U.S. and Canada, some using oil shale, others Boghead and/or cannel coals. Also in 1850 a commercial oil shale industry started in Scotland, one that would survive for a century.

In the decade following World War I, oil shale activity increased significantly in many countries. The first recorded utilization of oil shale in Germany was in 1916. By 1920, an expermental oil shale research plant had been built in Sweden, and oil shale research and development was initiated in Estonia. A small plant was built in Spain in 1922. In the early 1920's there were several experimental plants operating in the United States and Canada.

Utilization of oil shale in Manchuria was started by the Japanese about 1924, although small scale production was started by the Chinese a few years earlier. Operations are still being conducted by the Peoples Republic of China. The year 1926 saw the development of the large East Texas oil fields, which resulted in the end of the U.S. oil shale activity until after World War II. By the mid-1930's active industries existed in Scotland, Manchuria, Spain, Germany, Estonia, France and South Africa. The South Africa operation ran from 1935 to 1962 without subsidy of any sort and was probably the most successful. Operations began at the Glen Davis plant in New South Wales, Australia, in 1938.

Oil shale increased in importance during World War II. The Swedish industry was revitalized and became a model producer. Production of shale oil of importance to the war effort occurred in Great Britian, Australia, Estonia, Spain, South Africa, Sweden, France, Germany, and Japan (occupied China). Although war-damaged operations were restored and shale oil production appeared to be growing, it could not compete with with natural petroleum, natural gas, and coal, and with the exception of the industries in Estonia and China, all commercial shale oil operations were closed by 1966.

REVIEW BY COUNTRIES

France:

The French oil shale industry operated for over 100 years and was characterized by cycles of intense interest and lithargy that related to national issues. Oil shale research was conducted by Laurent and Rickenbach starting in about 1830. Rickenbach produced and named the material paraffin in about 1833. Laurent exhibited oil shale products, including paraffin, at the world fair in France in 1838. However, in spite of these early efforts, the oil shale industry in France never reached the level of production or importance of the Scottish industry.

The French industry reached its peak in 1947 when 500,000 tons of oil shale were processed.

Three plants were in operation in the 1950's but all operations ceased by 1962.

The potential for shale oil production in France still exists. The Australian companies Southern Pacific Petroleum and Central Pacific Minerals, under the name Societe pour le Developpment de I'Huile de Schistes, hold an exploration permit at Mantcey, 350 kilometers southeast of Paris. This permit was recently extended for an additional three years, until 1988.

During 1984, nine core holes totaling 295.5 meters were drilled along the Toarcian oil shale within the permit area. All holes intersected oil shale which showed an average thickness of 17 meters and averaged 9.6 gallons (41 liters) per ton.

No development is expected under the current status of the energy industries.

Peoples Republic of China:

Data from China appears to be erratic. It often appears that tons of shale oil, and barrels of shale oil may be transposed.

An oil shale industry has existed in China since 1926 when the Japanese occupied China and took over the production of shale oil at Fushun. Here a 450-foot thick oil shale deposit overlies one of the world's thickest coal deposits. The oil shale is relatively low-grade (15 gallons per ton), but has been and is being processed since it must be removed to reach the coal. The Japanese commercial oil shale operation was expanded to 80 retorts of 50 tons per day capacity each by 1928, and at least two replacements have been made since then. During World War II, Fushun was an important supplier of oil to the Japanese war effort. The Chinese resumed control of this operation after World War II. Coal mining is becoming an underground operation and stripping requirements are lessening thus reducing oil shale production.

A second oil shale operation was started at Maoming in the 1950's according to some records. However, the first recorded production record found states that the plant produced at a capacity of 12,000 barrels per day in 1963, 20,000 barrels per day in 1967, and at 40,000 barrels per day in 1970. In 1982 it was reported that there were six shale oil retorting plants which together may be processing as much as 1.5 million tons per year. The oil shale averages 6% or about 15 gallons per ton and is produced by open pit mining. No coal production is involved. Information on Maoming is limited and often contradictory.

It appears that with reported reserves of over 400 billion tons, China has abundent oil shale resources and with 50 years of continuous shale oil production history seems determined to develope a large shale oil industry regardless of changes in the world oil market.

Israel:

Occurrences of oil shale in Israel have been known for centuries. However, it wasn't until after World War I that British geologists investigated the Maastrichtian oil shale deposits of the region. In the early 1950's a small deposit of oil shale was discovered at EinBokek near the dead sea. This discovery encouraged the consideration of shale utilization, and research on direct burning was started. Exploration activities were haulted since natural petroleum was inexpensive and by the uncertainty of mining below the level of the Dead Sea in an established health resort area.

In 1960-1965 a rich oil sequence was accidently penetrated during a phosphate survey in the Negev (Northern Israel). This evidence that oil shale deposits might exist provided the basis for continued exploration and research when the "oil crisis" of 1973 indicated a necessity of finding alternatives for crude oil.

The research and exploration effort has resulted in proven reserves of over 10 billion tons of oil shale which to date is Israel's only identified indigenous fossil energy resource. It is planned to mine the Negev deposit that averages about 17 gallons per ton by open pit methods. A modified Paraho retorting process would be used to ultimately produce about 18,000 barrels of oil per day at a projected cost of approximately $35.00 per barrell. A demonstration plant of 1,000 to 2,000 tons per day is planned by the late 1980's, and increments will ba added until total capacity is reached in the 1990's.

A companion electric and steam power plant to burn the oil shale fines not suitable for oil extraction is an intrinsic part of the total complex planned. A prototype unit has demonstrated

feasibility, and upgrading to commercial size is now being considered.

Israel, In 1984, entered into a three year agreement with the U.S. Department of Energy to explore various aspects of oil shale development and utilization.

Morocco:

Like Israel, oil shale is the only abundent fossil energy resource in Morocco. I have found no early history of oil shale utilization, although the shales have been known for many years.

Moroccan oil shale occurs in three major deposits, Timahidt (15 billion barrels of 17-21 gallons per ton of oil in place), Tarfaya (5 billions barrels of oil at 13-15 gallons per ton), and Tangier (3 billion barrels per ton of unknowen grade). There are at least ten other oil shale occurrences in Morocco of currently unknown size or grade.

The Timahdit deposit is 400-500 meters thick and contains six rich zones averaging from 9-50 meters thick which are interbedded by lean shales. The deposit is covered by 100-200 meters thick sandstone/ limestone overburden. Mining by open pit is planned.

The Moroccan Office National de Recherches et D' Exploitations Petrolienes (ONAREP) and the U.S. firms of Davy McKee and Science Applications, Inc., have completed a pilot retorting plant to process the Timahdit shales. The retorts are "T-cubed" units which are the NTU batch retorts modified for semi-continuous operation. Plans were for the retorts to operate through 1985 accompanied by studies on mining and shale process comparisons.

The program seems to be somewhat confused at present. Discovery of natural gas appeared to be a solution to energy needs for a time, but it is reported this source is less than anticipated. Some problems with the oil shale retorts resulted in closing this portion of the work since natural gas appeared to be available. Since the gas supply is less than expected, the need for the oil shale retorting facility must be reevaluated.

Morocco, in a venture with Royal Dutch/Shell Oil Co., conducted feasibility studies on the Tarfaya deposit. A 300 barrell per day plant was planned. Status of this venture is unknown at present.

Russia:

Recorded history of oil shale in Russia is at least 300 years old, and probably is much older. In 1697 Perer the Great, sent shale to Holland for testing. Although it was quite rich (up to 80 gallons per ton) the turmoil that devastated much of European Russia during this period prevented its development. Even local use was limited by the availability of other cheap fuels such as firewood, peat, and imported English coal.

Use of oil shale did increase as English coal availability decreased. Cities near outcrops of rich shale turned to this fuel. Farmers, noting the influence of oil shale on the soil, developed great interest in its use. It was written " for this it is necessary to lay it (oil shale) in heaps and after burning scatter the remains on fields, particularly sandy soil."

By 1830 Russian shale had been "semi-coked" to produce roofing and paving materials. Ivanov reported in 1839 that shale could be thermally decomposed to produce gas for illumination.

As in other countries, the 1850's and 1860's saw an increase of shale production for burning oil, lubrication, and paraffin. Availability of natural petroleum in the early 1860's resulted inclosure of most of these operations, but interest continued at the academic and scientific level.

Interest in local fuels revived in 1916, but World War I, the Russian Revolution of 1917, and new economic policies complicated development.

Estonia, which was separated from Russia under the World War I peace treaty, became a center of investment for European oil shale interests between the wars. Plants of various designs were constructed by Germany, Sweden, England, and Estonia. Estonia became the research development capital of Europe during this period of depression in oil shale industries elsewhere in the world. Estonian oil shale, known as kukersite, is among the richest in the world. The oil content of virtually all kukersite used in Estonia exceeds 40 gallons per ton, with the average perhaps as high as 50 gallons per ton. Reserves are suffisient for a large industry.

In Russia, oil shale was considered but large scale production did not develop. In 1922, V. I.

Lenin wrote to the Presidum endorsing oil shale, but even then there was little progress. Russia took over Estonia in 1939 as World War II approached and expanded oil shale facilities. Germany invaded Estonia in 1941, and the Russian army disabled the entire industry as they withdrew. Germany immediately started on restoration, but production had not started when Russia regained possession of Estonia in 1944. The Germans also destroyed the oil shale facilities as they withdrew. The Russians resumed the German plans for expanding the industry, but work was not completed in time to aid in the war effort.

Operations in Russia have included a vigorous research and development program over the past 10 to 20 years. Research objective has been to convert oil shale to clean-burning fuels and valuable chemicals. Two modern retorts, the Kiviter and the Galoter, were developed with the objective of the local and world technology markets. In situ retorting has been tested, but with limited success. It has just been reported that a breakthrough in the burning of oil shale has been made. Injection of coarsely crushed shale has replaced the fine ground material formerly used. This permits the counter air flow to return it to the fire box until the organic part burns up completely. Since the combustion temperature in this case is reduced by about 500 degrees, the mineral portion does not cling to the walls as it formerly did, but falls into the ash trap.

Annual oil shale production in Russia ia about 33.1 million metric tons, less than 1% of total energy, but important in areas where other sources of energy are limited. About 80% of the shale is burned in boilers and the remainder converted to synthetic fuels.

About 100 oil shale deposits are known in the USSR and are concentrated mainly in Eastern Europe. Total shale resources are estimated to be about 193 billion metric tons.

Increased development for the near future is considered to be restricted to the Baltic Basin. Oil shale in other regions appear to be uneconomical because of poor quality and/or lack of technology.

The current energy program calls for wide use of low-grade, inexpensive types of solid fuels.

OTHER COUNTRIES:

The oil shales of Jordan, Turkey, and Yugoslovia are among those of other countries now under investigation for possible early development. Only the United States seems to have completely abandoned interest in the future need for utilization of oil shale.

I have only touched lightly on a few of the countries that will be discussed in some length in the planned book. Some of what I have said may need to be revised before publication. Information in part is difficult to come by, but this book, if and when published, will be the first attempt to cover world oil shales in one volume since the mid-to-late 1920's. References for material used will be noted in detail in the published book.