USING OIL SHALE AS AN ALTERNATIVE RAW MATERIAL FOR ENERGY PRODUCTION AND POTENTIALITY OF TURKEY

by Abdurrahman Murat

WHAT IS OIL SHALE

Oil shale is commonly defined as a fine-grained sedimentary rock containing organic matter (kerogen) that yields substantial amounts of oil and combustible gas upon destructive distillation (retorting). Most of the organic matter is insoluble in ordinary organic solvents; therefore, it is decomposed by heating to release such materials. What derives the importance of oil shale to produce energy including combustible gas and a number of procured products is how economic it can be recovered.

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Deposits of oil shale having economic potential are generally those that are at or near enough to the surface to be developed by open-pit, conventional underground mining or by in-situ methods. Oil shales have a wide range of organic content and oil yield. Commercial grades of oil shale, as determined by their shale oil yield, ranges from about 100 to 200 liters per metric ton (l/t) of rock. The U.S. Geological Survey has used a lower limit of about 42 lt/ton for classification of federal oil-shale lands.

USES, RESERVES AND STATUS OF OIL SHALE IN WORLD

Oil shale researches that fired up the energy sector during the crisis experienced all over the world draw a sinusoidal curve. First researchers of the oil shale started producing

Figure 1: A display of oil shale rock samples.

shale oil and reached the maximum level in the 1800s, but the production declined in 1859 upon the discovery of raw oil.

Oil shale studies that gained importance again during World War I (1915) entered the recession period with the discovery of new oil fields in the coming years and shale oil produced from oil shales gathered all attentions on it once again during the World War II years (1940-1945), but production works of shale oil have been suspended with the start of the stabilization period on the oil prices after the war.

The crisis occurring in oil production in the 1970s and the price increases encountered after this crisis have been caused shale oil production to become the main topic of the agenda and these developments have given acceleration to the research activities.

USES OF OIL SHALE:

UTILIZATION OF THE SHALE OIL AND GAS PRODUCTION

Shale oil production from oil shales is carried out by means of making the pyrolysis in the places where oil shales are available (in-situ) or after oil shales are extracted from the place where they become available (ex-situ) subsequently during mining activities. Industry uses of oil shale is in Brazil, China, Estonia and to some extent in Germany, Israel, and Russia. Several additional countries started assessing their reserves or had built experimental production plants, while others had phased out their oil shale industry. Oil shale serves for oil production in Estonia, Brazil, and China; In 1920s, in Fushun, Liaoning Province, China, shale oil indus¬try was set up. The Fushun-type retort, combined with pyrolysis and gasifi¬cation sections was developed.

UTILIZATION AS SOLID FUEL IN THERMAL POWER PLANTS

In Canada, fluidized-bed technology has been tested in the Lurgi's design. Coal with high sulfur content and oil shales with carbonate have been burned. In Israel, the energy has been produced in a power plant of 12 MW. In Jordan, the feasibility studies of oil shale-based power plant and also in Morocco, the laboratory and pilot power plant studies have been completed. Oil shale production in Estonia began in 1916 and the annual output reached 41 million tons in 1980. Oil shale with Kukersite type is used in Estonia in order to produce electricity, gas, liquefied hydrocarbon and other chemical products. Also residual shale is used as a raw material of high quality cement in Estonia, Germany, and China.

COUNTRIES	RESERVES (Million tons)
USA	3,340,000
AUSTRALIA	32,400
BRASIL	9,646
ISRAEL	15,360
THE REP. OF SOUTH AFRICA	73
JORDAN	40,000
MOROCCO	12,200
THAILAND	18,668
TURKEY	1,641
ALBANIA	6
ESTONIA	1,500
UKRAINE	2,674

Figure 2: The distribution of oil shale reserves all over the world.

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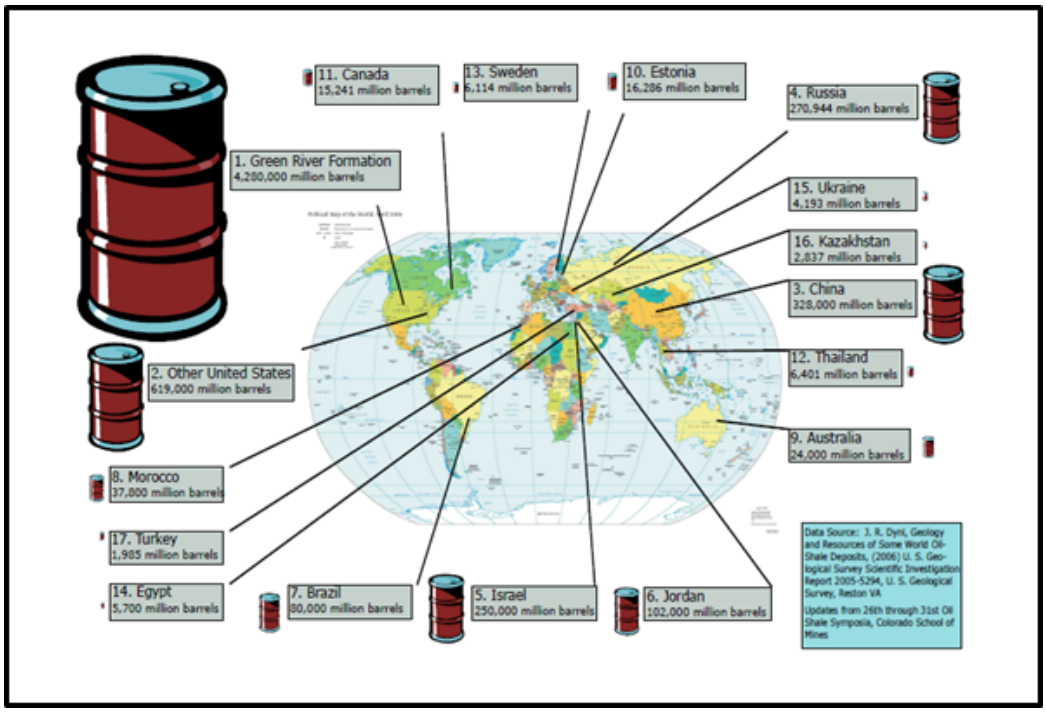

Figure 3: The distribution of oil equivalent reserves of oil shale all over the world.

"In the system established in Dotternhausen in Germany and called as "Rohrbach Process", electric energy is generated by burning the oil shale and residual shale is used as raw material of cement."

Apart from these, oil shales are used with success as fertilizer and soil stabilizer after various operations are carried out and also they are used in the neutralization of acidic soils since 1964.

The residual oil shale is produced more than 11 million tons every year by means of burning Kukersite in the Baltic basin. A portion of produced residual oil shale is evaluated as raw material in the construction industry and its remainder is destroyed by methods that will not harm the environment.

In the system established in Dotternhausen in Germany and called as "Rohrbach Process", electric energy is generated by burning the oil shale and residual shale is used as raw material of cement. In this way, the oil shale is both used as raw material of energy and cement is produced by using the residual shale.

Also, the precious metallic components (vanadium, uranium, etc.) are obtained from residual shales in the same complex. The distribution of oil shale reserves all over the world and oil equivalent reserves are shown in Figure 2 and 3.

When resource reserve distribution of potential shale oil that can be produced from oil shale reserves in the world is examined, it is seen that United States is ranked as the first with total 4.9 trillion barrel reserves and Turkey is ranked as the last with 1.985 million barrel reserves. Commercial production of shale oil is occurring in Estonia, China and Brazil.

"70% of oil shale production in the world is carried out in Estonia. Estonia has approximately 100 years of business experience and 30 years of commercial experience."

STATUS IN ESTONIA

70% of oil shale production in the world is carried out in Estonia. Estonia has approximately 100 years of business experience and 30 years of commercial experience. Oil shale is Estonia's most important energy source and 93% (550 TWh / year) of the electric used in the country is produced from two thermal power plants that are fired with oil shale (2,800 MW).

Enefit Company, which is a government agency, has performed the oil shale mining

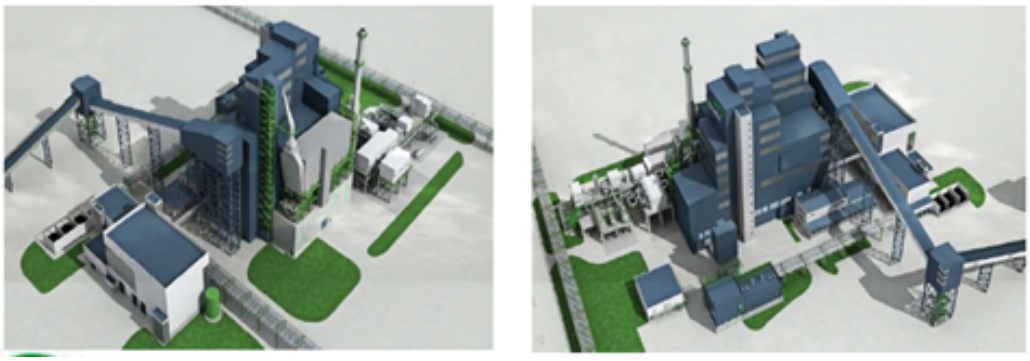

Figure 4: Model pictures belonging to Enefit280 shale oil production facilities.

Figure 5: A view of oil shale-fired power plants in Enefit-Narva.

activities and produced the shale oil through superficial retorting method by means of using vertical and horizontal integrated systems in Estonia and also it has carried out the electric production in significant quantities by burning the oil shale in the thermal power plants and has exported the electricity produced to the Baltic Region and Finland.

Enefit Company has produced approximately 1 billion ton oil shale together with 3300 workers employed in a field of 12,000 hectares in 2 open pits and 2 underground mines until today. Supplying almost all of electrical demand of Estonia, Enefit Company has carried out the shale oil production more than 200 million barrels as a result of retorting process ongoing during a time exceeding 30 years. The retorting plant called as Enefit140 is already an active plant even today. Also second plant Enefit280 has started the trial productions.

Estonia has carried out the shale oil production in Enefit140 facilities until today. A new and important project of Enefit Company is Enefit280 facility that will work with an operating life of 30 years.

Enefit280 facility has planned to produce 290,000 tons / year (1.8 mil. bbl / year) shale oil in a year by using 2.3 mil. tons oil shale. In addition, 280 GWh of electricity production will be carried out in the same facility. The total cost of the investment is approximately EUR 240 million. Also average cost of oil shale production is 14 EUR/ton. 1 MW of electricity generation costs 45 EUR.

Oil shale industry was established in Estonian in 1918. 2/3 of oil shale reserve with total 1.5 billion tons capacity of Narva open pit was used and it is estimated that approximately 500 million ton of reserves are still available.

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Overburden thickness in open pit mines is averagely 30 meters while average thickness of oil shale seam is 2.8 meters. There are oil shale seams in various thicknesses under this seam and their intercalations are generally composed of limestone. Production is carried out by dragline + trucks. The oil shale industry provides employment opportunities for 10,000 people in the country.

After Estonia has obtained the shale oil and electricity production from oil shale, it eliminates the ash by using it in different areas in order to reduce the environmental effects of remaining ash. The ash used in important cement factories can be used in the brick-making at the rate of 20-30% as well. Oil shale ash is used in the blocks drawing attention due to its light feature that is used in building construction through autoclave (pressure vessel) method by means of adding to cement and dry mixes.

"In Chına, The first commercial production of shale oil began at Fushun in 1930 with the construction of "Refinery No. 1, this was followed by Refinery No. 2," which began production in 1954, and a third facility that began producing shale oil at Maoming in 1963."

STATUS IN CHINA

In China, oil shale deposits are widespread in many regions, the proved re¬serves amount to about 32 billion tons presenting a potential energy source. In Chına, The first commercial production of shale oil began at Fushun in 1930 with the construction of "Refinery No. 1, this was followed by Refinery No. 2," which began production in 1954, and a third facility that began producing shale oil at Maoming in 1963. A new plant for retorting oil shale was constructed at Fushun, with production beginning in 1992. 90 Fushun type retorts, each having a capacity of 100 tons of oil shale per day, produce 90,000 tons of shale oil per year at Fushun (J. Qıan and J. Wang, s., 2002).

The Fushun oil shale and coal deposit of Eocene age is located in Northeastern China just South of the town of Fushun in Liaoning Province. In this area, subbituminous to bituminous coal, carbonaceous mudstone and shale compose the Guchengzi Formation of Eocene age. In the West Open Pit coal mine near Fushun, 6 coal beds are present. Overlying the Guchengzi Formation is the Eocene Jijuntun Formation that consists of oil shale of lacustrine origin.

The oil yield of the oil shale ranges from about 4.7 to 16 percent by weight of the rock, and the mined shale averages 7 to 8 percent (~78-89 lt/ton) oil. Coal mining at Fushun began in 1901. For the first 10 to 15 years of mining coal at Fushun, oil shale was discarded due to the overburden. Production of oil shale began in 1926 under the Japanese and peaked in the early 1970s with about 60 million tons of oil shale mined annually, then dropped to about 8 million tons in 1978. This reduction was partly due to increased discovery and production of cheaper crude oil within China.

In 2002, Fushun shale oil plant produced about 90,000 tons shale oil. In the case of Fushun type retort, for producing 1 ton shale oil, 33 tons oil shale are consumed (Fischer oil yield about 6 %). As the oil shale mining cost is no more than 10 yuan RMB per ton (as a by-product of coal mining), the oil shale feed cost for producing 1 ton shale oil accounts for about 330 yuan RMB. Addition of the production cost (manpower, electricity, steam, mainte¬nance, etc.), 750 yuan RMB per ton shale oil, gives about 1000 yuan RMB for the total cost. Shale oil is sold as fuel oil at the cost 1500 yuan RMB/ton, and so the plant gains the benefit for 1 ton shale oil about 500 yuan RMB, that makes 45 million yuan RMB per year. Due to the good economic situation, Fushun shale oil plant is now planning to double its production capacity, and is seek¬ing for advanced and elaborated technology with larger retorts. At present, besides the oil shale combustion plant, Huadian plans to build shale oil plant with the annual processing capacity of 1,500,000 tons oil shale (5,000 tons oil shale daily).

Harbin Gas and Chemical Company, in Heilongjiang Province, a com¬pany dealing with gasification of Yilan brown coal for producing town gas for Harbin City, is also

	OIL SHALE				
	FUSHUN	HUADIAN	LONGKOW	YILAN	SONG-YASAN
Province	Liaoning	Jilin	Shandong	Heilongjiang	
Age	Tertiary				
Burial	Coexists with coal	Oil shale	Coexists with coal		
Condition	Open pit mining	Underground mining	Underground mining	Open pit mining	
Recoverable reserves (million tons)	2,000	200	40	10	20

Table 1: Properties and Reserves of China oil shales.

INDICES	OIL SHALE			
	FUSHUN	HUADIAN	LONGKOW	YILAN
Fischer Assay, % (dry basis)				
Water	4.00	13.10	13.40	7.20
Shale oil	7.93	16.15	14.40	7.98
Char	84.80	64.30	66.70	80.39
Gas + losses	3.07	6.45	5.50	4.43
Proximate analysis, % (dry basis)				
Water	2. 70	8.49	9.39	3.74
Ash	73.82	49.77	50.92	58.46
Volatile matter	20.13	37.37	39.00	23.32
Fixed carbon	3.35	4.37		14.48
Elemental analysis, % (dry basis)				
Oil shale kerogen composition:				
C	79.07	76.94	73.41	77.38
H	9.93	10.54	8.28	6.38
O	7.02	8.77	14.73	12.26
N	2.12	1.21	1.05	2.02
S	1.86	2.54	2.53	1.96
H/C mole ratio	1.51	1.64	1.35	0.99

Table 2: Chemical Properties of Chinese Oil Shale.

now intended to utilize their coal mining by-product oil shale for retorting to produce shale oil (1,000 tons oil shale daily). Song Ya San Coal Mining Company in Heilongjiang Province is a large coal mining company with yearly production of 10 million tons coal, also plans to develop the oil shale business (1,000 tons oil shale daily). Longkow Coal Mining Company in Shandong Province, producing brown coal for more than twenty years already, also plans to mine its by¬product - oil shale for producing shale oil (2,500 tons oil shale daily). At the end of 2008, the company operated the largest oil shale plant in the world consisting eleven retorting units with 20 retorts in each unit, total 220 sets of Fushun type retort. Annual oil shale processing capacity is designed to be 11 million tons

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of oil shale, and annual shale oil yields to be 2,075,000 barrels.

Feasibility studies indicate that due to relatively low mining costs (as a by¬product of coal mining) commercial production of Fushun and Yilan oil shales is profitable, in spite of low Fischer Assay oil yield (only about 7.9 %). As for Huadian and Longkow oil shales, in spite of much higher mining costs, their commercial production will also be profitable as their Fischer Assay oil yield is high. Certainly, it is important to utilize advanced and elaborated retorting technologies at these shale oil plants. The world's increasing need in the liquid fuel stimulate shale oil production in China. More oil shale retorting plants for producing shale oil will be built.

STATUS IN JORDAN

The Jordanian government still maintains its investment activities for the establishment of new production facilities to evaluate oil shale resources.

In 2006, Jordan assigned fields for 4 different foreign companies (Shell, Enefit, Petrobras, Incosin) for the purpose of techno-economic report preparation in order to bring the oil shale resources in Attarat and El Lajun region into the economy. Estonia-Enefit Company, one of the companies mentioned above, and Near East Investment Company established by the partnership of Malaysian government has started their works and they have planned to begin to the electricity generation through oil shale-fired thermal power plant with 2X230 MWe installed capacity in 2017.

"Lacustrine oil-shale deposits of Paleocene to Eocene age and of late Miocene age are widely distributed in the middle and western Anatolia in western Turkey."

RESERVES, USES AND STATUS OF OIL SHALE IN TURKEY

The oil and natural gas reserves in Turkey are minor; solid fossil fuels are the primary potential energy resources. These resources include a wide variety of bituminous coal, lignite, oil shale, asphaltite, and peat deposits and vary in reserve quality and physical characteristics.

Oil shale comprises the second largest potential fossil fuel in Turkey after lignite. The main oil shale resources are located in the middle and western regions of Anatolia. The amount of proved explored reserves is around 1,641,381 tons (Table 1). Among the potential resources Beypazari, Seyitomer, Himmetoglu and Hatildag deposits are of major importance in terms of quality, amount and exploitability which constitute around 50% of the total oil shale potential of Turkey. Other potentially important resources are in Mengen (Bolu), Ulukisla (Nigde), Bahçecik (İzmit), Burhaniye (Balikesir), Beydili (Ankara), Dodurga (Çorum) and Çeltek (Amasya).

Lacustrine oil-shale deposits of Paleocene to Eocene age and of late Miocene age are widely distributed in the middle and western Anatolia in western Turkey. The host rocks are marlstone and claystone in which the organic matter is finely dispersed. Data on the oil shale resources are sparse because only a few of the deposits have been investigated. The oil shale resources of Turkey might be larger, but further studies are required before reliable resource estimates can be made. On the basis of available data, total resources of in-situ oil shale for eight Turkish deposits are estimated at about 2.0 billion bbls (Dyni, 2005).

Oil shale studies in Turkey have begun with the establishment of the Institute of Mineral Research and Exploration (MTA) and the first studies in our country have been started in order to carry out the shale oil production along with the world's. Oil shale exploration activities intensified in the 1970s; geological map of 1/25,000 scale for 1,370 km2 area and 1/10,000 scale for 561 km2 area that will have potential power in the future has been prepared. 89 split type drillings and 42

drilling activities with total depth of 4,870 m, have been performed throughout the researches as the prospecting works. Apart from these drillings; 204 drilling activities, total depth of which reaches up to 12,350 m, aiming to explore lignite have been evaluated in terms of oil shale. It can be said that with the new detailed oil shale exploration project in or near the coal production licence areas in Turkey, oil shale reserves can be powered up to 15 billion tons.

With regard to the evaluation of oil shale resources in Turkey, the studies were fulfilled by German experts in order to produce shale oil in Mengen (Bolu) district of our country during World War II. Due to the oil crisis encountered in the 1970s, oil shales have come to the fore again and scientific-technological projects have intensified in the same year. Because of burning technologies developing in the forthcoming years, the evaluation of oil shale in the thermal power plants with lignite has become the main topic of agenda.

The detailed organic geochemistry-petrography studies and burning tests were carried out in Beypazari, Seyitomer, Hatildag and Himmetoglu fields in the frame of "Turkish-German Technical Cooperation Agreement" between 1986-1988. Advanced burning technologies (fluidized bed, CFB) have demonstrated that oil shale located on lignite in Seyitomer field may be burned with lignite. In tests carried out in a pilot power plant with 2 MWe, it has been observed that the high calcium content of oil shale and lignite had a positive impact in reducing the polluting emissions generated during burning process. In the studies fulfilled, it has been determined that in case of mixing of 20% of Seyitomer oil shale and 40% of Himmetoglu oil shale with lignite, they can be used in a fluidized-bed thermal power plant.

Despite the fact that oil shale becomes one of the known alternative energy sources, it neither takes place among primary energy sources nor in the long-term energy demand projections and strategies in Turkey.

In this section, we have tried to present samples from resource assessment activities as well as bringing in the economy activities launched in many countries regarding oil shale and as a result of these activities it has been observed that a sufficient awareness could not be raised yet, in Turkey, while all studies have been implemented in a comprehensive way throughout worldwide. As a result, oil shale might be eliminated from

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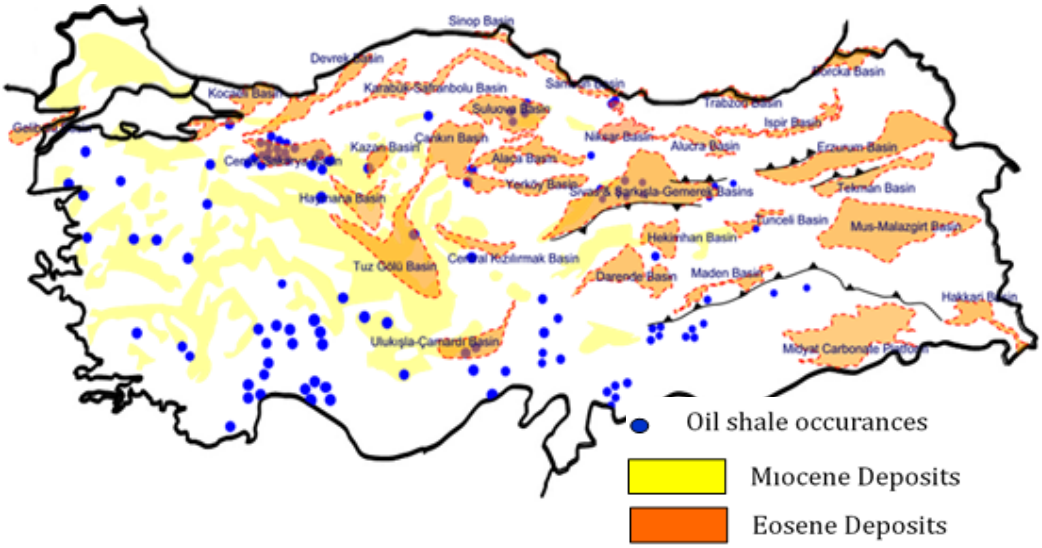

Table 2: Chemical Properties of Chinese Oil Shale.

assessment together due to its low calorific value.

"It has been believed that oil shale resources in Turkey can be evaluated at least by means of burning in oil shale fired thermal power plants and thus be brought in country's economy and accordingly to contribute to the country's energy raw material variety."

OIL FIELD	RESERVE (1000 ton)	AVERAGE CALORIFIC VALUE (kcal/kg)
Beypazarı (Ankara)	327,684	966
Seyitömer (Kütahya)	122,170	860
Hatıldağ (Bolu)	359,959	774
Himmetoğlu (Bolu)	65,968	1,390
Ulukışla (Niğde)	130,000	851
Mengen (Bolu)	50,000	1,000
Bahçecik (İzmit)	42,000	1,060
Burhaniye (Balıkesir)	15,600	732
Beydili (Ankara)	300,000	800
Dodurga (Çorum)	138,000	365
Çeltek (Amasya)	90,000	541
TOTAL	**1,641,381**	

Table 3: Oil Shale reserves in Turkey.

Detailed studies have been maintained in order to evaluate and urgently bring in the economy the domestic coals in Turkey. However, although Turkey's oil shale resources take place in the same environment with coal mine areas, mostly over and/or among coal seam levels, during the coal production, due to the low-calorific value (avg. 1000-2000 kcal / kg), is discarded without consideration together with the overburden rocks.

It has been believed that oil shale resources in Turkey can be evaluated at least by means of burning in oil shale fired thermal power plants and thus be brought in country's economy and accordingly to contribute to the country's energy raw material variety and available resource reserves as it becomes in Afsin-Elbistan lignites with average 1,100 kcal/kg used heavily in electricity generation purpose.

OIL SHALE PROJECTS IMPLEMENTED IN TURKEY

FIRST PROJECT

Turkish Coal Enterprises (TKI) and Turkish Petroleum Corporation (TPAO) jointly conduct a project having the topic of "Obtaining shale oil from oil shales through retorting process and/or energy production opportunities". In this project; geological survey, mapping, well logging, exploration activities and sampling procedures have been completed. Analysis and testing process still continues.

The project has been carried out in oil shale licenses that belong to TKI. The total cost of the project has been determined in TL 6 million and TKI and TPAO has taken part as a strategic partner in this project. Service procurement from MTA has been carried out and implementation activities related to geological survey and drilling services in the licensed fields as well as preparation activities related to the operable reserve reports has been conducted. In the scope of this project, analyses shall be carried out to determine the hydrocarbon potential of oil shales and the production quantities of shale oil. In the event that technological tests result in the economic dimensions and also open pit reserve determines in a sufficient amount, the feasibility report for the investment shall be

prepared. After the nature and sizes of investment is determined in the oil shale fields, TKI and TPAO (in joint venture) shall adjoin domestic and foreign investors from private sector by declaring the project finance models and share rates. The project is the first project realized in our country, which aims to generate energy by using oil shale under partnership of public institutions and it is aimed to contribute to diversity of our domestic energy raw material chain.

SECOND PROJECT

36 month term R&D project on "Obtaining Liquid Fuel from Turkey's Oil Shales with Solvent Extraction Method" is carried out between TKI and TUBITAK-MAM Chemistry Institute". In the scope of this project, it is aimed to determine the effects of factors such as the most appropriate solvent type, extraction temperature, time and pressure, solvent-oil shale ratio, grain size and additional additive type through studies to be done on samples taken from oil shale fields in Turkey by using autoclave.

It is aimed at making the discrete pilot scale trial by means of performing pilot scaled reactor pressure works in the samples received from several oil shale fields determined positive as a result of extraction activities. In addition, studies on the recoverability of the valuable elements found in inorganic structure in the oil shales will be made. These studies shall be continued with additional samples to be obtained from oil shale fields in 2016.

THIRD PROJECT

Final Situation in the 'Obtaining shale oil from oil shales through retorting process and/or energy production opportunities' Project.

In Bolu-Göynük oil shale field, 20 exploration borehole drilling have been completed in first phase until today and totally 4,146 m has been progressed. Among these borehole drilling logs, 3,964 samples have been compiled. Analysis and laboratory test works have been maintained in the laboratories of Turkish Petroleum Company (TPAO).

Also 6 exploration borehole drilling have been carried out in Ankara-Nallihan oil shale fields and totally 3,617 m has been progressed. The presence of live heavy oil filling the cracks in the range of 134-137 meters has been observed in drilling activity numbered TKIB-1, while weak natural gas (methane) output has been observed in drilling activity numbered TKIB-4.

Pyrolysis analysis of oil shale samples taken in the scope of the project is carried out in Research Center laboratories of TPAO. Fisher Assay analyses (oil yield %) are performed in the gasification lab. of MTA in the first phase, then Fisher assay analyzer is purchased by TPAO and delivered to support the project after its installation was completed. At the present time, 3,891 pyrolysis analyses and 385 Fisher Assay analyses have been completed. Evaluation and data processing activities in order to complete the analysis studies are maintained.

General Directorate of Mineral Research and Exploration (MTA) team continues the activities carried out in the field (geological survey, well logging and core sampling), accordingly reporting studies related to apparent + recoverable reserve account of oil shales and reporting studies related to the reserve of oil productive oil shale zones.

According to the first results obtained from the analysis of oil shales in the Bolu-Goynuk region; important data have been acquired to produce shale oil from oil shale rocks in this region. According to obtained data, it is understood that oil shales of Bolu-Goynuk field comply with the world standards in the context of shale oil production (SCO).

The short analysis needed in searching of

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the opportunities to produce electricity by means of establishing the oil shale-fired thermal power plant (moisture, ash, volatile in the ash and total sulfur, fixed carbon, volatile matter, upper and lower calorific value) are carried out in TKI GLI-Tunçbilek laboratories. According to Fisher Assay analysis results, 48 samples are selected for ultimate and proximate analysis by means of putting aside the samples at the rate of 4% oil yield and above. Selected samples have been subjected to analysis for Thermal Power Plant in TKI/GLI Tunçbilek laboratories. According to the analysis results, lower calorific values of samples (AID) change between 500 and 2,114 kcal/kg values in the dry sample. Also, analysis studies are maintained.

In addition, interviews aiming to develop a joint project together with TUBITAK-MAM Material Institute are continued in order to minimize the impact caused by wastes to be obtained from facility to be established at the end of the project and to assess these wastes economically.

RESULTS

1. The lignite and hard coal that take place among fossil energy sources, the existence of which is known in Turkey, have been given necessary importance till the day. Although they have been brought in the country's economy for years, the same importance for oil shale as an energy raw material may not be the case.

2. In today's world where the procurement of oil and electricity gradually get difficult; the attractiveness of producing the shale oil and/or electric energy from oil shales has increased at the point of increasing the energy diversity of our country in terms of both economic and strategic.

3. Oil shales in Turkey form the energy raw material that has the second largest reserve after lignite and also it is, yet, an untouched domestic resource.

4. In the scope of oil shale project conducted jointly by TKI/TPAO; in case that the reserve determination studies and trial production test studies that are carried out in the oil shale fields in Bolu-Goynuk and Ankara-Nallihan have been deemed suitable in terms of both economy and investment. It has been planned to establish a shale oil production facility and/or a thermal power plant in this region to produce the shale oil through retorting method on surface. It has been determined in shale oil yield (Fisher Assay) analysis of oil shales in these fields that oil yield changes in the medium and high economic level and between 750-2,250 kcal/kg calories. Analysis and performing tests still continue.

5. In the scope of the TKI/TPAO joint project, the interviews in various levels have been scheduled with the countries having shale oil production technology and accordingly studies in order to determine the domestic/foreign investors as well as environment friendly technology and production type are maintained in accordance with time schedule of the project. Works required to bring these facilities in our country's economy are continued.

6. In case of using of oil shales as domestic raw material, it has been believed that increasing in the energy raw material diversity and energy supply security will be able to play an important role to reduce the current deficit arising from energy import by means of obtaining liquid fuel and generating energy from oil shales.

7. TKI/TPAO and MTA provide the necessary support for the joint projects and it is aimed to conclude the investments to be carried out in order to produce shale oil and/or to install oil shale-fired thermal power plants by means of benefitting from our oil shale resources until the year of 2023.

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