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Şeyl Gases, Potential and Impacts

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Reseach Article

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Abstract

As a result of population growth, changing life styles and technological developments, the need for energy is increasing worldwide. Meeting this need is one of the most important issues of many countries in the world. It is of strategic importance for countries to meet their energy needs from domestic sources for their economies and energy supply security. Due to the limited oil and natural gas reserves, humanity has sought alternative energy sources. Although the development of alternative energy sources continues, countries need to utilize the underground riches most effectively.

In this study, determined reserves of shale gas (rock gas) obtained from bituminous shale rocks are examined and it has been observed that it is at a level to topple oil and natural gas from their throne. Under the light of the fact that the determined reserves are at a level that would change the energy balance in the world and countries' energy supply positions, and that Turkey is foreign-dependent in terms of energy need and generates almost half of its electricity from the natural gas it imports, the importance of utilizing shale gas reserves is highlighted.

Keywords: Bituminous Shales, Energy Sources, Rock Gas

Özet

Dünya genelinde nüfus artışı, yaşam şekillerinin değişmesi ve teknolojik gelişmelerin neticesi olarak enerji ihtiyacı artmaktadır. Bu ihtiyacın karşılanması dünya üzerindeki pek çok ülkenin en önemli konularından biridir. Ülkelerin enerji ihtiyaçlarını yerli kaynaklardan karşılayabilmeleri, ekonomileri ve enerji arz güvenlikleri açısından stratejik öneme sahiptir. Tespit edilen petrol ve doğal gaz rezervlerinin kısıtlı olması nedeniyle insanlık alternatif enerji kaynakları arayışına yönelmiştir. Alternatif enerji kaynaklarındaki gelişim sürmekle beraber, ülkeler yeraltı zenginliklerini en etkin şekilde değerlendirme gereği duymaktadırlar.

Bu çalışmada; bitümlü şeyl kayaçlarından elde edilen şeyl gazının (kaya gazının), tespit edilen rezervlere bakıldığında; petrol ve doğal gazın yerini sarsacak düzeyde olduğu görülmüştür. Tespit edilen rezervler dünya genelindeki enerji dengelerini ve ülkelerin enerji tedarik pozisyonlarını değiştirebilecek düzeyde olduğu, Türkiye'nin de enerji ihtiyacı hususunda dışa bağımlı olması ve elektrik enerjisi üretiminin yaklaşık olarak yarısına yakınını ithal ettiği doğal gazdan karşıladığı bilgisi ışığında şeyl gazı rezervlerinin değerlendirilmesinin önemi vurgulanmıştır.

Anahtar Kelimeler: Bitümlü Şeyller, Enerji Kaynakları, Kaya Gazı

1. Introduction

Technological developments in the world, population increase and individualization as a result of changing life styles cause an increase in energy need. In order to meet the increasing energy needs, besides fossil fuels, the importance of energy efficiency and renewable energy sources has started to increase gradually. The scarce reserves of existing fossil fuel resources have brought about new sources, and hydrocarbons and shale gas have become important items on the energy agenda of the world. Shale gas is obtained from bituminous shale rocks by using advanced production techniques. When the world reserve is examined, it is seen that this new source of energy will increase the diversity of energy sources and can change the balance of energy trade.

2. Materials and Methods

2.1. Bituminous Shale and Its Potential

Bituminous shale is a fine grained and layered rock and contains an organic substance called kerogen. When the rock containing this organic substance is heated, oil and gas are produced, and these products are called Petrol Shale and Shale Gas. Bituminous things are formed as a result of precipitation with algae living in the lake environment and inorganic material

carried from the land. Bituminous shale, which has been used as fuel for thousands of years due to its flammable feature, was used as a building stone in road construction and construction works for decorative purposes in 3000 BC in Mesopotamia in the Middle East. In later years, bituminous shale was used to obtain synthetic oil worldwide.

Bituminous shale is also called coal type rock, at the same time, electricity can be produced by using it as fuel in thermal power plants. The remaining part of the bituminous shale can be used as raw material in the cement and brick industry. Figure 1 shows bituminous shale [1].

Figure 1. Bituminous Shale

Bituminous shale deposits, which are widely available in various regions of the world, are gathered in 3 main groups: platform type, swamp and lacustrine type bituminous schists. Distribution and amount of bituminous shale resources by countries are shown in Figure 2 and the amount of reserves in the United States is three-quarters of the world total reserve [2].

In Turkey, oil shale works started with the establishment Mineral Research and Exploration (MTA) Institute and initial works focused on obtaining synthetic oil as in the whole world. Organic matter content and oil amount of bituminous shales are different from each other and an oil content between 100-200 l / ton is necessary for commercial value. According to another approach, the ratio of organic matter / minerals is desired to be between 0.75 / 5 and 1.5 / 5 for the commercial evaluation of bituminous shales [3].

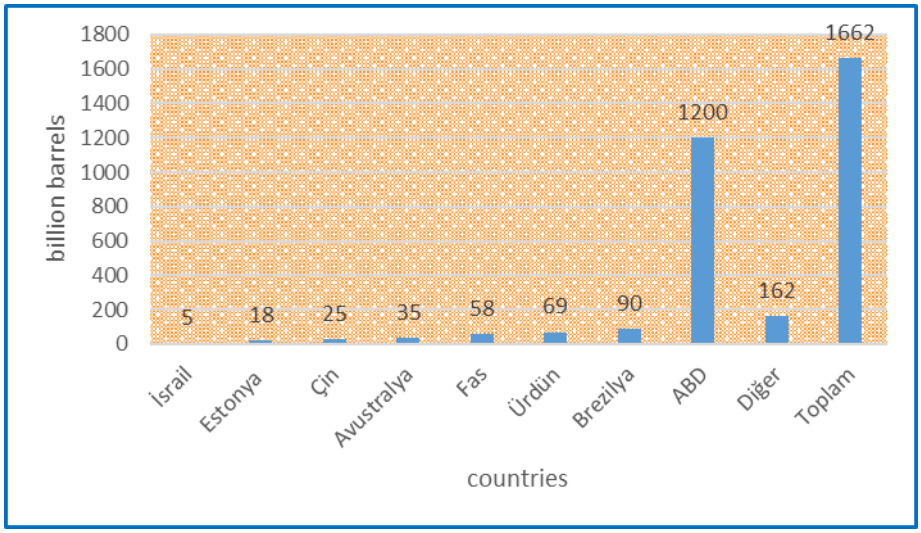

Figure 2. Distribution of bituminous shale resources by countries

The total potential geological reserves in 13 major fields in Turkey whose geological surveys have been completed is estimated to be at 555.344 billion tons. Calorific value of oil shale in Turkey is around 1000 kcal / kg or slightly below with high ash content. As a production method, a small part of the total reserve is suitable for open-pit and the rest is suitable for underground management. [2].

2.2 Shale Gas and Potential

Shale gas is a type of gas that can be found in pores in bituminous shale rocks and can be produced by unconventional methods. Although shale gas is also called rock gas, this is not a correct way of naming it. It is more correct to use the expression of shale gas since it is obtained from shale rocks.

In order to reveal the shale gas, long drillings are made along the rock by entering into the main rock, and the rocks are cracked with sand under very high pressure, sand is filled into these cracks and the rock is not allowed to compress again. Oil or gas in the bedrock is exposed along these fracturing zones.

In the areas thought to contain shale gas, the properties of shale underground are determined first. Then, a vertical probe is made to the depth where the shale layer is found, horizontal progress is made in the layer and holes are drilled in this layer. In order to reveal the

trapped gas in the rock, a mixture of water and sand is injected under pressure. This process is called hydraulic cracking process. 98% of the cracking liquids is biocides and hydraulic acid, and 2% sand. During this process, the mixture is injected into the formation by using steel pipes to prevent the groundwater from becoming contaminated. Scheme for extracting shale gas is shown in Figure 3 [4].

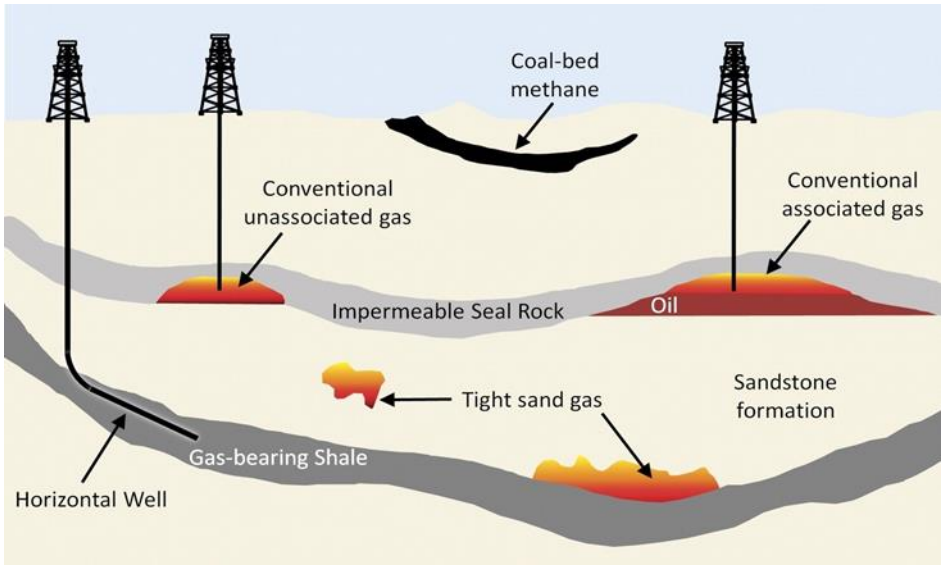

Figure 3. Shale Gas Extraction Method

The first shale gas production in the world began in the United States in 1821, and industrial production began in 1970. Production was discontinued due to the relatively affordable cost of conventional fuels, and production began after 2000, since it was more economical. Until 2010, 15 thousand 467 wells were drilled and almost all of them were drilled in North America. In North America, 146 trillion m3 was determined in situ, whereas 20 trillion m3 of producible shale gas potential was determined. These studies have caused natural gas prices to drop by 35% in the USA, thus the USA has been able to export natural gas [5].

According to the oil production short-term outlook report published by the U.S. Energy Information Administration, oil production is projected to increase to 13.2 million barrels per day by the end of 2020. If this happens, the US will be the world's largest producer. Two-thirds of this production is expected to come from “tight reservoir oil” produced by hydrofracking of shale rocks [6].

Oil production from petroleum shale (organic rock that can produce oil and gas when heated) is expected to have a potential of 12% in global oil production, corresponding to approximately 14 million barrels per day [7].

The World Shale gas reserve map prepared by the International Energy Agency is shown in Figure 4 and the size of the reserve on the American continent is remarkable. It is seen that the shale gas reserves in Turkey are located in Southeastern Anatolia and Thrace [8].

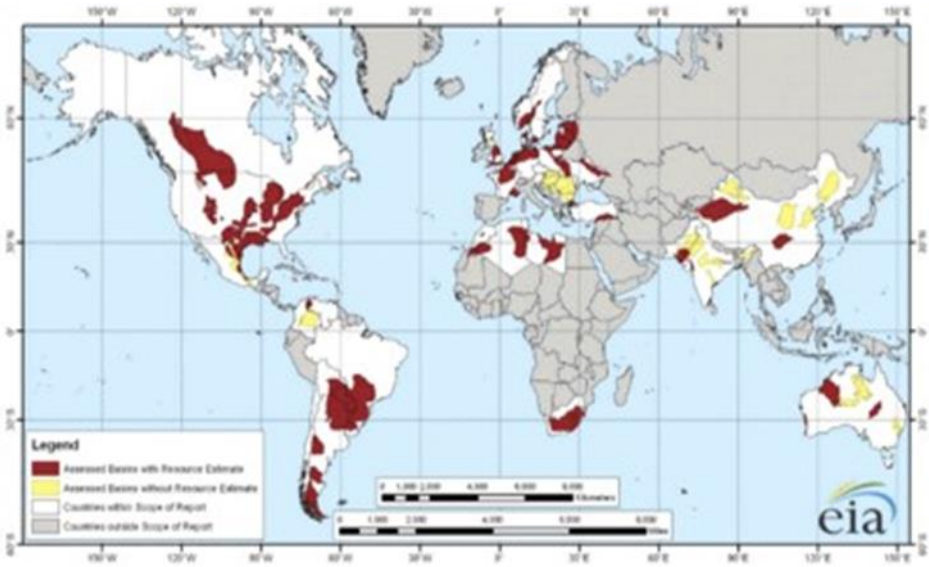

Figure 4. World Shale Gas Reserves

In the detailed map given in Figure 5 and prepared by the International Energy Agency, while potential shale gas basins in Turkey are located in Marmara (Thrace) and Southeastern Anatolia region, it is observed that there are shale gas basins in the Salt Lake and Sivas region in the Central Anatolia Region [9].

The official data on research and development of the potential of shale gas in Turkey is very limited. Official institutions in Turkey do not have a record of the information about shale gas reserves in Turkey and how much reserves are available to drilling. According to data from the US Energy Information Administration, there are 4.6 trillion m^3 of shale gas reserves in Turkey. The two regions where these reserves are the richest are the Southeastern Anatolia Region and the Thrace Basin. In these regions, total drillable shale gas is 679 billion m^3 and shale oil is 4.7

billion barrels. If available reserves in Turkey are drilled, it is projected that natural gas needs of nearly 40 years can be met [10].

Figure 5. Turkey's Shale Gas Reserves

Approximately between 13,000 m^3 and 27,000 m^3 of water are required per well to drill shale gas, and it is important to use the ground and surface waters needed for this process in a controlled way. In addition, some of the water used in hydraulic fracturing process returns to the earth. This returned water must be recycled without harming the environment, or must be rendered harmless to the environment [11].

The seismic works by Turkey Petroleum Corporation (TPAO) and the MTA in Konya, Ankara and Kirsehir, shale gas indications were determined in Central Anatolia Region. Field studies have started in Diyarbakır with the cooperation of TPAO and private company to evaluate the shale gas reserves in the South Eastern Anatolia Region. [12].

The new goal of the energy industry, which is in search of new resources with the increase in energy demand worldwide, the decrease in easy and accessible resources, and the increase in oil prices, is the search for shale gas with non-traditional methods. As a result of search in Turkey, shales rich in organic matter and in the nature of bedrock was found between Ergani-Abdulaziz mountain, which was spread to an area of1560 m^2. Geochemically, no more than 20% of oil can migrate in the bedrock and it is estimated that the remaining 80% may be oil or equivalent gas.

Since 2010 studies in Turkey, fracturing operations with non-traditional methods are carried out in Thrace and Southeast [13].

Shale found in Turkey has essential features required for economic production in terms of layer depth and thickness with appropriate mineral composition for hydraulic fracturing process. With the Petroleum Law No. 6326, issues related to hydraulic cracking related to shale gas production are regulated in circularization and notices [14].

Shale gas will account for about half of the global gas production growth by 2035, and much of this increase is expected to originate from the USA, China and Australia. The increase in shale gas production will accelerate the formation of various commercial relations, putting pressure on natural gas producers' oil-dependent natural gas pricing mechanism. As a result of this situation, countries such as the USA and China with shale reserves are expected to reduce oil and natural gas imports and even take the exporter position in view of the current shale gas potential of the USA [15].

According to the report prepared by the International Energy Agency, it is stated that the use of shale gas will stabilize the greenhouse gas composition in the atmosphere at about 650 Ppm and the increase in atmospheric temperature at 3.5 degrees in the long term [16].

Shale gas exploration and production studies are continuing in the world, and as a result of these activities, the energy import and export amounts of the countries vary. Turkey is to closely follow these developments, and increase its efforts to ensure the security of energy supply by utilizing its determined shale gas resources the most effective way.

4. Conclusion

Energy is important for every country economically and politically. To ensure their supply security, countries should be able to meet their energy needs from domestic sources as much as possible. Shale gas, which is on the agenda in the world energy sector in recent years, has the power to change the balances in the energy sector.

Today, the world energy sector, which is mainly based on oil and natural gas, has taken a new shape with the reality of shale gas. Countries with shale gas are expected to change from energy importer to energy exporter position, and the changes in oil and natural gas prices will directly affect the economies of countries.

Shale gas exploration and production activities in Turkey, which have become more efficient and economical with the new production technology, have increased and a significant

amount of potential have been identified. For Turkey, which meets approximately half of the electrical energy generation from natural gas it imports, finding and utilizing a new source will contribute greatly to the national economy by reducing its natural gas imports.

Shale gas may not have a significant impact on meeting Turkey's energy needs in the short term; however, it is projected that if Turkey, importing a large portion of its energy needs, utilizes its shale gas potential, it will contribute to Turkey's energy supply security. When evaluated from this point of view, it is necessary to expand shale gas investments and increase production and drilling activities.

It is important that the water used during the shale gas drilling process is disposed of in a manner which does not harm the environment after the process is finished. It is possible to use this waste liquid for the same purpose again. However, if it remains as wastewater, it is necessary to put more efforts to prevent pollution of ground and surface waters.

In meeting energy needs, the utilization of shale gas, in addition to fossil and renewable energy sources, will both reduce the risks arising from imports and contribute to the country's economy as it is a domestic resource.

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