

Turkey Coal Preparation Report 2019

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ABSTRACT

In line with the objectives to reduce dependency on foreign energy resources and increase the share of domestic coal in energy supply, significant developments took place in Turkey's coal sector in recent years. As a result of recent intense exploration and reserve development works, coal reserves reached to nearly 20 billion tons. Saleable coal production exceeded 70 Mt in 2017 and 80 Mt in 2018.

The R&D studies in the field of clean coal technologies have gained speed and, in parallel with these developments, coal preparation plants have become widespread especially in the last 15 years. In this study, the coal preparation industry in Turkey is summarised. In this respect, the coal production, imports and consumptions of the country have been reviewed and major coal preparation plants, their capacities and technologies, annual washed coal production figures and R&D studies on clean coal technologies are given briefly.

KEYWORDS: Turkey, coal, coal preparation, Turkey country report

1 COAL PRODUCTION

The share of domestic coal in Turkey's energy production in 2017 was approximately 42%. But, considering the current situation of the production project stock, it can be foreseen that this ratio will decrease below 40% in the next few years.

In the last 50-year period, 147 Mt of domestic hard coal, 2.1 billion tons of lignite, 22 Mt of asphaltite and 500 Mt of imported coal are consumed in Turkey, while their oil equivalent was 88 Mtoe hard coal, 427 Mtoe lignite, 10 Mtoe asphaltite and 332 Mtoe imported coal.

After a lower performance of approximately 59 Mt in 2015, saleable coal production in Turkey has been over 70 Mt in 2017 as in 2016, particularly due to the government incentives given to the domestic coal-fired power plants (Figure 1).



Figure 1 Coal productions in Turkey

Saleable hard coal production, which was approximately 3 Mt only 10 years ago, decreased to 1.1 Mt in 2018, the lowest level of the last 93 years. Lignite production has reached to its highest level in 2008 with 76 Mt. Production, which started to decline later, decreased to 56 Mt during the period of privatization of domestic coal-fired power plants between the years 2013 and 2015. As of 2017, saleable lignite production has been 71.5 Mt. The oil equivalent of saleable coal production amounted to in total 14.4 Mtoe, including 723 thousand toe hard coal and 13.7 Mtoe lignite (MENR/GDEA 2018).

2 COAL IMPORTS

Starting at extremely low amounts before the 1980s, Turkey's coal imports exceeded 10 Mt in the 1990s and 20 Mt in the 2000s. The rate of increase in coal imports was 67% in the decade between 2007 and 2017. Coal imports were around 40 Mt in 2017 and 2018 (Figure 2).

The most important reason for the increase in coal imports in recent years is the significant increase in demand for steam coal for electricity generation. When this trend is taken into consideration, it is understood that imports will continue to increase in the coming years. Coal imports are likely to rise to 55-60 Mtpa in the next 4-5 years.

The country that Turkey imported the highest amount of coal in 2017 has been Colombia with 14.2 Mt. This country is followed by Russia with 14.1 Mt. Then, respectively; USA with 5.4 Mt, South Africa with 2.4 Mt, Australia with 1.3 Mt and Canada with 621 thousand tons.



Figure 2 Coal imports of Turkey

3 COAL CONSUMPTION

In the supply of domestic coals, lignite is predominant. As of 2017, the share of lignites in meeting primary energy demand is 9.5%. The share of domestic hard coal and asphaltites is almost negligible.

The contribution of coal to the primary energy demand in Turkey has ranged from approximately 20% to 30% when considering the last 50 years. As of 2017, the ratio of domestic coal to primary energy demand was 10.1% while this figure was 16.8% for imported coal.

Coal usage in power sector is more significant than in primary energy. As of 2018, the share of imported coal in total electricity generation was 22% and the share of domestic coal was 15% (Figure 3).

The domestic coal use in industry and residential heating is declining as in the electricity sector. The share of coal in industrial sectors has dropped to 16.2% as of 2017, while its share was over 30% 10 years ago. The decline in the use of coal in the industry is mainly due to the fact that the domestic lignite has lost its market in the cement sector to natural gas or petroleum coke.

As of 2017, the share of coal in residential heating was realized as 16.9% in total, where 13.3% was for imported coal and 3.6% was for domestic coal. The decline in the use of coal is largely due to the widespread use of natural gas in residential heating in recent years, and it can be said that this trend will continue in the coming years.

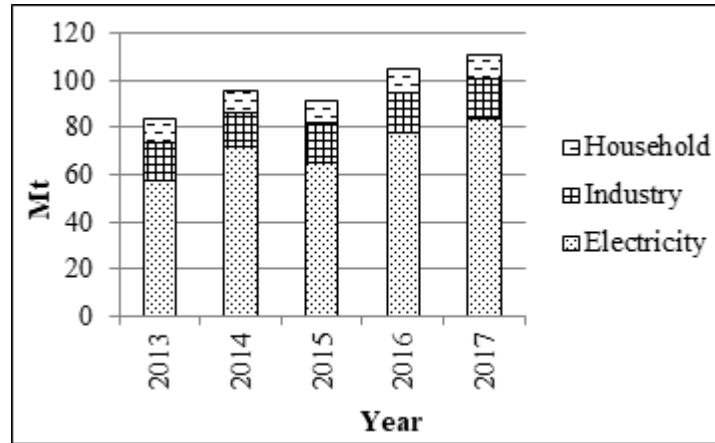


Figure 3 Sectoral distribution of coal consumptions in Turkey

4 WASHED/SALEABLE COAL PRODUCTION

Turkey has both hard coal and lignite deposits, although lignite reserves are quite greater. As a result of exploration and reserve development works carried out in recent years, a significant increase in the coal resources has been achieved in Turkey. As of beginning of 2019, Turkey has approximately 1.5 billion tons of hard coal reserves of which 730 million tons is proven and 17.5 billion tons of lignite reserves of which approximately 14 billion tons is proven.

All of the hard coal reserves in Turkey are in the Zonguldak Basin. The average lower thermal value of the basin coals varies between 6,200 – 7,250 kcal/kg.

The quality of the Turkish lignite is generally very poor and heating values are quite low. It varies from 1,000 kcal/kg to 5,000 kcal/kg, but the lower thermal value of approximately 50% is less than 1,500 kcal/kg and approximately 90% is less than 2,500 kcal/kg. Most lignite deposits contain high levels of ash, volatile matter, moisture and sulphur.

Hence, a very large part of domestic coal production in Turkey needs washing and enrichment processes. This figure was approximately half of the country's total run-of-mine coal production in 2017 (Figure 4). All hard coal production in Turkey is washed. Depending on the specification and end-use, lignites may be washed and/or screened prior to transport or use.

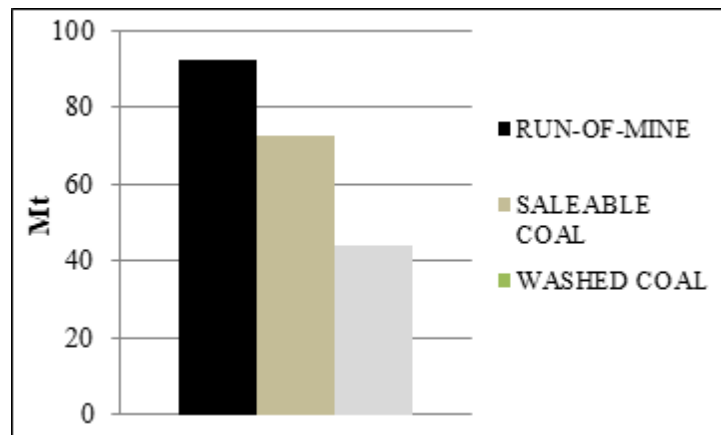


Figure 4 Run-of-mine, saleable and washed coal production in Turkey, 2017

5 COAL PREPARATION PLANTS IN TURKEY

There are currently over a hundred coal preparation plants in operation in Turkey and their capacities ranging from 50 to 1000 t/h (Table 1). Approximately twenty of these plants treat bituminous coal, and the rest treat the lignite of the country.

Table 1 Some important coal preparation plants in Turkey (updated from Güngör, 2010)

Plant name	Capacity (tph)	Coarse circuits	Fine circuits
TKİ Eynez	800	Drewboy	Dense medium cyclone
TKİ Dereköy (Soma, Çiftay)	700	Drum separator	Dense medium cyclone
TKİ Tunçbilek	700	Drum separator	Dense medium cyclone
TKİ Işıklar	700	Drum separator	Dense medium cyclone
TKİ Tunçbilek-Ömerler	600	Drum separator	Dense medium cyclone
Zonguldak-Çatalağzı	500	Jig	Jig
İmbat Mining Co. (Soma)	500	Drewboy	Dense medium cyclone
Soma Coal Mining Co. (Soma)	350	Drewboy+drum	Dense medium cyclone
Park Teknik Co. (Çayırhan)	300	Drewboy	Dense medium cyclone
Park Teknik Co. (Seyitömer)	300	Drewboy	Dense medium cyclone
Park Mining Co. (Zonguldak-Kozlu)	300	Drewboy	Dense medium cyclone
Park Mining Co. (Zonguldak-Üzülmez)	300	Drewboy	Dense medium cyclone
Zonguldak-Armutçuk	220	Jig	Shaking table
Muğla-Yeniköy	220	Drum separator	Dense medium cyclone
Zonguldak-Amasra	210	Drum separator	Dense medium cyclone
De-Ka Mining Co. (Zonguldak)	200	Drewboy	Dense medium cyclone
Çelikler Mining Co. (Çorum)	175	Drewboy	Dense medium cyclone
Eski Çeltek Mining Co. (Suluova)	175	Drewboy	Dense medium cyclone
Uysal Mining Co. (Tekirdağ)	175	Drewboy	Dense medium cyclone
Zirve Mining Co. (Zonguldak)	175	Drewboy	Dense medium cyclone
TKİ Orhaneli	150	Drewboy	Dense medium cyclone
TKİ Deniz	150	Drewboy	Dense medium cyclone
Yunus Emre	150	Drum separator	Knelson concentrator
Ortur Mining Co. (Balıkesir)	150	Drum separator	Dense medium cyclone
Hema Coal Mining Co. (Kandilli)	150	Drewboy	Dense medium cyclone
Milten Mining Co. (İstanbul)	150	Drewboy	Dense medium cyclone
Polat Mining Co. (Balıkesir)	125	Drum separator	Dense medium cyclone
Özerdemler Mining Co. (Kütahya)	120	Drum separator	Dense medium cyclone
Kartalkaya Mining Co. (Azdavay)	120	Drewboy	Dense medium cyclone
Özçevreci Mining Co. (Balıkesir)	100	Drum separator	Dense medium cyclone
Enerji Mining Co. (Kepsut)	100	Drum separator	Dense medium cyclone
De-Ka Mining Co. (Azdavay)	100	Drewboy	Dense medium cyclone
İbrice Mining Co. (Tekirdağ)	100	Drum separator	Dense medium cyclone
Merdivenli-Muğla	100	Drum separator	Dense medium cyclone
Çelikler Mining Co. (Dodurga)	75	Drewboy	Dense medium cyclone
Forbes Mining Co.	75	Drewboy	Dense medium cyclone
Volkar Energy Co. (Tekirdağ)	75	Drewboy	Dense medium cyclone
Arılar Mining Co. (Zonguldak)	60	Drewboy	Dense medium cyclone
Bahadır Mining Co. (Zonguldak)	60	Drewboy	Dense medium cyclone
Yılmazlar Coal Mining Co. (Zonguldak)	60	Drewboy	Dense medium cyclone
Tuncerler Mining Co.	50	Drum separator	Dense medium cyclone
Yeni Çeltek Coal Co. (Merzifon)	50	Drum separator	Dense medium cyclone

The typical coal preparation practice in Turkey starts by controlling the top size (mostly 150 or 100 mm) either by passing the coal through a rotary breaker or directly from a crusher, and classifying the crushed coal into coarse, fine and slime fractions (Özbayoğlu 2016).

Over the past 50 years, dense medium separation has been the preferred method of beneficiation. Static (drums, tanks, and vessels) and dynamic (cyclones) heavy medium equipment have been installed to treat coarse (+18mm) and fine (-18+0.5mm) coals, respectively. The coal spiral has become popular in the country to treat 0.5x0.1 mm sized slimes, especially for lignite. Clean coal of spiral is dewatered by sieve bend followed by vertical centrifugal dewater machine. Underflow of sieve bend is cleaned by passing it from multi-cyclone circuit to recover very fine coal particles. Slimes of bituminous coal have not been concentrated by flotation for a long time and they are dewatered by thickening and filtering, and then fed directly to the thermal power plant. Generally, two stage dense medium separation is applied with both coarse and fine size coal to produce three

products: clean coal, middlings and refuse. Middlings are fed to thermal power plants. In the last years, density-based FGX Dry Separator were installed in some mines to remove high density rock from run-of mine coal (Özbayoğlu 2016).

About twenty of the plants are in Zonguldak Hard Coal Basin, mostly with capacities between 50 and 500 t/h. Major plants in operation in the basin are at Çatalağzı, Kozlu, Üzülmöz, Armutçuk and Amasra regions. The plants in the basin generally use drawboy units for coarse coal separation and dense medium cyclones for fine coal. However, Çatalağzı plant (500 t/h) uses jig concentrators in both coarse and fine circuits and Armutçuk plant (220 t/h) uses both jig and shaking table.

Lignite preparation plants have become widespread especially in the last 15 years and individual plants have outputs between 50 and 800 t/h. The largest capacity lignite plants are located in the Soma and Tunçbilek basins. Among these, Eynez plant has a capacity of 800 tph and Soma-Dereköy, Tunçbilek and Soma-Işıklar plants have 700 tph. Most lignite preparation plants are based on dense medium separation facilities. Static (drums, baths, vessels) and dynamic heavy medium (cyclones) equipment is generally used to treat coarse coal (+18 mm) and fine coal (0.5–18 mm) respectively. Some lignite washery coarse circuits are based on drum separators or drawboys (float-sink systems) with dense medium cyclones generally deployed for fine circuits (Güngör, 2010; Mills 2014).

6 SIGNIFICANT INDUSTRY CHANGES IN THE LAST 3 YEARS

The recent trend in coal preparation plants in Turkey is to recover as much fine coal as possible from the slimes and it affects not only to increase the overall efficiency of the plants by recovering most of the coals reporting to settling pond facility, but also help recycle processing water.

Two different multi cyclone groups were integrated at Tavşanlı region in 2010 and in 2012 to upgrade washery tailings, creating a product with an ash content of 19% and calorific value of ~25 MJ/kg. Similarly, HI-G Dryer systems which consist of linear motion vibratory screen and a radial design cluster of 4 inch unibody hydrocyclones was installed at Soma region in 2013. As a result, a significant amount of fine coal from Tavşanlı and Soma regions have been recovered. This saleable fine coal product is blended with supplies of low calorific value lignite and sold to power plants and other industrial users. The technique has since been replicated at other washeries (Özbayoğlu 2016).

7 R&D OUTCOMES AND DIRECTION

The R&D efforts in the field of clean coal technologies in Turkey have gained speed particularly in the last 10 years. These efforts focus on the following main areas: Coal preparation and upgrading, monitoring and process control, combustion technologies (conventional and oxycombustion), coal gasification, liquefaction, underground coal gasification, gas cleaning technologies, gas conditioning, production of liquid fuel, hydrogen and valuable chemicals from syngas, SO_x removal and CO₂ capture in flue gas.

The principal areas of current coal preparation R&D efforts in Turkey are fine coal processing and dewatering, monitoring and process control, and methods of improving the quality and consistency of saleable coal. Some of the studies carried out within this scope are listed below:

- Removal of the ash from low grade coal by using some extraction techniques
- Assessment of coal washery wastes as raw material for the production of cement, brick and building materials
- Determination of suitable briquetting conditions for Turkish lignite, development of briquetting process

Although not directly related to coal preparation technology, research in coal gasification / liquefaction or for alternative uses of coal largely requires and includes coal preparation technologies. The R&D activities that have been accelerated in this field in Turkey in recent years are listed below.

- Liquid fuel production from coal and biomass mixtures
- Investigation of liquid fuel production potential by solvent extraction method in Turkish bituminous shale beds
- Production of liquid fuel from synthesis gas with microchannel reactor technology
- Light olefin production from purified synthesis gas
- Coal gasification systems optimization

- Development of underground coal gasification technology for Turkish coals
- Plasma coal gasification and plasma filtration system development
- Coal gasification by biological method and production of humic acid
- Production of humic acid based materials from coal for use in various fields (painting, drilling, rubber, waste water treatment etc.)
- Organo-minerals production studies from coal
- Research on the characterization of coals and analysis of combustion behaviour
- Oxygen rich combustion of lignite and biochar in circulating fluidized bed combustion system

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