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Energy balance application for Erdemir Coke Plant with thermal camera measurements

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Abstract

Ereğli Iron and Steel Works (Erdemir) began its activities on May 15 1965 with an annual production capacity of 450 000 tons and has made important contributions to Turkey's economy ever since. Today, with a total amount of crude steel production capacity of three million tons, it is the largest iron and steel factory and the sole producer of flat steel in the country. Erdemir produces hot and cold rolled coils, zinc, tin, and chromium plated steel.

Coke factories are very important facilities of integrated steel plants. Metallurgical coke, one of the main input factors of the blast furnaces as a source of energy and chemical reagent, obtained from a blend of different coking coals through a process of heating coal in an oxygen free atmosphere, are produced in coke factories.

In Erdemir, equipment failures, corrosion, heat losses and wear of refractors have been determined by thermal camera measurements since 1994. It is used as a predictive tool where data are analyzed with the use of a computer program. The results are distributed to related departments via the company intranet systems.

In this study, an energy balance application has been done for the coke plant of Erdemir. An energy input and output model has been established in order to determine the lost energy in the process. According to the study, the sensible heat of the red-hot coke accounts for approximately 59.60% of the total heat output from the coke oven, a considerably large heat quantity. On the other hand, heat losses in the form of radiation were determined with the use of thermal camera measurements whereby the results are shown in Sankey diagrams along with other related data relevant to the Erdemir Coke Plant.

Keywords: Coke plant; Energy consumption; Thermal measurements; Energy balance

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1. Introduction

As long as the blast furnace (BF) integrated route remains a dominant means for producing steel, coke will continue as a major source of energy to the industry. Total coke consumption has been reduced significantly over recent years, attribute primarily to increased levels of coal, oil and gas injection to the BF, and varies between <300–530 kg/thm. In addition, because of the by-product gas produced during coke making, the process forms an integral part of the energy balance for the entire integrated works. Thus, despite efforts to the level of coke consumption, coke making will continue as an important component of the steel making process into the future [1].

On the other hand, it is another important factors that reducing specific energy consumption in the coke ovens. Calculation of the energy balance of coke ovens gives us some dramatic data in order to control energy consumption of coke ovens.

2. Coke making

Coal in its basic form is not suitable for direct use in the blast furnace burden. It contains too many harmful or useless elements for the melting process in a reducing atmosphere and is not strong enough to carry the blast furnace burden. It must therefore be converted to metallurgical coke. A coke battery cross-section and production process of coke can be seen in the Fig. 1 [1].

Coke is produced by heating particulate coals of very specific properties in a refractory oven in the absence of oxygen to about 1100 °C (2000 °F). As temperature increases inside the coal mass, it melts or becomes plastic, fusing together as devolatilization occurs, and ultimately resolidifies and condenses into particles large enough for blast furnace use. During this process, much of the hydrogen, oxygen, nitrogen, and sulphur are released as volatile by-products, leaving behind a poorly crystalline and porous product. The quality and properties of the resulting coke is inherited from the selected coals, as well as how they are handled and carbonized in coke plant operations [1].

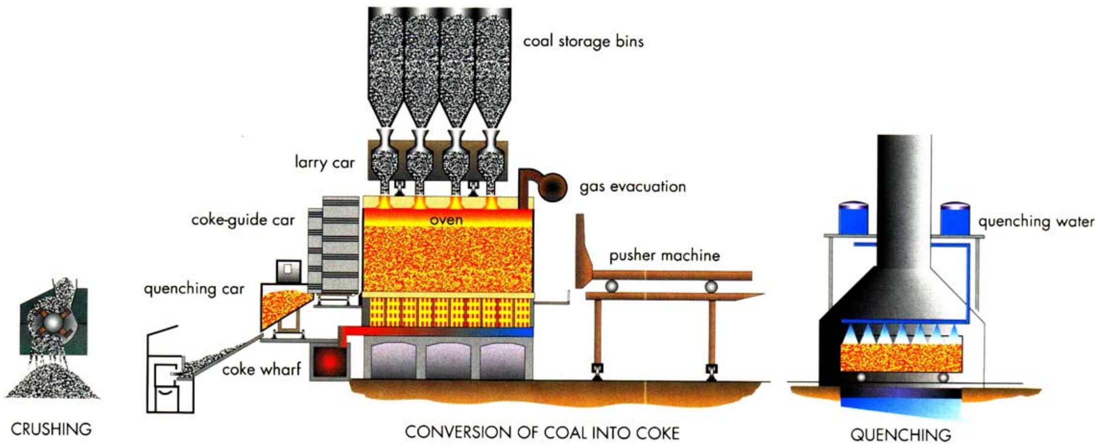

Fig. 1. Conversion of coal into coke [7].