

Chapter 25: Solid Fuels – Coal, Coke, Charcoal

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Abstract

This chapter concerned solid fuels e.g. coal, coke and charcoal, its composition, calorific value as well as its industrial significance. Solid fuels are fuels that are made out of carbon and are burned to become energy used in the industries and electricity retreats or used at home. Chapter explains the chemical make-up of coal including carbon, hydrogen, sulfur, nitrogen and ash contents and explains their environmental impacts on the calorific value and combustion properties. Coke is obtained by carbonization of coal and is even mentioned to be involved in the metallurgy particularly in blast furnace in the process of making iron and steel. Charcoal is a waste of wood which undergoes a process called pyrolysis and is discussed in connection with its application in smelting, cooking and chemical industries. The other environmental concerns that are considered in the chapter are the processes of combustion, efficiency optimization, and emission, ash disposal and the control of the pollutants. The concerns and problems like fuel selection, storage and management in industries are discussed in a bid to reveal efficiency and viability of activities. Using the principles of chemistry and industry, students can obtain the idea concerning the energy production, fuel description, and management of the environment. Energy engineering, metallurgy, environmental science, optimization of industrial processes require knowledge of solid fuel, and in this respect, they are still used in energy and industry industries.

Keywords: Solid fuels, Coal, Coke, Charcoal, Calorific value, Combustion, Industrial applications, Environmental impact

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25.1. Introduction

Solid fuels are carbon based materials which have literally been used as primary source of energy over thousands of years. They are generally obtained through natural or processed carbonaceous materials and they are broadly used in combustion to produce heat and power. Coal, coke and charcoal are the most widespread solid fuels. Regardless of the increasing popularity of liquid and gaseous fuels, solid fuel still remains a major player because it is abundant, has high calorific value, is easy to store, and it is cost-effective. Use of solid fuels was firstly used in ancient civilizations and the earliest fuel used was wood and charcoal which was used to cook, heat, as well as melt metals. The high carbon content and the high temperatures generated by charcoal made its use very common in ancient metallurgy. The Industrial Revolution was a significant shift in the use of energy where coal was widely introduced. Due to coal, the industrial revolution became the foundation of new industrialization and the new industrialization was made possible through coal, which powered steam engines, factories, railroads, and power plants, bringing about rapid industrial and economic growth. As technology progressed, coal was refined to make processed solid fuels like coke in order to enhance efficiency and lessen impurities particularly in the production of iron and steel. The use of solid fuels is related to serious environmental issues such as carbon dioxide emissions, particle matter, and other pollutants despite their benefits. However, solid fuels are still significant constituents of the world energy systems because of their high distribution and economic feasibility.

25.2. Coal

Coal is a naturally formed, sedimentary, and carbon-based rock and one of the most crucial solid fuels that are utilized worldwide. It consists mostly of carbon together with a certain degree of hydrogen, oxygen, nitrogen, and sulfur with the non-combustible inorganic matter making up ash. It is estimated that coal was formed out