

Chapter 21: Cement – Composition & Manufacturing

Seecharan Banjare^{1,*} Sandhya Rani Panda^{2,*}

^{1,2}MATS School of Science (Chemistry), MATS University, Pandri, Raipur (CG)

Abstract

This chapter presents a detailed analysis of the cement content, raw materials and the production process of cement with reference to its importance in the construction industry. Cement is a binding substance that is employed to manufacture concrete and mortar, which is mainly made up of calcium, silicon, aluminium, and iron compounds that are obtained as a result of limestone, clay, and other minerals. The chapter outlines the process involved in the making of clinker in the kiln process, with the most essential chemical reactions being listed in the form of decomposition of calcium carbonate, silicate formation and aluminate phase formation. Several varieties of cement, such as Ordinary Portland Cement (OPC) and Pozzolanic Portland Cement (PPC), are presented in terms of their composition, properties, and application. This chapter also describes the process of grinding, blending and quality control involved in order to come up with consistent cement to be used in industries and construction. The industrial considerations include the focus on energy consumption, design of kilns, and environmental impact and ways of achieving efficiency and sustainability in manufacturing. Through the theoretical knowledge of chemistry and the practical nature of manufacturing processes combined, students have the ability to gain a holistic picture of cement production, the properties of materials, and optimisation in applications, which will equip them to work in civil engineering, manufacturing material industries and industrial chemistry.

Keywords: Cement, Clinker, OPC, PPC, Raw materials, Manufacturing process, Construction applications.

^{1,*}Corresponding author

Mr. Seecharan Banjare and Dr. Sandhya Rani Panda

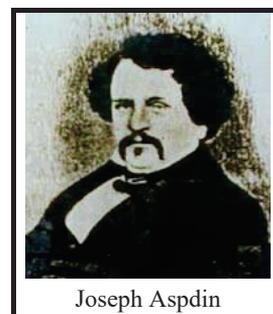
E-mail address: seecharanbanjare143@gmail.com, drsandhyarani@matsuniversity.ac.in

21.1.Introduction

Cement is one of the materials which are the foundation of construction, as it is used as a binding substance, which holds together the aggregates (sand, gravel, and crushed stone) in order to constitute concrete and mortar. Cement is essential in construction projects since as a hydraulic binder, it hardens and remains strong even when submerged by water, thus applicable in construction of buildings and bridges as well as dams and roads. The strength, durability, and versatility that it offers has seen it become the backbone of the present-day infrastructure across the world.

Historical Background:

Cement-like materials were utilized thousands of years ago. The ancient civilization of the Egyptians, the Greeks, and the Romans utilized natural hydrolytes lime and pozzolanic materials in building strong structures. Pozzolana cement, produced by Romans, volcanic ash and lime, was also used to construct great works of the Romans, like the Pantheon and aqueducts, several which have survived to this day. The most widespread type of Portland cement used today was invented in 1824 by Joseph Aspdin in England and is known as modern Portland cement. Aspdin refined a blend of limestone and clay by heating it to a fine powder which when mixed with water formed a powerful strong and strong material that surrounded what appeared to be natural stone.



Joseph Aspdin

Global Significance:

- The global cement production is of more than 4 billion tonnes per year impacting its important contribution to construction.