# Chapter 23: Glass – Composition & Industrial Production

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**Abstract**

The chapter discusses glass as a composition, a production, and industrial use, and its flexibility as well as significance in the construction industry, electronics, and the everyday use of glass. Glass is a clear, non-crystalline solid that is mainly made of silica ($SiO_2$) and other additives such as soda, lime, boron, and alumina to alter such characteristics as thermal expansion, permanence, and transparency. The chapter outlines the production processes in the industries such as batch preparation, melting, forming (float, blow, and pressing) and annealing that provide uniformity and minimize internal stresses. The various categories of glass including soda-lime glass, borosilicate, and safety glass are discussed together with their characteristics, composition, and use in the construction industry, laboratory equipments, electronics, and in the automobile sector. Another issue that is discussed in the chapter is the problem of quality control, minimization of flaws, energy and environmental involvement in large-scale production processes. Combining the knowledge gained through the theory with the practical manufacturing processes, the students acquire knowledge of glass chemistry, material properties, and industrial optimization, which will make them ready to work in the sphere of materials science, chemical engineering, industrial production, and product design. The chapter highlights the importance of glass to the contemporary technology, structural use and sustainable industrial processes.

**Keywords:** Glass, Soda-lime, Borosilicate, Industrial production, Annealing, Safety glass, Material properties.

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## 23.1.Introduction

Glass is non-crystalline, brittle, and rigid which is a feature of amorphous (non-crystalline) solid. Compared to crystalline solids, where the atoms are arranged into an extremely regular structure over an extended period of time, glass is not arranged into an extended period structure, in spite of the fact that it has a limited period molecular structure. This optical, chemical and mechanical nature of glass is limited in its structure that is not forgettable so far in modern technology and in the everyday life. These raw materials are typically heated in a mixture of Silica ($SiO_2$), soda ($Na_2O$ ) and lime (CaO) in high temperatures and are then cooled rapidly (quenching) to form the glass. This prevents the formation of crystalline structure solidifying the disorganized atoms to position. The amorphous structure that is obtained is transparent, offers better chemical resistance, and mechanical diversity. Glass can be modified to satisfy the needs of the customers such as windows, lenses, containers, optical fibers and laboratory equipment via alteration of its composition and cooling rate.

### Historical Background

Glass has a history that dates back to thousands of years. Glass made beads and small ornaments in Mesopotamia and Egypt, c. 2500 BCE, are the first known man made glass products. The Egyptians had also invented glass casting and core-forming to make vessels and jewelry by the year 1000 BCE. Glass blowing (1st century BCE) enabled the Romans to develop the art of glass-making, enabling them to make thin-walled containers and windows in mass production that radically changed its applications. The Middle Ages glassmaking was based in Venice is the island of Murano where glassmakers were perfected in the art of a transparent and decorative glass. The industrial revolution prompted the introduction of mechanized production of glasses and therefore led to large-scale production of glass in the form of bottles, flat glass and optical lenses. The 20th and 21st centuries have seen the development of specialty glasses including



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