

# Chapter 28: Water Chemistry – Impurities & Analysis

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## Abstract

The chapter is a literature review of the water chemistry that includes impurities, water quality parameters and analysis techniques. Salts, metals, organic substances and microbial contaminants that have an influence on the utility of water in consumption, industrial processes and chemical processes are dissolved in water, which is a critical element in the life cycle and industrial processes. The chapter defines categories of impurities, such as ions that cause hardness ( $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ), alkalinity, dissolved oxygen, and fluctuations in pH and how they affect industrial processes, boilers, cooling systems and household usage. Titration of hardness, spectrophotometry of trace metals and pH are used to determine water quality and are outlined in detail. There is industrial relevance, and effects of water impurities on scaling, corrosion, efficiency and quality of products are highlighted. Monitoring and control strategies of water quality are incorporated with the concepts in theory to illustrate the practical applications in chemical, pharmaceutical, power and food industries. Through the integration of chemical analysis, process knowledge and practice, students learn about the science of water chemistry, water quality evaluation, and problem solving in industrial practice, which prepares them to work in the environmental science, water treatment, chemical industry, and in fields related to human health.

**Keywords:** Water chemistry, Impurities, Hardness, Alkalinity, pH, Industrial applications, Analytical techniques.

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## 28.1. Introduction

In the purest sense of this word, water is a simple chemical compound of hydrogen and oxygen ( $\text{H}_2\text{O}$ ). But this chemically pure water is not very easily found in nature. Due to this fact, water is considered a universal solvent and therefore dissolves well, suspends well, or reacts with many different substances that it encounters in its natural cycle. Since water is moving through the atmosphere, the soil and rocks, or it is being stored in the natural bodies like rivers, lakes, and groundwater reservoirs, it obtains different impurities. Such impurities are both natural sources, such as the minerals that are found in rocks, the gases that have been dissolved in the atmosphere and the organic matter of plants and microorganisms, and human activities, such as industrial effluents, agricultural run off consisting of fertilizers and pesticides, domestic sewage and urban wastes. Through this, natural water can never be free of a combination of dissolved, suspended, and biological contaminants. The impurities have a considerable effect on the physical, chemical, and biological properties of water. They may influence taste, colour, smell, hardness and turbidity and even be deadly to health. Hence, knowledge of nature and types of water impurities is important in the treatment of water, environmental awareness, protection of human health, and in industrial use, as it makes water safe and reliable to use at home, in farms, and in industries.

## 28.2. Impurities classification

The pollutants in water are very varied and diverse. These impurities are categorized into four broad categories in order to have a systematic study and effective treatment based on their physical form, chemical nature, biological origin and radiological properties. Both types of categories have different impacts on water quality, and a certain approach to their elimination and management is needed (Fig. 28.1).