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Chemical Characteristics of Natural Water

Chiranjeevi Sirikonda*

Department of Chemistry, Osmania University, Hyderabad, Telangana, India

Editorial

Natural water's chemical composition is extracted from a variety of sources of solutes, including atmospheric gases and aerosols, weathering and degradation of rocks and soil, subsurface solution or precipitation reactions, and cultural effects arising from human activities. The application of chemical thermodynamics principles will reveal broad interrelationships between these processes and their impact. Chemical equilibrium rules, such as the law of mass action and the Nernst equation, can be used to closely analyse certain mineral solution or precipitation processes. Other reactions are irreversible, necessitating the analysis of reaction mechanisms and speeds. The chemical composition of the Earth's crustal rocks, as well as the ocean and atmosphere, are important factors in determining the sources of solutes in natural freshwater.

Many environmental factors, including temperature, rock strata structure and location, and biochemical effects associated with plant and animal life cycles, both microscopic and macroscopic, affect how solutes are taken up or precipitated, as well as the quantities present in solution. The chemical principles and environmental influences, when combined and applied with the further impact of the general circulation of all water in the hydrologic cycle, form the foundation for the evolving science of natural-water chemistry.

Chemical analysis of water samples in the laboratory or onsite sensing of chemical properties in the field provide the foundational data for determining water quality. Changes in the composition of flowing water, as well as the impact of particulate suspended content, make sampling more difficult. Some constituents are fragile and must be determined on-site or samples must be preserved. The majority of the constituents are measured in gravimetric units, such as milligrams per litre or milliequivalents per litre.

Water studies involve more than 60 constituents and properties often enough to allow for consideration of the sources from which each is obtained, the most likely types of elements and ions in solution, solubility controls, predicted concentration ranges, and other chemical factors. The mechanisms that regulate the concentrations of elements that are typically present in quantities less than a few tens of micrograms per litre are not always obvious, but current evidence indicates that many are regulated by the solubility of their hydroxides or carbonates, or by sorption on solid particles. Many dissolved organic compounds can now be identified with pinpoint accuracy.

To summarise large amounts of data, chemical analyses can be grouped and statistically analysed using means, medians, frequency distributions, or ion correlations. The graphing of analyses or groups of analyses helps in demonstrating chemical associations between water, possible sources of solutes, a regional water-quality regimen, temporal and spatial variance, and the assessment of water supplies. Graphs may depict water form based on chemical composition, ion relationships, or ion groups in individual waters or multiple waters at the same time. Mathematical equations, graphs, and maps can be used to demonstrate the relationships between water quality and hydrogeologic characteristics such as stream discharge rate or ground-water flow patterns.

Around 80 water studies from the literature are tabulated to demonstrate the relationships mentioned, and some of these, as well as many others that are not, are also used to demonstrate graphing and mapping techniques.

Graphs of some of the tabulated analyses show relationships between water composition and source rock type. Human activities have the potential to significantly alter water composition, both directly through contamination and indirectly through water production, such as the intrusion of seawater into groundwater aquifers.

Various organisations have issued water-quality guidelines for residential, agricultural, and industrial use. Water quality standards for irrigation projects are especially complicated.

For rational water quality management, a basic understanding of the processes that regulate natural-water composition is needed.

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***Address for Correspondence:** Sirikonda Chiranjeevi, Department of Chemistry, Osmania University, Hyderabad, Telangana, India, E-mail: chiranjeevi.sirikonda@gmail.com*

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