Properties and Sources of Boron

In this guide

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5. Boron (CAS No. 7440-42-8) is a naturally occurring element in the earth’s crust. Common borate compounds include boric acid, salts of boric acid (e.g., sodium tetraborates, which are also referred to as borax), and boron oxide.

6. Boron originates from both natural and anthropogenic sources. Natural sources include the weathering of boron-containing rocks and soils, seawater spray, volcanic activity, and geothermal emissions (Coughlin, 1996). Anthropogenic sources include industrial manufacturing, fossil fuel combustion, pesticide application, and agricultural irrigation. In drinking water, most boron comes from detergents, fertilizers, and wastewater. Natural processes like weathering contribute more significantly to environmental boron levels compared to anthropogenic activities (US EPA, 2008). Human exposure to boron through drinking water occurs primarily in areas with boron-rich aquifers or where borates are released from industrial or agricultural sources (WHO, 2009).

7. Boron has a molecular weight of 10.81 g/mol and does not exist in its elemental form in nature. In both water and soil, its fate is largely governed by pH, which determines whether boron exists primarily as undissociated boric acid (dominant at acidic pH) or as borate ions (dominant at alkaline pH above the pKa of 9.2). Both species are highly soluble and remain in solution, not readily removed by natural processes. Adsorption to soil or sediment, which is maximized around pH 7.5 to 9.0, decreases at higher pH, reducing boron’s capacity to bind to soil surfaces. In calcium-rich waters, borate ions can form complexes with calcium, altering boron speciation and its behaviour in aquatic environments (WHO, 2009; Health Canada, 2023).

8. Boric acid (commonly denoted H_3BO_3 or H_3BO_4), exhibits high solubility (49 g/L), and has a low octanol–water partition coefficient ($\log K_{ow}$ = 0.175). Other borate compounds, such as sodium tetraborate and boron oxide, are also highly soluble and stable, with their distribution influenced by pH, local geology, and water composition. The chemical and toxicological properties of boric acid and other borates are considered similar on a molar boron equivalent basis when dissolved in water or biological fluids (WHO, 2009).