

Chloride and Salt

You're probably familiar with "chlorine bleach." Commercial bleach and many other common substances use various forms of chlorine to disinfect surfaces or even to purify water. The chloride ion is the most common form of chlorine and is one of the two elements that make up table salt, a.k.a. sodium chloride (NaCl). We use table salt to make food taste better and as a preservative. NaCl and other chloride-containing salts (MgCl₂, CaCl₂, etc.) are also commonly used to melt the snow and ice that can accumulate on streets and sidewalks in winter.

Chloride (Cl⁻) has a negative charge, while ions of sodium (Na⁺) and calcium (Ca²⁺) have a positive charge. As sodium chloride (NaCl) or calcium chloride (CaCl₂) dissolve in water, the ions separate and move freely. In fact, the term 'salt' can generally be used to describe the compound formed when a positive ion combines with a negative ion out of solution, but would tend to dissolve back into its original ions if once again put into solution. Therefore, when you measure chloride, you are measuring the concentration of chloride ions in the water. Scientists can often tell whether the chloride came from NaCl or CaCl₂ by determining whether levels of sodium or calcium are the same as the chloride.

But where do the salts that are spread onto roadways end up? Salts do not just disappear or evaporate. They are carried by rain and melting snow into storm sewers, small streams, or groundwater and eventually into larger streams and ponds. Chlorides can enter water from runoff from road salts, soil leaching, and industrial and animal waste. During spring runoff, levels of chloride can range from 10,000 mg/L in ditches along rural highways to 25,000 mg/L along urban highways. Unpolluted water has less than 1 mg/L chloride, although some waters may have more if there is weathering or leaching from nearby mineral-rich soils and rocks. A measurement from Wappingers Creek in 1905 (before the use of road salts) showed Cl⁻ concentrations of 0.6 mg/L, and normal concentrations in streams at Hubbard Brook Experimental Forest are about 0.5 mg/L. At present, chloride concentrations in the Hudson River are around 21 mg /L.

Why should we care about salty runoff? Salt pollution in streams and ponds can kill aquatic vegetation and damage fish eggs, young fish, and other aquatic organisms. Salt also corrodes bridges and cars and causes damage to underground pipes. Further, road salts can seep into groundwater, polluting the wells from which many people get their drinking water. If a lot of salt gets into the groundwater, the water can taste unpleasantly salty and potentially be harmful to people on a sodium-restricted diet. The Environmental Protection Agency recommends that such individuals not drink water that has more than 20 mg/L of sodium, because it may exacerbate hypertension problems. The EPA also maintains that drinking water needs to have less than 250 mg/L chloride. This is the concentrations around which the water begins to taste salty.