Stream Team Academy Fact Sheet Series

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Stream Team Academy Fact Sheet #35

Icy Roads = Salty Streams

An Educational Series For Stream Teams To Learn and Collect

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During winter months in Missouri, we can expect roads to occasionally be slick with ice or snow. The main way we keep roads safe during winter weather is to treat them with road salt. Road salt, also known as rock salt, is made of halite, although it often contains many mineral impurities and chemical additives (which can give it various colors). Halite is the natural mineral form of sodium chloride (NaCl), and when purified, is used as table salt. Road salt works because salt lowers the freezing temperature of water. For instance, we all know that fresh water freezes at 32º F, but sea water doesn't freeze until it reaches 28.4º F. However, once roads fall below 10-20º F, road salt alone ceases to be effective and other treatment methods such as sand or calcium chloride may be used.

The usage of road salt has been increasing since the 1940s. The U.S. now spreads around 20 million tons of salt a year to keep roads ice-free. In 2018, The Missouri Department of Transportation (MODOT) used about 20,000 tons of road salt just in the St. Louis region. Like most substances we add to our environment, salt eventually finds its way into our waterways. Road salt dissolves into sodium and chloride ions upon contact with water, and both end up in our waterways via runoff and storm drains. Roadside soils are also often contaminated with salt and can persist in these soils for years after repeated application with every precipitation event. This salt eventually travels through the soil and enters shallow groundwater, which can interact with the surface water in streams. Watersheds in urban centers often have higher chloride levels, as they have thousands of miles of roads, parking lots, and sidewalks to treat.

Unpolluted stream water generally has chloride levels below 20 mg/L. Sea water in comparison is about 20,000 mg/L of chloride. Missouri Water Quality Standards list 230 mg/L and 860 mg/L as thresholds for chronic and acute chloride pollution for aquatic life, respectively. That is, exposure to chloride levels over 230 mg/L for a few days is toxic to aquatic life, whereas just hours-long exposure to levels above 860 mg/L are toxic to most creatures. Many urban streams such as those in the St. Louis area like River des Peres and Black Creek, for example, regularly surpass these levels.

So how does road salt pollution impact stream life? The ions that make up road salt, chloride and sodium, also function as important electrolytes within the cells of living things. However, a sharp change in the concentration of chloride, sodium, or other ions in the water impairs aquatic animals' ability to maintain a proper concentration of water and electrolytes in their cells, known as an osmotic balance. Fresh water has a lower concentration of ions than cells do, so tissues in freshwater

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organisms tend to lose ions and gain water, as molecules travel from high to low concentrations. These organisms are adapted to absorb and retain ions efficiently while excreting a large amount of water to maintain an osmotic balance. If placed in salt water, excretory organs become overwhelmed and the animal's tissues become dehydrated and overdosed with ions, causing death. Relatively few aquatic organisms can cope with both fresh water and salt water, except those living in estuary habitats. Additionally, road salt contains impurities such as iron, lead, aluminum, and phosphorus. As a result, streams polluted by road salt tend to lack biodiversity.

Like many water pollutants, once salt gets into waterways, the only way to get rid of it is to let it dilute as it moves downstream. It isn't readily absorbed or converted into a more innocuous substance. Chloride pollution can be detected through water quality testing; however, both directly with chloride strips and by measuring conductivity. A spike in conductivity after winter weather events could be from road salt pollution. Many Level 1 and above Stream Team volunteers in the St. Louis region regularly test for chlorides in winter using provided chloride test strips and have collected data for chloride-specific monitoring research.

Road salt is still the most economical way to keep roads ice-free and safe for travelers. However, pre-treating roads with brine (salt water) instead of rock salt right before winter weather has also proven effective at both preventing ice from forming while also reducing the amount of salt needed, and saving cities money at the same time. A recent study by Dr. Danelle Haake (Stream Team 2760) of St. Louis University, found that cities in the St. Louis area that used brine treatment (Ballwin, Jennings, and Webster Groves) had an average of 45% less chloride in their stormwater runoff than cities that used rock salt (Manchester, Ferguson, and Rock Hill). Hopefully, best management practices such as brine will become more widespread and popular in the future, allowing cities to both protect water quality and keep commuters safe.

Links for more information:

Study coordinated by Danelle Haake: **Comparison of Contributions to Chloride in Urban Stormwater from Winter Brine and Rock Salt Application | Environmental Science & Technology (acs.org)**

Why Spraying Saltwater On Roads Could Save Missouri Money And Reduce Runoff | St. Louis Public Radio (stlpublicradio.org)

Winter in St. Louis | Missouri Department of Transportation (modot.org)