Easy on the Salt

My Amazon Prime account is easily my best friend in the winter. Free 2-day shipping makes it easy to order anything from toothpaste to coffee beans online without ever having to venture out into the cold. While this freedom that online shopping offers, it disconnects me from faraway products that are braving snowstorms from the Northeast and Midwest to get to my lazy ass in Utah. This luxury brings with it many problems, including winter road management, an industry that has costs of more than $2 billion per year (8). Apart from the deliciously addictive tabletop variety, salt (or sodium chloride) serves a greater purpose in clearing roads for safe travel and keeping goods flowing uninterrupted from place to place. Salting walkways and roads is so common that it takes the invisible backseat to other problems associated with our car-dominated lifestyles. Road salt is the cheapest, most readily available, and economically viable option even though it causes multiple environmental problems such as polluting groundwater and damaging ecosystems of lakes, streams, and roadside vegetation. We need to find a way to decrease the amount of road salt we use, increase its effectiveness, and explore the alternatives without compromising our safety standards.

The EPA estimates that the United States uses 15 million tons of salt for de-icing purposes each year (8). The US has nearly 300 million vehicles registered and more than 4 million miles of roads and streets (7). As America continues to grow towards a more urbanized way of life, the amount of roads needed to be built, maintained, plowed, and salted will continue to increase. Our way of life is completely dependent on our access to the roads that facilitate the delivery of our packages and shipment of goods. Nearly every modern business is dependent upon the supply of goods that are largely transported by trucks and driven along interstates across the country. The close proximity of local businesses or the easy access of online shopping severs our connection to the origins of our food or other products that are essential to our lifestyle. This convenience of our modern way of life is often taken for granted until the first snowstorm hits, immobilizing us, jeopardizing our safety, and increasing public intolerance for delay of our modern necessities and comforts. No one is exempt from the effects of winter weather.

The highest commodity in winter road management is salt that is used to keep our roads ice-free. It does this by lowering the freezing point of water and breaking the bond between the ice and the pavement. Salt is the deicer of choice because it is cheap, readily available, easy to store, and easy to apply. Salt application is utilized before, during, and after a storm. When applied during the storm, as a deicer, it helps melt and destroy bonds that have already formed on the pavement and with the help of traffic it turn the remaining stuff into slush to be plowed. However, deicing may not be the most efficient way to salt our roads because oftentimes we over apply and take a "more is better" approach. A planning tool from the salt institute recommends the application of one ton of salt per mile of two-lane road, per storm. It is estimated that around 2.5 million tons of road salt are applied annually to roadways in the Chesapeake Bay watershed alone (10). It is common to over salt and it is the higher concentrations of salt that are so damaging to ecosystems surrounding major interstates, highways, and urban roads.

After salting the roads it doesn't just disappear after it dissolves; it splits into sodium and chloride ions, gets carried away in runoff and deposited into surface and ground water (6). It is estimated that 40% of the country's urban streams have chloride levels that exceed safe guidelines for aquatic life, largely because of road salt (6). Salt affects the water's density, reducing water circulation and preventing oxygen from reaching the bottom layers of water. Amphibians are some of the most affected organisms by the chloride increase. Newts exposed to the high concentrations of salt found in roadside streams was examined in the Utah State University laboratory and were found to have severe developmental deformities – bent bodies and tails, cysts, and missing gills (1). Salamander eggs develop abnormally when exposed and cannot retain the water needed to avoid freezing and disease (1). By throwing off the water's natural chemistry it reduces the overall nutrient load. High chloride concentrations can interfere with how freshwater marine organisms as well as roadside vegetation regulate their salt uptake. Trees and plants along the roads are more susceptible to dehydration and the salt hinders their ability to effectively absorb water. This opens up more opportunity for salt-tolerant invasive species.

While the total elimination of road salt is impossible it can be combined with alternative deicing compounds to ease up on the amount of chloride we dump into the

environment. Organic compounds including beet juice, sugarcane molasses, and cheese brine have been experimented with. Blending in certain abrasives such as sand or gravel can help in more local environments where traffic is minimal but isn't effective in larger urban areas because of its tendency to get packed down from the high traffic making cleanup difficult and expensive.

Other alternatives include applying salt before or early on in the storm, known as anti-icing. Anti-icing's ability to prevent snow and ice from binding to the asphalt and can make the post-storm cleanup slightly easier and allow crews to use less salt overall. In addition to early application, salt can be combined with liquid salt brine or pre-wet, along with other melting agents to make the salt stickier and actually stay on the road instead of bouncing off into gutters and roadsides which would mean more salt application (3). Sodium chloride is really only effective at higher temperatures (above 12 degrees F) and costly alternative chemicals like calcium chloride and magnesium chloride will melt ice more effectively at lower temperatures. While more expensive than sodium chloride, they could be used with forecasting technologies and we could break out this expensive stuff only when necessary, allowing us to apply less salt that is more effectively de-icing roads in colder areas.

Implementing technologies like specialized weather forecasting and Road Weather Information Systems (RWIS) are an enormous help to determine when to salt, where to salt, and what to use. These technologies help road maintenance workers, or "snowfighters," determine real-time weather conditions at particular locations and help prevent unnecessary salting. Sensors collect data on air and pavement temperatures, levels of precipitation, and the amount of deicing chemicals already on the pavement. This information is incredibly helpful because it determines the amount and type of chemicals needed for application in addition to the timing of the application that can be crucial and variable in areas. RWIS stations can be pricey but the costs can be offset by the reduced use of deicing chemicals. According to the Federal Highway Administration, the Massachusetts Highway Authority saved $39,000 on salt and sand costs in the first year after installing nine RWIS stations. Based on that information it is estimated that a complete RWIS in Boston could save up to $250,000 per year (8).

So what can we do? Individual means aren't sufficient by themselves to make a significant impact without some local help to reform the practices on highways and city roads. Urge your municipality to invest in technologies that make it easier to predict weather information that will help prevent over-salting. Urge them to invest in alternative chemicals and utilize organic compounds and urge them to practice anti-icing more than deicing. New development can pose an opportunity to invest in superior engineered roads that can prevent some of the deteriorating effects salt has on cars and bridges and offset potential costs associated with that to invest in new technologies. Individually we can cut down on salt application by shoveling more often and using abrasives, like sand or gravel, that aren't efficient in highly trafficked areas, but can be spread on our walks and driveways to increase traction. It's important to remember that less is more and that proactive shoveling is not only good for our health but will also help minimize our impact on the environment.

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