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Road Salt: A Primer on the Factors Affecting Supply and Demand





This brief provides basic information for motorists, policymakers, and the media regarding the factors that affect the supply and demand of road salt. Highway and public works agencies require substantial supplies of salt each winter to keep travelers safe and to avoid sustained disruptions to commerce. However, despite the ubiquity and importance of road salt, the factors that affect its availability, distribution, storage, and the like are often not well understood by the general public. Recent harsh winter events have highlighted how critical it is for counties and municipalities across the country to be prepared to effectively treat their roadways, and for motorists to be aware of how road salt improves safety in a cost-effective manner.

This primer was developed by interviewing customers and suppliers from public works agencies in varying locations, and officials at salt producing companies.

Additional background information was obtained by reviewing US Geological Survey (USGS), Bureau of Labor Statistics, and National Oceanic and Atmospheric Administration (NOAA) website data.

SUMMARY

Taken together, the information collected points to several key takeaways and recommendations. Although there is essentially a limitless amount of salt globally, transportation and storage logistics can make it challenging for highway authorities to ensure they have a sufficient supply to meet local and regional needs during severe weather events. As such, salt supplies should be ordered as early as possible, with particular attention paid to how the previous winter's conditions affected wholesale supplies. As a general rule, it is advisable to have at least one year's worth of salt on hand by the beginning of autumn. For agencies that do not have sufficient storage capacity, partnering with neighboring jurisdictions to order, store, and share supplies may be a viable option. Additionally, although the up-front costs of ordering large quantities of road salt may appear high, the economic costs of road closures are astonishing, and road salt application generally "pays for itself" by keeping lines of commerce open and preventing traffic crashes.





The winter of 2013-2014 was among the coldest on record in many states. Frequent incidents of snow and sleet led to the mobilization of snow fighters from coast to coast. In addition, ice storms paralyzed the southeast. National media attention focused on the slow initial response to the ice and lack of preparation. We watched as Atlanta children were forced to stay in schools with frantic parents unable to reach them. Across the country from fall into spring, freezing temperatures and numerous ice and snow storms wreaked havoc on our roads.

In many parts of the country, public works and transportation agencies nearly depleted their entire inventories of salt. Mid-season replenishment of supplies was challenged by a nationwide spike in demand compounded by the impact of winter weather on transportation supply networks. In the Midwest, freezing on rivers, canals, the St. Lawrence Seaway and Great Lakes forced costly and less efficient adjustments to the logistics chain.

With elected officials well aware of the significant economic and safety concerns at stake, it was a very challenging season for winter maintenance crews. In some cases, agencies ran low on materials, causing them to limit salt use to priority locations, which put motorists in other places at greater danger.

In contrast, in 2011-2012, the United States had almost no winter precipitation, creating two years of drought conditions across much of the country. That left salt domes full and, in some cases, forced layoffs at salt mines. Transportation logistics were also a major issue for salt suppliers and their customers when demand was low. While agencies typically agree to take delivery on at least 80% of salt ordered, the glut of mined salt and the limited needs created a situation in which purchased product had no place to be delivered and stored.

As the winter of 2014-2015 begins, many government agencies are facing heavily depleted salt supplies and are concerned about the potential for another challenging winter. Bid volumes have increased nationwide, while supplier inventories are depleted as producers continued to receive orders late into the previous spring.

In consideration of these concerns, this primer was developed to provide a better understanding of the factors affecting supply and demand of road salt, and particularly those factors impacting preparedness for the 2014-2015 winter.



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Why is Road Salt a Crucial Product?



Rock salt is a natural mineral that is deployed to treat icy, slushy, and snowy roads. Salt continues to prove itself as a cost-effective material that helps keep roads open to commerce and safe for drivers and passengers. Typically, the salt is spread from dump trucks in crystals and from tanker trucks as liquid brine solution for pre-treating. Significant research has been conducted to identify best practices for salt application and management, and studies show that when properly adhered to, these strategies allow for the safe use of road salt without detrimental effects to the environment (Stone, et al., 2010).

Salt is a deicer; it melts through packed snow and ice, breaking these hazards' bonds with the pavement, and ultimately facilitating their complete removal from the roadway by

snowplows. This is distinct from the use of abrasives – such as sand or cinders – which are often used to add traction to roads in winter. Abrasives don't melt snow and ice; they're inert and have no impact on melting points. In order to work, they must remain between the tires and the ice. This requires frequent reapplication, as layers of abrasives get covered up by fresh snowfall or removed by vehicle traffic. Abrasives therefore must be used in larger quantities, stretching limited equipment and personnel resources thin at the height of winter weather emergencies. They also have to be cleaned up each spring, making them more costly than salt in terms of material and overall manpower.

In addition to the cost, limited effectiveness, and inconvenience of an abrasive such as sand, cinders pose



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an additional set of problems – namely, their toxicity. Cinders are coal ash, the residue left over from burning coal to generate electricity, and contain dangerous substances such as arsenic, lead, mercury, chromium, and cadmium. When stormwater washes coal ash from a road into a ditch or sewer, these toxic compounds leach into the water and soil.

In recent years, the American Highway Users Alliance has commissioned and publicized studies examining winter safety and mobility issues, and has reported that the economic impact of snow-related road closures far exceeds the up-front cost of timely snow removal and roadway treatment. In some Snow Belt states and provinces, for example, the daily economic costs (direct and indirect) of statewide road closures can reach as high as \$300-\$700 million (IHS Global Insight, 2012).

Additionally, according to the Federal Highway Administration, 544 million vehicle-hours of delay are due to wintry road conditions each year. Given this exorbitant economic impact, the long-term payoff of adequate snow preparations more than justifies the expense: Deicing pays for itself within the first 25 minutes after salt is spread, and during the first four hours following salt application, the direct benefits to road users are \$6.50 for every \$1.00 spent on the operation (Kuemmel and Hanbali, 1992).

More importantly, the use of road salt greatly improves public safety. More than 1,300 people are killed annu-

ally on the nation's roadways due to snowy, slushy, or icy pavement, and another 117,000 are injured. Studies have found that road surface condition is the single biggest safety factor during a winter event (more significant than visibility, precipitation intensity, and other issues), and that a 10% improvement in the surface friction of a road results in a 20% reduction in crashes. Overall, the use of road salt has been shown to reduce collisions by up to 88% and injuries by 85%; on four-lane roads, that estimate rises to 93% (Fu and Usman, 2013).

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Taken together, these findings demonstrate that clear winter roads save lives and keep the economy moving, and that timely application of road salt is a highly cost-effective means of achieving this goal. However, as we've seen during tough recent winters, making adequate preparations for the season can be daunting for highway authorities and public works departments. Whether it be estimating needs, storing inventory, or even having to place mid-season resupply orders, there is no shortage of challenges when it comes to keeping the nation safe and mobile during inclement weather.

Are there Shortages of Road Salt?



The US Geological Survey reports that world continental resources of salt are practically unlimited. There is no current shortage of this resource in the earth or the oceans. The U.S. has the world's second largest

supply of salt, with salt primarily coming from Kansas, Michigan, New York, Ohio, and Texas. Approximately 38-43% of domestic salt production is used for highway de-icing.



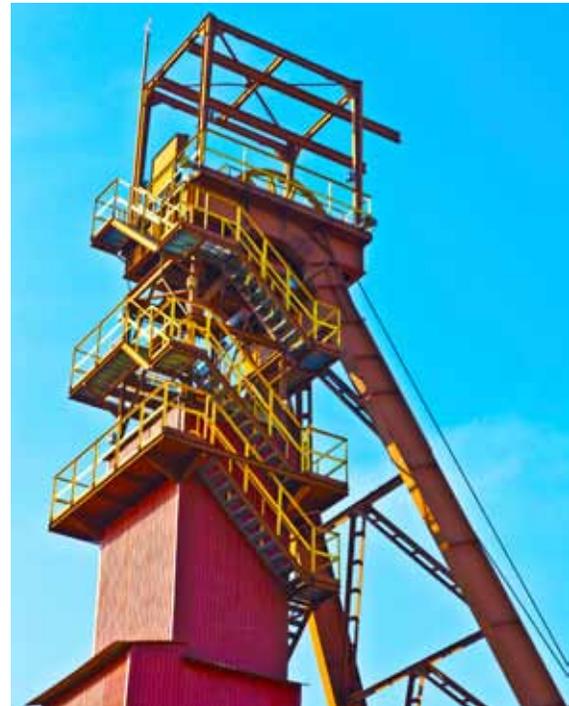
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What are the Factors Affecting Supply and Demand of Road Salt?

Though there is no shortage of the mineral itself, challenges can arise in ensuring that adequate supplies are available when and where they are needed. This section will identify and discuss several key factors and issues.

Mining Supply

Before getting into detail about highly fluctuating factors, it is important to note that the national domestic mining supply is quite stable over time. Production output is determined by the number of labor shifts and the operational capacity of the massive mining equipment. Output cannot be dramatically changed from day to day, or even year to year. Three shifts of skilled, trained labor are needed to keep a mine operating 24 hours a day. When demand drops, it can be unsustainable to maintain three shifts, but large numbers of workers cannot easily be hired and then laid-off whenever demand spikes or troughs. Major capital investments in mining equipment is also a time-consuming affair, which involves the complete shutdown of a mine for an extended period of time while existing equipment is replaced. When domestic needs are high, international suppliers have a greater role in helping American mines cover the demand: truck, rail, and water carriers



from Canada supply northern States, while markets within reach of ports receive product from Canada, Chile, Mexico, and other countries.

It is generally not economical for American companies to export during low domestic demand years.



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In most cases, transportation logistics, rather than mining, is the largest and most difficult cost for suppliers and customers to predict. Salt is transported in bulk in ocean vessels, within the inland waterways by barge, and across land by truck and rail. Salt companies contract with transportation services on an as-needed basis.

Generally, between May and October, all transportation modes are operating efficiently. However, each mode also has other customers. For example, the success of the grain harvest may affect barge traffic, and a spike in asphalt paving needs to address winter potholes can reduce dump truck availability. When truckers are needed to drive long distances, federal "Hours of Service" rules apply. These rules limit driving time and can force drivers to stop before they reach their destination, when poor weather or long waits at loading sites run up the total number of working hours.

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During the peak season, when salt is often ordered during emergency conditions, the transportation network can become considerably less efficient and more costly. Frozen waterways require re-direction of bulk salt, usually by truck. In some cases, trucks and drivers may be harder and more expensive to keep under contract. And of course, when conditions are perilous, safety needs may demand a slower and more careful process. In the winter of 2013-2014, transportation logistics were particularly difficult, with an unprecedented number of frozen waterways, covered railroad tracks, and unreliable highways. Multiple companies reported that the need for trucks in 2014 has exceeded available supply.



Federal and State environmental regulations are stringent and affect stockpiling of salt for transfer. These regulations vary from place to place, and prevent the open stockpiling of salt to differing degrees depending on the location. These regulations increase transportation costs by limiting the amount of salt that can be off-loaded in any one place, restricting the amount unloaded to only what can be fully covered on an impervious pad. As important as they are, environmental requirements can be costly. States that work with salt suppliers and shippers on environmental requirements recognize that storage practices cannot change instantaneously without massive costs that are passed back to the State transportation departments who ultimately purchase the salt and need it delivered as quickly and

cheaply as possible. In addition, during summer months, some winter storage depots are unmanned and delivery times can be restricted by the customers, with limited delivery windows only on certain days of the week.

Agencies that are located within 50-100 miles from a port, mine, or waterside pad are generally able to get through a harsh winter easier with less storage than a municipality that must move salt 150 miles or more. Governments with at least a typical year's worth of salt storage capacity are considerably better suited to handle demand spikes than those with only enough storage for one-third of their annual needs.



Weather

Understanding the supply impact from the previous winter's weather is the most critical factor in planning. Whether it's the El Niño effect, the shifting polar vortex, or just typical variations in weather patterns, the conditions each winter always seem to come as a surprise.

In 2013, municipal and state storage facilities had plenty of supply from the previous year. But after the 2013-2014 winter, the depleted storage supplies

have led to a 30% increase in orders on average.

Multiple salt companies reported that they worked as hard as possible to replenish supplies, but customers were buying them as fast as they could supply them. In a typical year, suppliers' stocks begin to rise as early as March. After 2013-2014, some suppliers are still struggling to keep up with orders.



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It is important for transportation agencies to be well prepared as each winter approaches. To develop best practices, agencies must prepare for a full season of harsh weather, and always consider the lingering impacts of the previous winter on salt supplies, the transportation logistics chain, and labor. The likelihood of major logistics disruptions is another important planning consideration. Agencies that prepare earlier and more thoroughly keep the media and politicians happy. Construction of larger salt storage facilities, developing cross-jurisdictional agreements with neighboring agencies, pre-ordering supplies during the summer, and developing creative financing plans for capital improvements to facilities are all best practices worth considering.

At the national or regional level, the demand for salt tends to rise and fall to around the same degree for nearly all customers. But locally, some agencies are better prepared than others in preventing spikes in demand when available supplies are low. Good pre-season planning is perhaps the best way to quickly reduce the likelihood of a sudden demand spike for a State or municipal agency. Agencies that pre-plan early orders and have abundant storage capacity are in a better position to replenish their supplies at lower costs.

By having more storage, it is easier for agencies to order supplies when the commodity is plentiful and less costly. Having a typical year's worth of salt on hand makes it less likely that agencies will need to place mid-winter resupply orders, which can sometimes be expensive and unreliable, particularly if the logistics network is disrupted.

In many cases, budget problems are the main reason that salt storage is inadequate. However, creative financing plans can help make construction possible, and agreements with neighbors can be helpful in sharing the burden of paying off incremental financing costs. For example, the City of Des Moines was able to build a large facility that holds as much as two seasons of salt by partnering with a landfill and neighboring municipalities to site the facility and finance the construction. Since then, the city's ability to pre-order large quantities of salt at a discount has saved it enough money to fully pay off the loans needed to raise capital to build the storage facility.

Through interviews with both a variety of salt customers and salt producers, it is clear that many agencies have made great improvements in storage capacity, cross-jurisdictional agreements, and early ordering. Agencies that cooperated



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across jurisdictions were able to position themselves better when placing orders, and enhanced cooperation among highway authorities on contracts may also lead to improvements in supply sharing when needed under emergency conditions.

The following four recommendations summarize some key ways that government agencies can weather the market peaks and values associated with salt supplies:

1 *Partner with neighboring jurisdictions to order supplies together and share supplies of salt.*

2 *Expand capacity to have at least one typical year's worth of salt on hand each autumn.*

3 *Consider innovative financing strategies to generate the capital needed for facility construction and use savings from more efficient operations to pay off the capital costs.*

4 *Order salt supplies as early as possible, with particular attention to the previous winter's impact on wholesale supplies.*

About the American Highway Users Alliance

The American Highway Users Alliance is a non-profit association consisting of motoring clubs, trucking and bus companies, RVers, motorcyclists, and a wide-range of businesses that use the roads and need them to be safe and efficient. Members of the Highway Users pay the fuel taxes and other user fees that help fund road improvements and maintenance.



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