Richard A. Alaimo Associates

200 High Street, Mt. Holly, New Jersey 08060 Tel: 609-267-8310 Fax: 609-267-7452

February 16, 2017

Ms. Meredith Tomczyk, Acting Township Manager
Mount Laurel Township
100 North Mount Laurel Road
Mount Laurel, New Jersey 08054

RE: Mount Laurel Township
Brine Report
Our File No. M-0170-0007-004

Dear Meredith:

As requested, the Alaimo Group evaluated the use of the brine for pretreatment of Township Streets in advance of a snow event, the report is attached. The report provides a brief introduction and addresses both the advantages and disadvantages of "anti-icing". The report also discusses the Township's current operations and describes the equipment necessary if the Township decides to start an anti-icing procedure. A cost analysis including three (3) options is presented.

Only two (2) local municipalities (we found) are anti-icing, Evesham Township and Cinnaminson Township. Burlington County has started an analysis of the process, no decision has been made if they will be doing anti-icing in the future. Also, the County has approached municipalities regarding anti-icing, plowing and salting County Roads. Please advise if the Township has received the correspondence from the County.

Should you have any questions that require additional information, please contact our office.

Very truly yours,

RICHARD A. ALAIMO ASSOCIATES

William R. Long, PE
Associate

WRL/kem
Enclosure
c: Jerry Mascia, Director of Community Services
Bruce Basim, Acting Public Works Director
Richard A. Alaimo, President, RAAA
M:\Projects\M01700007004\Tomczyk - Brine Report.docx

MOUNT LAUREL TOWNSHIP
OUR FILE M-0170-0007-004
ENGINEER'S REPORT

USE OF BRINE FOR PRETREATMENT OF TOWNSHIP STREETS

1.0 INTRODUCTION

The use of liquid salt brine to pretreat roadways before a winter storm event has become a widely accepted practice by state DOTs and cities throughout the United States. The New Jersey Department of Transportation and several cities and municipalities throughout the state have incorporated the use of liquid brine as part of their snow and ice management programs. In Burlington County, both Evesham Township and Cinnaminson Township have brine making equipment and use brine to pretreat the township roads. Both of these towns also brine the County Roads within their township under a contractual agreement with the County.

Salt brine solution is commonly made by dissolving granular or rock salt (sodium chloride – NaCl) with tap water. Salt brine works by lowering the temperature at which water will freeze, which helps to prevent the formation or development of bonded snow and ice with the road surface. Preventing the bond makes it easier to plow the roads.

The optimum brine for treating roadways is 23.3% salt concentration by weight because this precise salt concentration has the lowest freezing point (-6°F). The effectiveness of brine decreases as the pavement temperature drops. Most transportation agencies do not consider brine made with rock salt to be suitable for use at temperatures below the range of 15° to 20° F. Some agencies use calcium chloride or magnesium chloride to make brine that has a lower freezing point, while some use calcium chloride or magnesium chloride or proprietary additives (such as Magic Minus Zero) when making the brine to lower the effective temperature range of the solution.

The use of salt brine to pretreat roadways is known as "Anti-icing. Brine applications are typically made a day or two before the anticipated snow event. If the roads are lightly traveled, applications can be made as far as three days in advance. Brine should not be used as a pretreatment if it is anticipated that the storm will start out with rain, which would wash the brine away. When a brine solution made with NaCl is applied to the dry road, the water in the solution evaporates leaving a salt crystal residue in the surface pores/texture of the pavement. When the snow storm begins, the precipitation from the snow rehydrates the salt crystals to reform brine.

Traditional snow and ice control involves deicing the roadways by spreading solid rock salt on the pavement after the storm has begun and snow has accumulated on the pavement. This practice frequently leads to a compacted snow layer that is tightly bonded to the pavement surface. As a result, the deicing process usually requires a large quantity of salt to weaken the bond between the snowpack in the road service.

It has been reported that most users reduce their annual rock salt usage by 30% by pretreating the roads with brine.

This report will describe the advantages and disadvantages to using brine to pretreat the road and will include a cost analysis of the use of brine as a pretreatment method.

2.0 ADVANTAGES

- The use of salt brine decreases the likelihood of snow and ice bonding with the pavement, which makes subsequent plowing operations easier. As a result, the cost of placing crews on the roadways to plow and apply rock salt is reduced.

- Brine can prevent frost from forming on pavement surfaces.

- Brine can be applied to roadways during the days in advance of the storm during regular working hours. As a result, the labor expenses that could be associated with spreading rock salt during "overtime" are reduced.

- Anti-icing is environmentally friendly since it uses less salt due to the reduction in rock salt used for deicing of the roadways. The reduced amount of salt used results in less salt in the runoff and consequently results in less impact to the soil, groundwater, and surface water.

- The reduced amount of salt used results in a reduction in deicing residue on the streets.

- The Snowfighters's Handbook (Salt Institute 2007) indicates that anti-icing requires anywhere from 1/3 to 1/4 of the material of deicing. The Handbook also states that research has shown that timely applications of anti-icing materials can cut the cost of maintaining a safe road surface by 90% compared to traditional deicing.

- Anti-icing leads to better pavement conditions and may reduce the number of traffic accidents, injuries and deaths.

- The public is less tolerant of failure in snow and ice control than in any other road department function. A snowstorm affects the entire community — often entire states. Unless a storm is handled capably by maintenance forces, it can upset considerably the daily routines of individuals, endangering public safety and adversely affecting business and commerce.

- Anti-icing returns road to passable conditions quicker, resulting in less delays or traffic incidents and allows emergency vehicles to get through sooner. The reduction in delays and incidents has a positive economic impact by allowing workers to arrive at their jobs at a near normal pace which maintains productivity.

- Crews can cover more territory by beginning treatment in advance of a storm.

- Liquid brine can be applied by trucks traveling at higher speeds than conventional salt spreading.

- Wear and tear on salt spreading vehicles is reduced.

- The use of brine solutions can help clear snow and ice in a more effective and efficient manner, cutting two or three days off some post storm cleanups.

- Snow plows don't need to be driving as often during dangerous snow conditions.

- It is estimated that 40% of solid rock salt spread on the road either bounces to the side of the road or is blown to the side of the road by passing vehicles. This salt is wasted and increases environmental impacts.

3.0 DISADVANTAGES

- Brine should not be used if the storm is anticipated to begin as rainfall. Rain will wash away the brine. Once the use brine as a pretreatment process has been adopted, the Township residents will anticipate seeing the brine on the pavement prior to every storm and may question why brine is not applied prior to all storm events.

- Special equipment is needed for applying the brine and for manufacturing the brine if the brine is not purchased. Cost of the brine making equipment and storage tanks have a payback period of several years.

- Accurate weather prediction and judgment by the public works department is necessary in determining whether brine should be applied.

- Making the brine, cleaning up the brine making equipment and transferring the brine from storage tanks on-site to the truck or trailer mounted holding tanks requires labor.

- Anti-icing using brine made with rock salt should not be conducted when the pavement temperature is below 20° F or forecast to fall below 20° F. Additives are available to lower the freezing point of the brine at additional cost.

- If brine is applied when the pavement temperature is too warm, or when the air humidity falls within certain ranges, the road surface can become slippery. Consequently, there can be an increase in traffic accidents if the brine is applied during inappropriate weather conditions.

- Liquid brine can become diluted and can refreeze more quickly than solid road maintenance materials. Brine will not freeze on the road when it is applied, but it becomes diluted as snow and ice melts. Unless the road is cleared of snow and ice by plowing and subsequent deicing, the road will refreeze eventually.

- Anti-icing should be conducted during normal or low traffic volume. A following vehicle for traffic control may be needed during periods of high-traffic volume. This concern is not typical for Township roads.

- There are widely varying opinions on whether brine increases corrosion. Some contend that the use of brine skips the step where salt crystals melt into snow and ice and turn to liquid, so the salty solution is splashing onto vehicles and their undercarriages for a longer time compared to dry salt. At least one Transportation Agency issued a statement that the salt brine and salt brine blends used by that agency are not causing an increase in corrosion to vehicles. Their theory is that salt brine is the exact same chemical composition as dry salt mixed with ice, snow or rain – just salt and water. The Agency also contends that less salt used translates into less corrosion potential regardless of whether it is dry salt or wet salt (brine).

- Both liquid brine and rock salt can have corrosive effects on stormwater infrastructure and bridges. When dry rock salt is applied to the roads, a brine is created as the rock salt mixes with ice, snow or rain. The brine has the same chemical composition as the liquid brine used for pretreatment, so the corrosiveness is the same.

- Some states add magnesium chloride when making the brine because it is effective at lower temperatures. Magnesium chloride is more corrosive than sodium chloride (rock salt) under humid conditions. When vehicles are parked in garages soon after being exposed to this brine solution, the humidity in the garage has the effect of increasing corrosion

4.0 DESCRIPTION OF CURRENT OPERATIONS

Mount Laurel Township currently applies dry rock salt to the Township streets as a means of deicing. Salt is applied by the Public Works Department after the snowfall has begun as a deicer and again after the roads have been plowed, as necessary. Salt is also applied on icy roads from frozen rain or whenever the Public Works Department is called by the Police Department for icy conditions.

Salt was applied 23 times in 2015 and 11 times in 2016. As of February 7, salt has been applied 2 times in 2017. The quantity of salt purchased in 2015, 2016, and 2017 was 1,476 tons, 0 tons, and 450 tons respectively.

5.0 BRINE MAKING EQUIPMENT AND DELIVERY

The equipment used to make salt brine varies in the rate at which the brine is made and the level of automation. A higher production rate and a higher level of automation come at a higher price tag. The brine can be made continuously or in batches. The continuous operation uses sensors to monitor the salt concentration during production. The batch process is more labor intensive since valves have to be turned to transfer the batch to the storage tank once the batch is made. Some equipment used to make batches also requires the operator to use a hydrometer to determine the salinity of the solution when making the batch.

The brine making equipment can be stored either inside a building or outside; however, the controls for the fully automated system must be stored inside. The brine storage tanks can be stored inside or outside. The decision whether to use inside or outside storage facilities depends on the freezing temperature of the solution and the lowest air temperature expected in the area. If the lowest air temperature is at or below the freezing-point of the solution, then inside storage should be used. However, if that is not possible, heat can be applied either with heat tapes or immersion heaters in the outside storage vessel to maintain the solution temperature above the freezing-point.

The trucks used for liquid application can range in size depending on the size of the brine holding tank. The holding tank is either mounted directly on the truck or mounted on a trailer that is pulled by the truck. The holding tanks can be skid-mounted, trailer-mounted, or mounted on a self-loading support mechanism that slides into and out of the truck. Small pickup trucks are typically used for tanks under 500 gallons. The brine is applied using pumps and spray bars mounted on the trucks or trailers. The application of the brine can be controlled by automated spray technology tied to the vehicle speed. The automated technology ensures that the brine is applied to the roadway at a set rate and temporarily shuts off the spraying when the vehicle stops.

6.0 COST ANALYSIS

The following cost analysis assumes that all brine making equipment, except for the controls for the continuous flow system, as well as all storage tanks would be stored outside in the public works yard. The controls for the continuous flow system would be stored in a small shed to be constructed in the public works yard.

Current Rock Salt Application Costs:

Mount Laurel Township has approximately 150 miles of Township roads. We estimate that about 1/3 of the roads are deiced with rock salt on both sides of the road and that the majority of the roads are treated with a single pass down the center of the road. Assuming that the rock salt is spread at a rate of 400 pounds per lane mile and that the rock salt costs $75 per ton, the material cost for rock salt is $3,000.

During a typical application of rock salt, the Public Works Department uses 9 spreaders and it takes approximately 12 hours to treat all of the Township Roads. Assuming an average labor cost of $60 per hour, the present labor cost to spread rock salt (assuming time and a half for over 8 hours) is $7,560.

The total labor and material cost (excluding gasoline and vehicle maintenance costs) for applying rock salt to all Township streets is approximately $10,560.

Brine Application Cost:

The rate at which brine is applied to the roadway varies depending on the anticipated weather conditions. The rates can vary between 30 to 60 gallons per lane mile. This report will assume an application rate of 50 gallons/lane mile. Based on this assumed application rate and assuming 200 lane miles of roads, 10,000 gallons of brine would be required to pretreat the roads. Approximately 2.288 pounds of salt is required to make a gallon of brine with 23.3% salt. The cost of the salt (based on $75 per ton) to make 10,000 gallons would be $858.

The cost to make the brine would include the cost of the water to make the brine, the cost of the electricity to operate the equipment, and the labor cost. The cost of the water and the cost of the electricity are not significant compared to the labor cost.

6.1 Option 1 (Continuous Flow Brine Maker)

The automated brine maker is capable of making 6000 gallons per hour. If we assume a production rate of 4,000 gallons per hour, it would take 2.5 hours to make the 10,000 gallons required to pretreat the roads. Based on our assumed labor rate of $60 per hour, it would cost $150 to make the brine. Assuming another hour to clean up the equipment, the total labor cost would be $210 for 10,000 gallons.

We estimate that it would take 32 man-hours to pretreat the Township streets with brine. At an assumed labor rate of $60 per hour and assuming regular time for all applications, the labor cost would be $1920.

The total labor cost for making and applying the brine using the automated brine maker would be $2,130. Adding the cost of the rock salt to make the brine ($848), the total cost for labor and materials would be $2,978.

CAPITAL COSTS:

Cargill AccuBrine NXT automated brine maker (including 2 storage tanks)	$104,000
Electric Services	$8,000
Concrete Pads	$12,000
Water Service	$3,000
Water Service Connection Fee	$5,000
Shed for Controls	$8,000
Sub-Total	$138,000
Brine Delivery Equipment:	
Brine sprayers	$30,000
Total Capital Cost	**$170,000**

LABOR AND MATERIAL SAVINGS:

Applying Rock Salt:	$10,560
Making and Spraying Brine:	$2,978
Labor and Material Savings per storm event:	$7,582
Assumed number of storm events:	8
Labor and Material Savings per year:	$60,656
PAYBACK PERIOD:	**2.80 years**

6.2 Option 2 (Batch Process Brine Maker)

The batch brine maker is capable of making 800 gallons per hour. Assuming a production rate of 600 gallons per hour, it would take 16.7 hours to make 10,000 gallons of brine. Based on our assumed labor rate of $60 per hour, it would cost $1000 to make the brine. Assuming another hour to clean up the equipment, the total labor cost would be $1,060 for 10,000 gallons.

Assuming again 32 man-hours to pretreat the Township streets, the total labor cost for making and applying the brine using the batch brine maker would be approximately $2,980. Adding the cost of the rock salt to make the brine ($848), the total cost for labor and materials would be $3,828.

CAPITAL COSTS:

Cargill AccuBatch automated system (including 1 storage tank)	$46,200
Additional Storage Tank	$6,000
Electric Service	$6,000
Concrete Pads	$12,000
Water Service	$3,000
Water Service Connection Fee	$5,000
Sub-Total	$78,200
Brine Delivery Equipment:	
Brine Sprayers	$30,000
Total Capital Cost	**$108,200**

LABOR AND MATERIAL SAVINGS:	
Applying Rock Salt:	$10,560
Making and Spraying Brine:	$3,828
Labor and Material Savings per storm event:	$6,732
Assumed number of storm events:	8
Labor and Material Savings per year:	$53,856
PAYBACK PERIOD:	**2.01 years**

6.3 **Option 3 (Purchase Brine)**

Brine is available for purchase at about $0.50 per gallon. The cost to purchase 10,000 gallons would be $5,000. Assuming again 32 man-hours to pretreat the Township streets, the total labor and material cost for purchasing and applying the brine would be approximately $6,920.

Two (2) storage tanks (5,000 gallons each) would be required for holding the brine. The sprayers would be used to draw the brine from the storage tanks to the holding tanks on the skids.

CAPITAL COSTS:	
Storage Tanks	$12,000
Concrete Pads	$12,000
Sub-Total	$24,000
LABOR AND MATERIAL SAVINGS:	
Applying Rock Salt:	$10,560
Purchasing and Spraying Brine:	$6,920
Labor and Material Savings per storm event:	$3,640
Assumed number of storm events:	8
Labor and Material Savings per year:	$29,120
PAYBACK PERIOD:	**0.82 years**

6.4 Option 4 (Interlocal Agreement)

As mentioned previously, both Evesham Township and Cinnaminson Township have brine making equipment and brine spraying equipment. Mount Laurel Township could investigate entering into an interlocal agreement with either Township to provide pretreatment of Mount Laurel's roads.

6.5 Conclusion:

The cost analysis indicates a payback period of 2.8 years for the automated brine maker and 2 years for the batch brine makers. The payback period analysis in this report assumes that the use of brine for pretreatment would substitute for the first application of rock salt to 200 lane miles of Township roads and that the Township currently applies 400 pounds of rock salt per lane mile. The analysis also assumes eight (8) winter snow events per year. The payback period would be affected if any of these assumptions are changed.