

Temple University Deicer Study
White Paper Rebuttal

**DON'T BE
MISLED**

**AquaSalina[®] test sample
amended (diluted) 0%**

**BEET HEET[®] test sample
amended (diluted) over 97%**

**In head to head ice melting, 23.3%
NaCl brine outperformed, or
performed as well as, AquaSalina
at 9 out of 12 measuring points.**

Temple University Deicer Study

White Paper Brief by K-Tech Specialty Coatings, Inc.

INTRODUCTION

This White Paper Brief is in response to a deicer study co-sponsored by the Pennsylvania Department of Transportation and the Federal Highway Administration, US Department of Transportation. This study, referred to as the “study” hereinafter, was conducted by Temple University and performed under Contract # 4400011166 and Work Order # TEM 003. The title of the study is *Effective Use and Application of Winter Roadway Maintenance Material Enhancers* and was published on October 19th 2015. The purpose of this White Paper Brief is to alert transportation agencies of serious issues K-Tech Specialty Coatings, Inc. has identified with this study and its findings.

K-Tech Specialty Coatings, Inc., hereinafter referred to as “K-Tech”, is the developer, manufacturer and sole distributor of BEET HEET[®] Concentrate. BEET HEET[®] Concentrate, referred to as “BEET HEET” hereinafter, was one of the “novel” deicers tested by Temple University researchers and included in said study.

K-Tech is committed to laboratory testing to research, develop, and verify the performance of its products. K-Tech has compiled an extensive amount of ice melt capacity data on BEET HEET and BEET HEET blends. At least 9 independent labs have participated in BEET HEET testing over the last 7 years, including the PNS (Pacific Northwest Snowfighters). K-Tech has also compiled ice melt capacity data on many other competing products, including “well brine” deicers very similar to AquaSalina, another deicer tested by Temple University researchers and included in said study.

After thoroughly reviewing:

- The contents of the study
- K-Tech’s ice melt capacity data, as reported by independent laboratories
- K-Tech’s customer’s field experiences with products tested in this study

K-Tech was compelled to publish this White Paper Brief outlining disturbing issues we identified with this study and its findings.

SUMMARY OF TESTING

The Pennsylvania Department of Transportation and the Federal Highway Administration, US Department of Transportation co-sponsored this study to:

- 1.) Evaluate the performance and potential environmental effects of winter maintenance additives.
- 2.) Determine the top three performers. (page 4)

The deicers evaluated were:

- rock salt
- salt brine

and four proprietary deicers or “material enhancers”:

- AquaSalina
- BEET HEET
- GreenBlast
- Magic Minus Zero

TESTING

Environmental impact testing included:

- Chemical Analysis
- Toxicity Testing
- Corrosion Testing

Performance testing included:

- Deicing Performance - Ice Melt Capacity Testing
- Anti-Icing Performance - Freezing Point Testing

PERFORMANCE RANKING

After chemical analysis, toxicity and corrosion testing were completed Temple researchers determined that direct environmental effects associated with the tested deicers were “expected to be minimal”. Therefore, “performance was deemed to be the most important consideration” (page 7) making the deicing and anti-icing test results the most important factors of the study.

When deicing and anti-icing testing were completed, Temple researchers stated the following.

“When evaluating the performance of all deicers based on both deicing and anti-icing,

- AquaSalina always has the best performance
and
- BEET HEET always has the worst performance.” (page 5)

Non-exothermic chlorides in the form of sodium chloride (NaCl) and potassium chloride (KCl) are good ice melters and freeze point depressants. Exothermic chlorides in the form of calcium chloride (CaCl₂) & magnesium chloride (MgCl₂) are great performing ice melters and freeze point depressants, particularly when enhanced with organic based performance enhancers. Considering each deicer’s:

- Non-exothermic chloride content levels (page 44)
- exothermic chloride content levels (page 44)
- organic performance enhancer levels, more specifically, sugar content levels (page 44)

it’s K-Tech’s fervent opinion that this study’s conclusion that AquaSalina is the best performing novel deicer and BEET HEET is the worst performing novel deicer is not only unlikely, but completely impossible. The following table outlines each deicer’s exothermic and non-exothermic chloride levels as well as each deicer’s estimated total sugar content and total active ingredient content. (page 44)

Deicer Name	Total Exothermic Chloride Content	Total Non-Exothermic Chloride Content	Organic Enhancer	Estimated Total Sugar Content	Total Active Ingredient Content
AquaSalina	12.90%	9.20%	None	None	22.10%
GreenBlast	27.50%	None	None	None	27.70%*
Magic Minus Zero	22.40%	None	20.00%	9.70%**	32.10%
BEET HEET	15.30%	6.40%	28.80%	15.00%***	36.70%

Notice that every non-AquaSalina novel deicer included in this study contains significantly more exothermic chloride and total active ingredient than AquaSalina. In fact, BEET HEET contains 18.6% more exothermic chloride than AquaSalina and 66.0% more total active ingredient.

So, how did Temple researchers find and conclude that “AquaSalina always has the best performance and BEET HEET always has the worst performance”?

BIASED METHODOLOGY & TESTING

Temple researchers made a decision at the outset of the study to classify Magic Minus Zero and BEET HEET as “solid” deicers, while classifying AquaSalina and GreenBlast as “liquid” deicers. (page 7) This decision, and others, severely biased this study rendering it wholly incapable of accurately determining “the top three performers” in any environmental or performance category. Here’s why.

- The deicer amendment rates that Temple researchers used for the “solid” deicers, Magic Minus Zero and BEET HEET, are significantly greater than the deicer amendment rates Temple researchers used for testing the “liquid” deicers, AquaSalina and GreenBlast. Amendment rate is the amount each novel deicer was diluted before testing. The greater the amendment rate, the greater the bias against the deicer.
- Within the “solid” deicer class, the amendment rate used for the BEET HEET deicer was significantly greater than the amendment rate used for the Magic Minus Zero deicer.
- Within the “liquid” deicer class, the amendment rate for the GreenBlast deicer was significantly greater than the amendment rate used for the AquaSalina deicer.

Consider the following amendment methods and rates Temple researchers used for this study.

Deicing Performance Testing – Deicer Amendment

Solid Deicers

- BEET HEET was amended by adding it to rock salt at a rate of 5 gallons per ton. (page 7)
- Magic Minus Zero was amended by adding it to rock salt at a rate of 10 gallons per ton, or 100% more novel deicer than BEET HEET. (page 7)

Liquid Deicers

- GreenBlast was amended by adding it to 23.3% NaCl brine at 20% of total volume of the solution, or four volumes of 23.3% salt brine to 1 volume of GreenBlast. In other words, GreenBlast was amended with 23.3% NaCl brine by 80%. (pages 7)
- AquaSalina was amended 0%. In other words, AquaSalina was tested “as received” or 100% AquaSalina and 0.00% 23.3% NaCl brine. (page 7)

The rate of amendment, the amount of novel deicer contained in each deicer test sample and the percentage by which each deicer sample contains more novel deicer than the BEET HEET sample is as follows.

Deicer Name	Rate of Amendment	Milliliters of Novel Deicer In Test Sample	% More Novel Deicer Than BEET HEET
AquaSalina	0.00%	0.9000	4,333%
GreenBlast	80.00%	0.1800	786%
Magic Minus Zero	94.88%	0.0406	100%
BEET HEET	97.37%	0.0203	

Anti-freezing Performance Testing – Deicer Amendment

Solid Deicers

- BEET HEET was amended by adding it to rock salt at a rate of 5 gallons per ton. The BEET HEET treated salt was then further amended by diluting it with Nanopure™ water down to 28% salt by weight. (pages 7, 66)
- Magic Minus Zero was amended by adding it to rock salt at a rate of 10 gallons per ton. The Magic Minus Zero treated salt was then further amended by diluting it with Nanopure™ water down to 30% salt by weight. (pages 7, 66)

So not only did the Magic Minus Zero sample contain 100% more novel deicer than the BEET HEET sample (10 gallons per ton vs. 5 gallons per ton), after dilution with Nanopure™ water, the Magic Minus Zero sample contained 7% more salt by weight than the BEET HEET sample (30% vs. 28%).

Liquid Deicers

- GreenBlast was amended by adding it to 23.3% NaCl brine at 20% of total volume of the solution, or four volumes of 23.3% salt brine to one volume of GreenBlast. In other words, GreenBlast was amended with 23.3% NaCl brine by 80%. (page 7)
- AquaSalina was amended 0%. In other words, AquaSalina was tested “as received” or 100% undiluted AquaSalina and 0.00% 23.3% NaCl brine. (page 7)

The rate of amendment, the percentage of novel deicer contained in each deicer test solution and the percentage by which each deicer solution contains more novel deicer than the BEET HEET solution is as follows.

Deicer Name	Rate of Amendment	Percent of Novel Deicer in Test Sample	% More Novel Deicer Than BEET HEET
AquaSalina	0.00%	100.00%	13,430%
GreenBlast	80.00%	20.00%	2,602%
Magic Minus Zero	98.52%	1.48%	100%
BEET HEET	99.26%	0.74%	

BIASED METHODOLOGY & TESTING REVIEW

When amendments are considered, or lack thereof for AquaSalina, it becomes self-evident why AquaSalina “always performed the best” and why BEET HEET “always performed the worst”.

1. The AquaSalina test sample was the only novel deicer not amended.
2. Of the three novel deicers that were amended, the BEET HEET test sample was amended the most, 97.37% for the deicing testing and 99.26% for the anti-icing testing.
3. For the deicing testing, the AquaSalina test sample contained 4,333% more novel deicer than the BEET HEET test sample.
4. For the anti-icing testing, the AquaSalina test sample contained 13,413% more novel deicer than the BEET HEET test sample.

Although this White Paper Brief focuses primarily on this study’s deicing and anti-icing test results, readers must know that this study’s incredible bias against BEET HEET impacted each and every test result. When Temple researchers say, “...rock salt and BEET HEET were the most corrosive.” (page 5), what did Temple researchers expect? The BEET HEET test sample was 97.37% rock salt!

ADDITIONAL ISSUES OF CONTENTION

Although almost entirely mooted by this study’s incredible bias, there are a number of other issues with this study and the researcher’s findings.

- Temple researchers modified the original SHRP H-205.1 and 205.2 ice melt capacity tests by reducing the sample sizes by 76%. It is K-Tech’s fervent opinion that reducing the standard sample size of the SHRP H-205.1 from 4.17 grams to only 1.0 gram and the SHRP H-205.2 sample size from 3.8 mL to only 0.9 mL significantly increased each test’s margin of error and decreased its accuracy, particularly when it comes to rock salt samples that have been treated with liquid enhancers. Consider this about treated rock salt test samples. If the sample size is only 1.0 gram, how much liquid deicer would need to be added to that 1.0 gram sample if the deicer application rate was 5 gallons per ton of salt? Approximately 40% of one drop of deicer!

Tables 7 and 8 (page 58), support K-Tech’s position. The BEET HEET ice melt capacity test results have extremely high standard deviations, significantly higher than all the other deicers. K-Tech believes the BEET HEET ice melt capacity tests failed to meet the minimum acceptable levels of variation for successful SHRP H-205.1 testing.

Wanting to verify the validity of Temple’s BEET HEET ice melt capacity test results, K-Tech

formally requested from Temple researchers all ice melt capacity data point data. K-Tech's simple request was denied. This action further supports K-Tech's suspicion that the BEET HEET ice melt capacity results did not meet the minimum standards for successful SHRP H-205.1 testing. If true, the BEET HEET ice melt capacity test results would have been invalid and should never have been used.

- Temple researchers concluded that AquaSalina was the “best performing” deicer, yet they never even tested AquaSalina as a salt pre-wetting agent, or “solid” deicer.
- Temple researchers concluded that BEET HEET was the “worst performing” deicer, yet they never even tested BEET HEET as a direct application liquid deicer or anti-icer, or “liquid” deicer.

CONCLUSION

It is K-Tech's fervent opinion that this study was fatally flawed from the very beginning, making it incapable of accurately determining the top three performing deicers in any category. This is due to Temple researcher's decision to divide the four novel deicers into two classes, “solid” and “liquid” deicers.

This decision made it necessary for Temple researcher to use different test methods for each class. The different test methods made it necessary for Temple researchers to use altogether different amendment rates for each class. Comparing deicers by subjecting some to one set of test methods and amendment rates and subjecting others to a different set of test methods and amendment rates, goes against the most basic testing principles, especially when it wasn't even necessary.

According to the Deicing Materials Summary (pages 38 - 45), all four novel deicers are multipurpose deicers, meaning, all four can be used, in one form or another, as salt pre-wetting agents and/or direct application liquid deicers and anti-icers, i.e. “solid” and/or “liquid” deicers.

By the way, multipurpose deicers are the norm in the industry. Using one novel deicer for salt pre-wetting and a second novel deicer for direct application de-icing or anti-icing, would be highly unusual and very unlikely for a number of very elementary reasons, including:

- Risk of cross contamination
- Need for additional storage tank(s) and supporting infrastructure
- It complicates the use of liquid deicers unnecessarily.

Yet, the way Temple researchers chose to test these novel deicers it seems as if they really thought the sponsor of this study, or users in general, would be employing two novel deicers, one for “solids” and one for “liquids”. The author of this paper has visited nearly 1,000 roadway maintenance facilities and has never seen an example of a single agency using one novel deicer for salt pre-wetting and a second novel deicer for direct application deicing or anti-icing.

If Temple researchers would have:

- Subjected all four novel deicers to the exact same “solids” and “liquids” test methods
- Used the exact same amendment rates for each novel deicer
- Adhered to the original SHRP H-205.1 and H205.2 sample sizes

K-Tech contends that the test results would have been completely different and much more accurate.

To better understand this reasoning, consider these facts about the deicer Temple researchers contend was the “best performing” deicer when compared to the other three novel deicers.

1. AquaSalina contains the least exothermic chloride (12.9%). (page 44)
2. AquaSalina contains the least total active ingredient (22.1%). (page 44)
3. AquaSalina contains the most water (approximately 77.9%). (100.0% minus 22.1%)
4. AquaSalina does not contain an organic performance enhancer. (page 44)
5. AquaSalina has the lowest specific gravity (1.21). (page 44)

Deicers with very weak solutions, or low active ingredient content levels, are very weak ice melters too. 23.3% NaCl brine has one of the lowest active ingredient content levels in the deicer industry (23.3%). It’s also one of the worst performing ice melters when compared to most commercially available proprietary deicers. With that said, consider that AquaSalina contains even less active ingredient than 23.3% NaCl brine (22.1% vs. 23.3%).

Bearing this in mind, consider AquaSalina’s ice melt capacity performance head to head (0.9 mL vs. 0.9 mL) versus 23.3% NaCl brine and GreenBlast. (Table 4, page 56) Note: For liquid deicers, brine volumes of less than 0.9 mL indicate the liquid deicer was freezing, not melting ice.

Table 4. Average Volumes of Brine Collected for All Deicers (Unit: mL)

Time (min)	0°F				15°F				25°F			
	10	20	40	60	10	20	40	60	10	20	40	60
Rock Salt	0.0	0.0	0.1	0.2	0.6	1.0	1.8	3.7	1.3	3.0	5.3	6.3
Magic Minus Zero	0.0	0.0	0.0	0.1	1.0	1.9	3.3	4.4	1.9	3.9	5.9	7.2
BEET HEET	0.0	0.0	0.0	0.1	0.2	1.5	2.6	3.5	1.1	3.1	5.7	7.3
Salt Brine	0.8	0.7	0.7	0.5	1.2	1.3	1.4	1.3	1.8	2.1	2.4	2.5
GreenBlast	0.6	0.6	0.4	0.5	1.2	1.4	1.4	1.3	1.7	2.3	2.4	2.7
AquaSalina	0.8	0.7	0.6	0.6	1.1	1.3	1.4	1.5	1.8	2.1	2.3	2.6

1. At 0°F, AquaSalina created slightly more brine (melted ice) than 23.3% NaCl brine only at the 60 minute measuring point. In fact, AquaSalina had negative brine volumes (less than 0.9 mL) at all four measuring points indicating that AquaSalina was freezing at 0°F, not melting ice.
2. At 15°F, AquaSalina created slightly more brine than 23.3% NaCl brine only at the 60 minute measuring point.
3. At 25°F, AquaSalina created slightly more brine than 23.3% NaCl brine only at the 60 minute measuring point.
4. In total, AquaSalina outperformed 23.3% NaCl brine at only 3 out of 12 measuring points!
5. 23.3% NaCl brine outperformed, or performed as well as, AquaSalina at 9 out of 12 measuring points!

Considering that AquaSalina and 23.3% NaCl brine were both tested “as is” and undiluted, and each was subjected to the same exact test methods, their head to head ice melt capacity results would be the most accurate comparison this study makes. By the way, when snowfighters compare the performance of deicers in the field, they compare them head to head, gallon(s) to gallon(s) and ice melted to ice melted. The density of each deicer is of no importance to these front line snowfighters, nor should it be when researchers study them in a lab. This does nothing but skew the laboratory results even further from actual field performance.

In closing, it's K-Tech's position that this study is not an accurate reflection of head to head deicer performance, but rather, a reflection of the degree of bias each deicer was subjected to. This study was heavily biased in favor of 100% "as is", undiluted AquaSalina, hence, AquaSalina "always performed the best". This study was heavily biased against BEET HEET, which was amended 97.37% for the deicing testing and 99.26% for the anti-icing testing, hence, BEET HEET "always performed the worst".

Based on each deicer's active ingredient makeup and content levels, and Temple researcher's own incredibly biased test results, logic contends that if each novel deicer had been subjected to the same test methods and the same amendment rates, the true performance rankings would have been the exact opposite of what Temple researchers concluded and reported in this study, making BEET HEET the best performing deicer and AquaSalina the worst performing deicer. Logic strongly suggests that if AquaSalina had been amended even the slightest amount, 23.3% NaCl brine would have outperformed AquaSalina at every temperature level.

This study was ill-conceived, poorly conducted and incredibly biased, making it very misleading and intellectually dishonest.

Sincerely,



Denver L. Preston

General Sales Manager - Winter Products
K-Tech Specialty Coatings, Inc.
Ashley, IN 46705
Office (260) 587-3888
Cell & Text (260) 585-0332
dpreston@ktechcoatings.com

* Page 44 of this study reports that GreenBlast contains 0.20% "Performance enhancer". Nothing in this study identifies what the enhancer is. However, because it's identified as a "Performance enhancer" it should be included in GreenBlast's total active ingredient content.

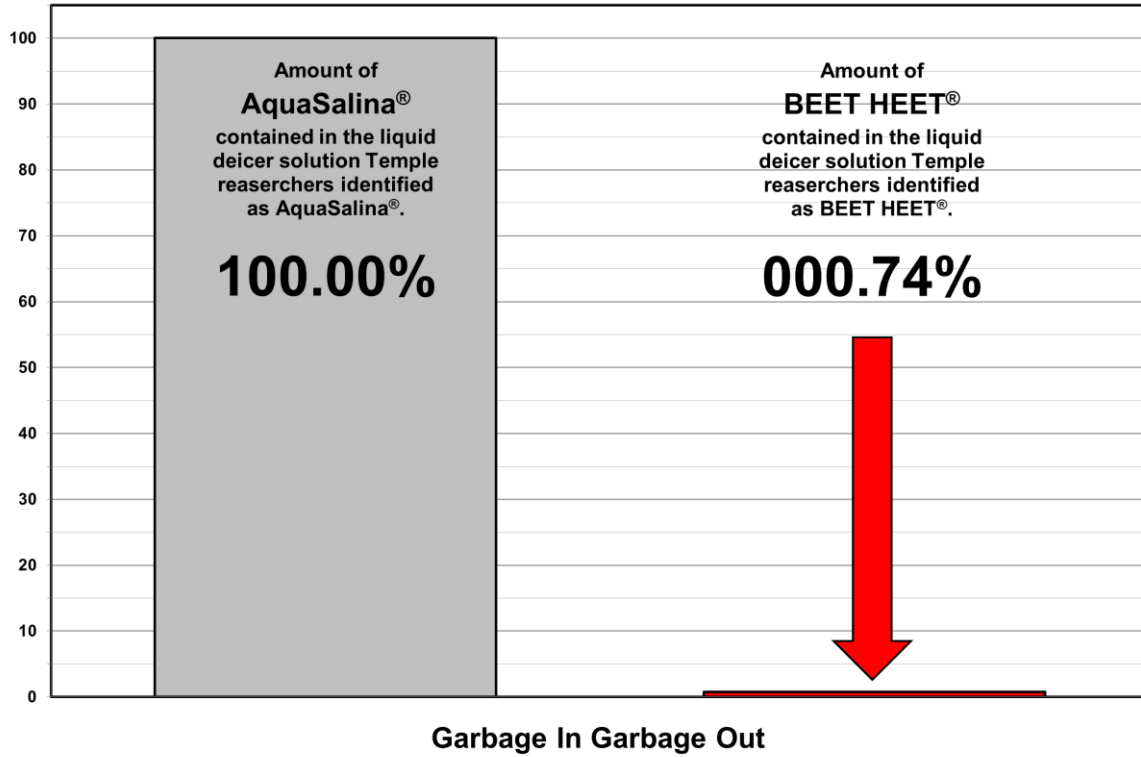
** Page 44 of this study reports that Magic Minus Zero contains 20.00% molasses. An internet search suggests that Magic Minus Zero is sugar cane molasses. An internet search suggests that sugar cane molasses contains approximately 48.00% total sugars "as invert". 20.00% of 48.00% is 9.60%. Since cane molasses weighs more than the chlorides contained in Magic Minus Zero, the sugar content would be approximately 9.70% by weight.

***Page 44 of this study reports that BEET HEET Concentrate contains 28.80% organic. The organic in BEET HEET Concentrate is sugared sugar beet molasses. Sugared sugar beet molasses contains approximately 51.40% total sugar "as invert". 28.80% of 51.40% is 14.80%. Since sugared sugar beet molasses weighs more than the chlorides contained in BEET HEET, the sugar content is slightly higher than 14.80% by weight. The actual sugar content of BEET HEET is 15.00% by weight.

Temple University Deicer Study

Percent of Original Deicer in Tested Deicer Solution

Tests conducted using these solutions: Eutectic Freeze Point, Corrosion Value, Toxicity



Temple University Deicer Study

Percent of Original Deicer in Tested Deicer Solution

Tests conducted using these solutions: Ice Melt Capacity

