

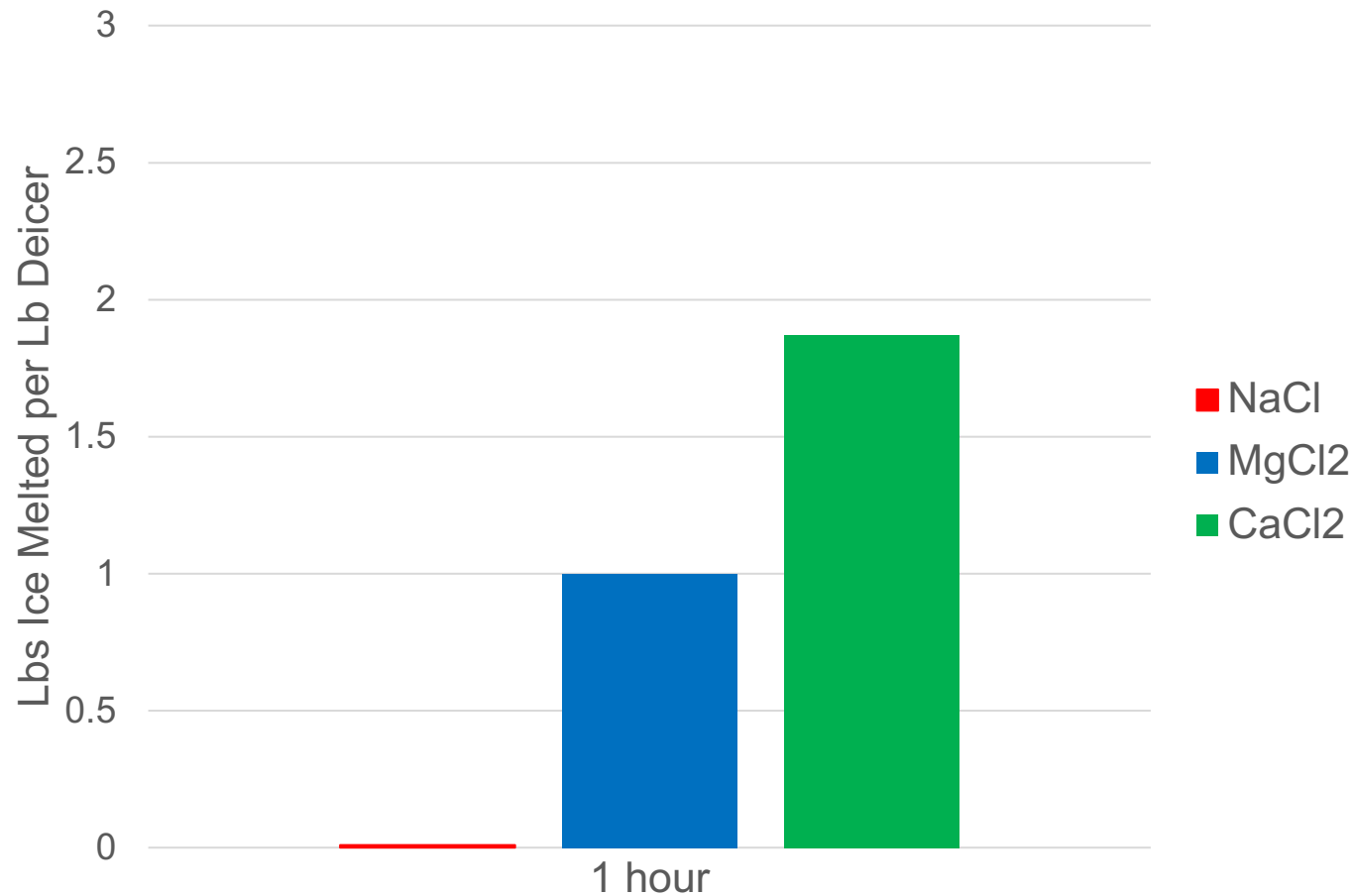


# Investigating Pre-wetting with a New Ice Melter Performance Test

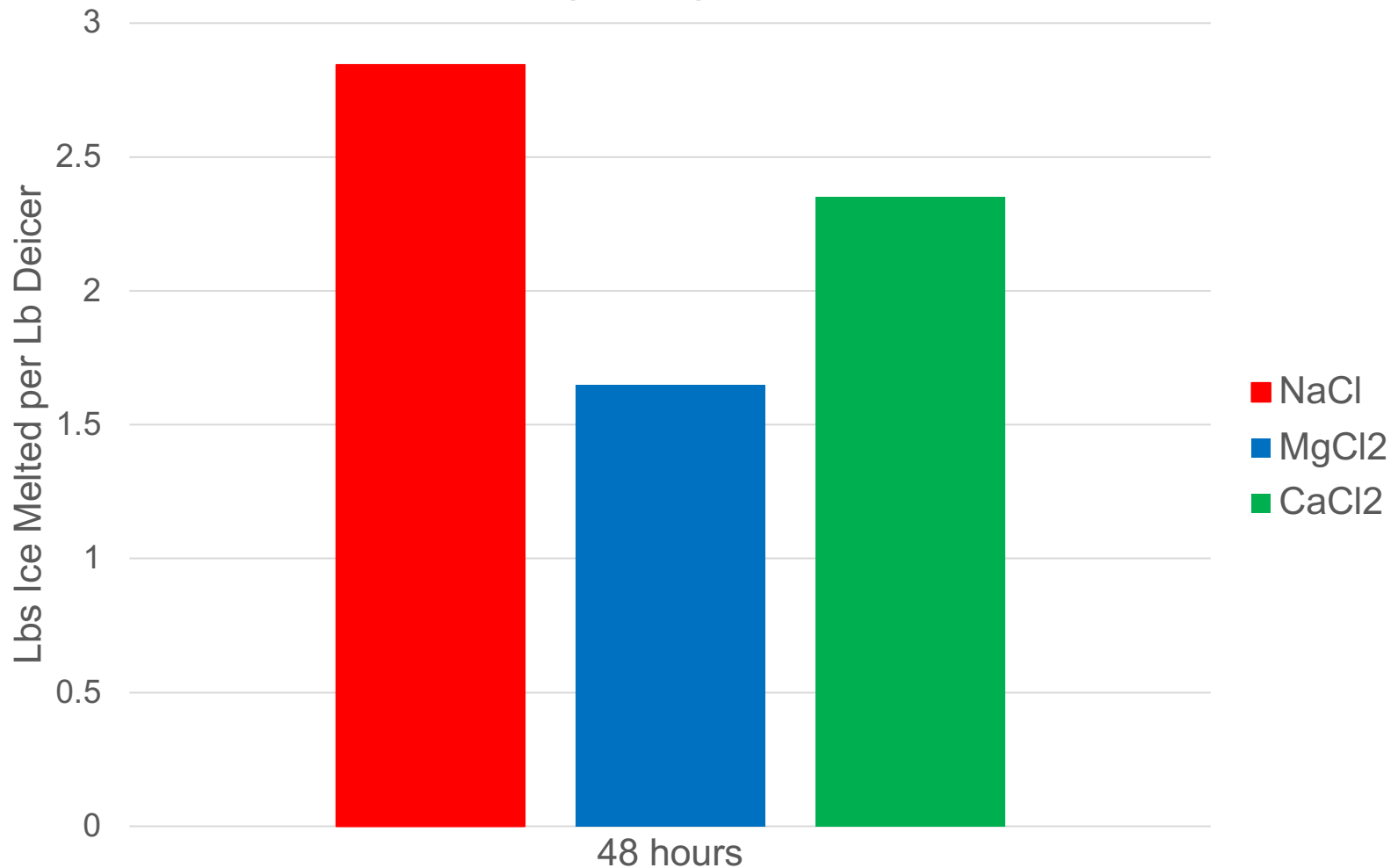
Scott Koefod  
Cargill Salt Group

## Salt's Deicing Performance at Cold Temperatures is Both Rate & Thermodynamically Limited

**Ice Melt at -4 °F (-20 °C) After 1 Hour**



## Ice Melt at -4 °F (-20 °C) After 48 Hours



## Salt's Ice Melt Rate Can be Enhanced by Pre-wetting

- Increased ice melt rate = lower effective temperature
- What is the mechanism of rate enhancement?
- Does the choice of pre-wetting liquid matter?
- Is there an optimum ratio of pre-wetting liquid to salt?
- Can we quantify the improvement in ice melt performance?
- How can we start answering these questions?

# Improved Method for Measuring Ice Melting by Tracer Dilution



# WORLD SALT SYMPOSIUM

June 19-21, 2018

Park City UT, USA

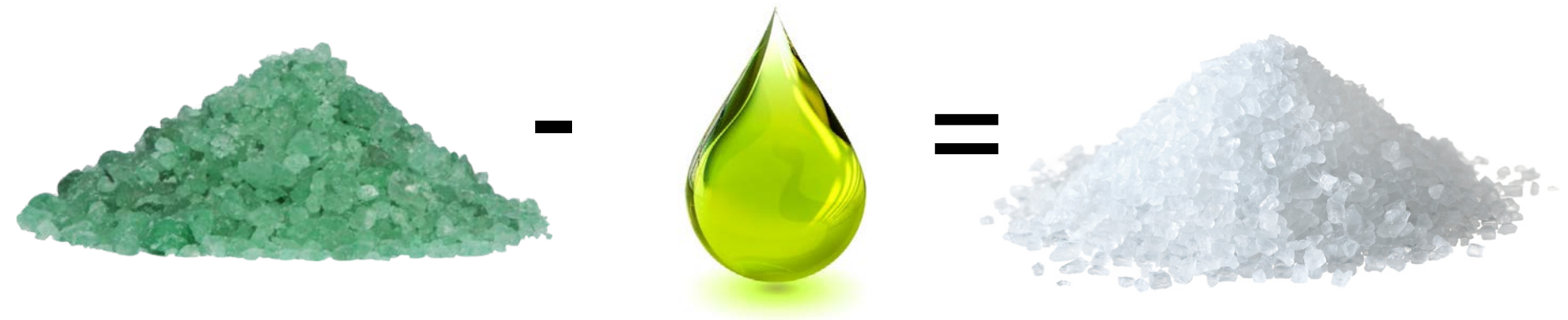


## Tracer Dilution Approach

- Mix rock salt, pre-wetting brine, and ice
- Analyze initial brine for  $\text{Cl}^-$  and a “tracer” (e.g.  $\text{Mg}^{+2}$  or  $\text{Ca}^{+2}$ )
- Analyze brine after ice melting
- Brine will be diluted by melted ice + dissolved salt
- Mass of ice melted can be determined algebraically with high accuracy and precision
- 99.8% accurate measurement of ice melt controls
- Method shows excellent agreement between salt’s measured ice melting capacity and the theoretical value predicted from the phase diagram (within  $< 2\%$  error).



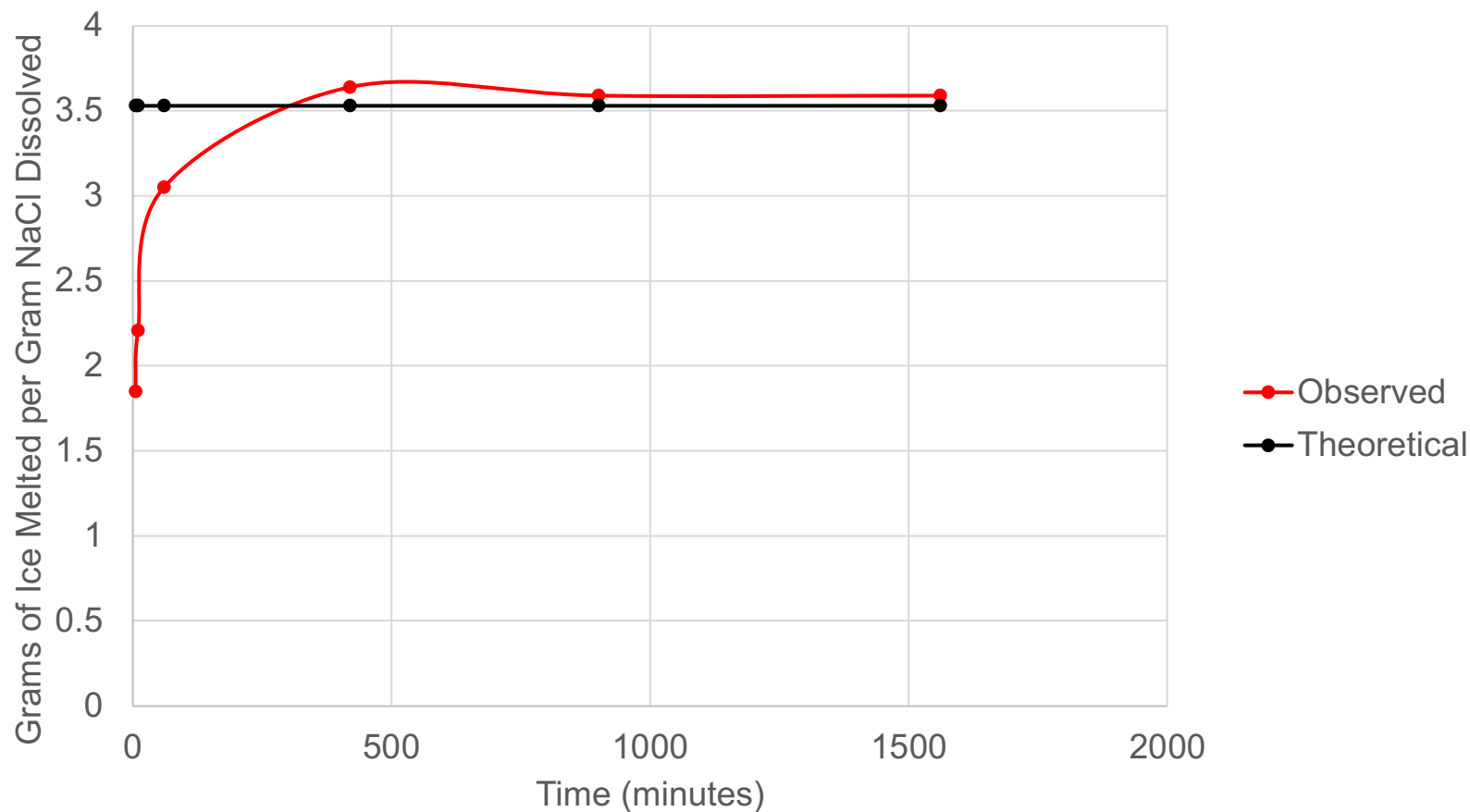
## Measuring the effect of pre-wetting agents on the ice melt rate of salt



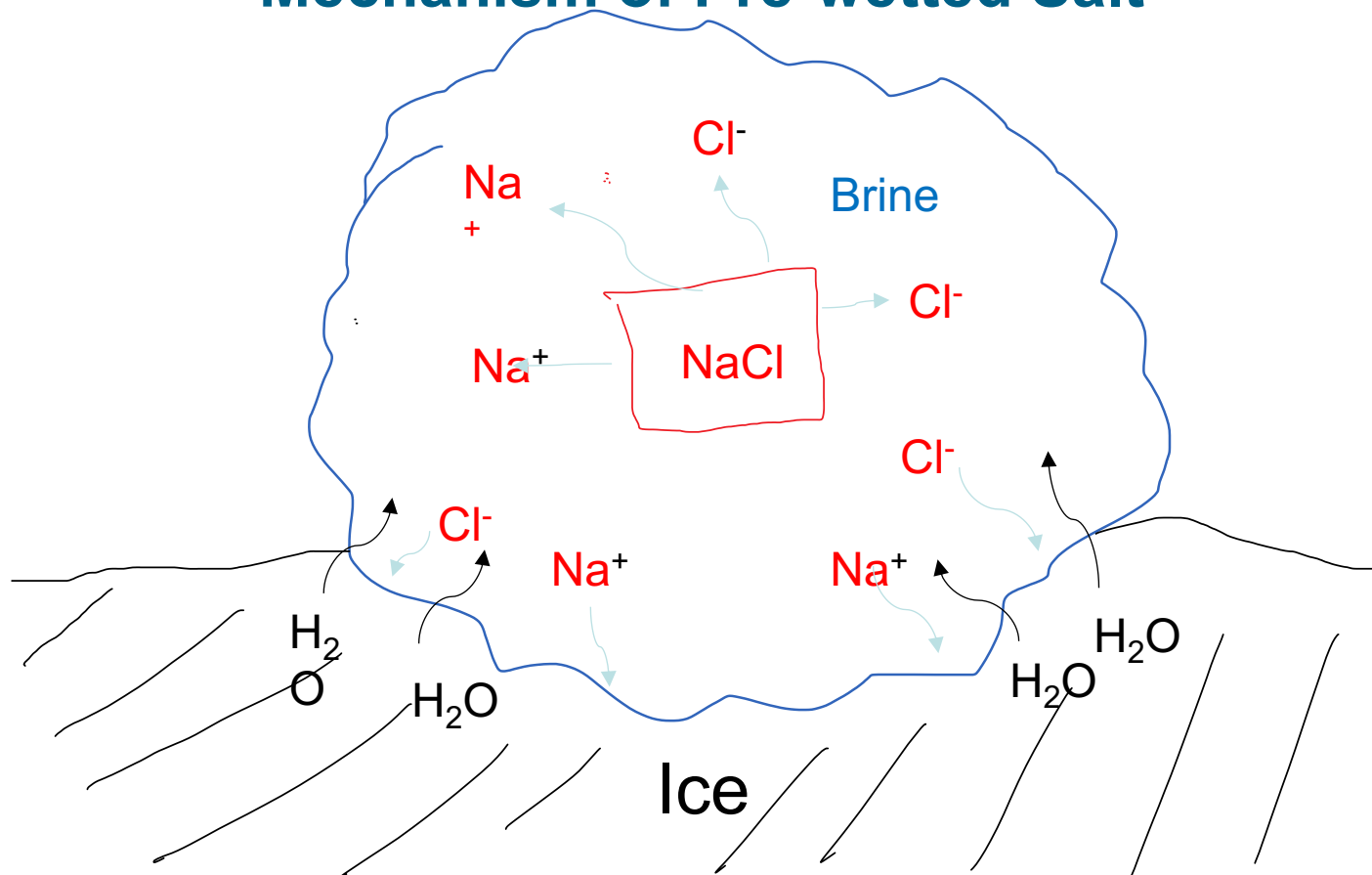


# Initially Ice Melting Rate Lags Behind Salt Dissolving Rate

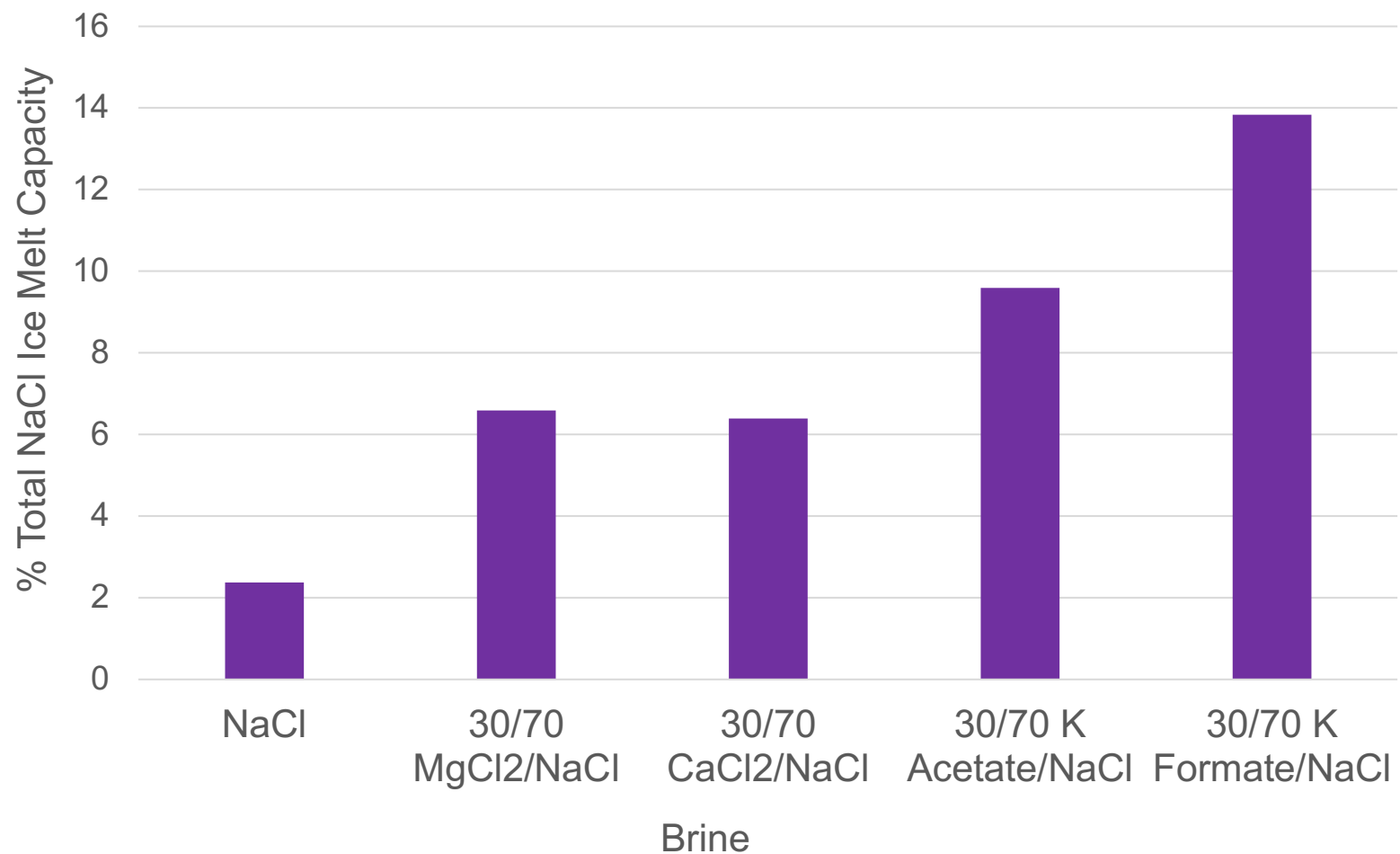
Ice Melting by Salt-Only (Pre-wetted with Pre-equilibrated  $\text{CaCl}_2$  brine) at  $-3^\circ\text{F}$



## Mechanism of Pre-wetted Salt



## Ice Melt by Salt-Only in Excess Different Brines at -3<sup>0</sup>F (-19.3<sup>0</sup>C) and 10 Minute Mix



## Conclusions

- Ice melting rate and capacity can be measured with good precision (coeff of variation  $\sim 0.6 - 6\%$ ) and accuracy by an indirect “tracer dilution” approach
- Approach permits measuring the effects of different pre-wetting liquid compositions and application rates on the ice melting rate of rock salt at different temperatures
- Approach permits a way to quantify the cost effectiveness of different pre-wetting strategies as a function of temperature and mixing conditions
- Pre-wetting accelerates ice melt rate by facilitating salt dissolution and efficiency of contact with ice
- Addition of  $\text{MgCl}_2$ ,  $\text{CaCl}_2$ , K Formate, and K Acetate brines to NaCl brine increases the ice melting rate of pre-wetted rock salt at very cold temperatures compared to plain NaCl brine.