

# MDSS

## Chemical Concentration Module



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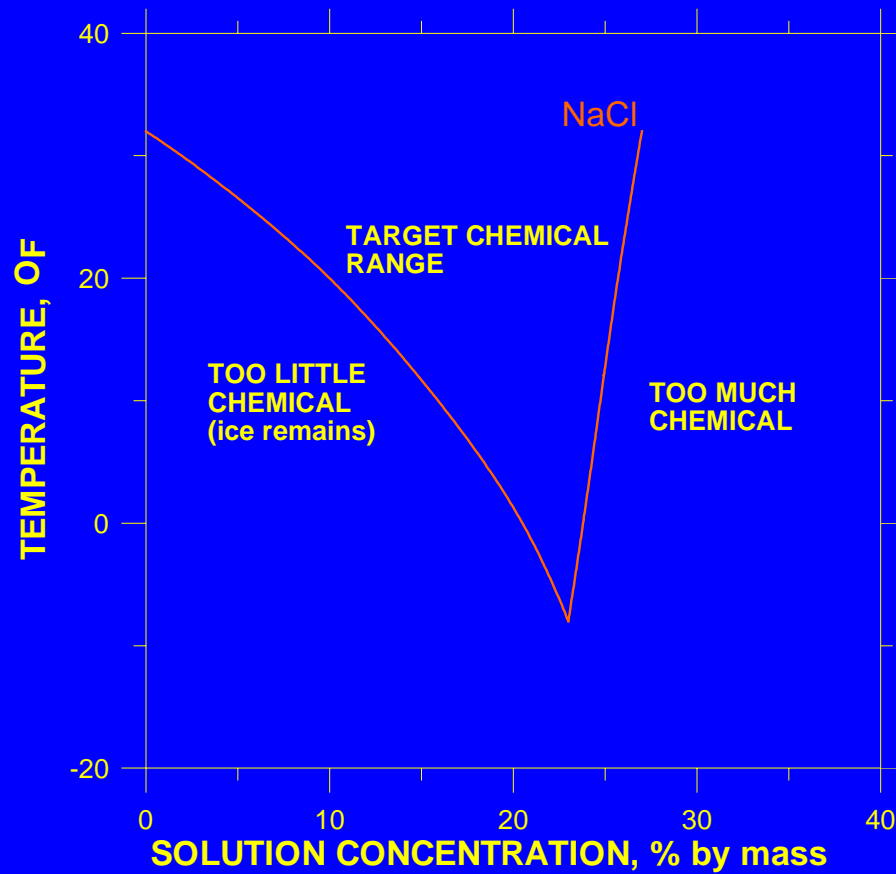
# HISTORY OF SALT

- **Many uses throughout history**
  - **Bodily requirements**
  - **Preserve food**
  - **Cure hides**
  - **Heal wounds**
  - **Freezing point depressant**

# SALT – FREEZING POINT DEPRESSANT

- Ice cream making
- Ice manufacture
- **HIGHWAY DEICING**
- Iron ore antifreeze
- coal antifreeze
- refrigerating brines
- refrigerating cars

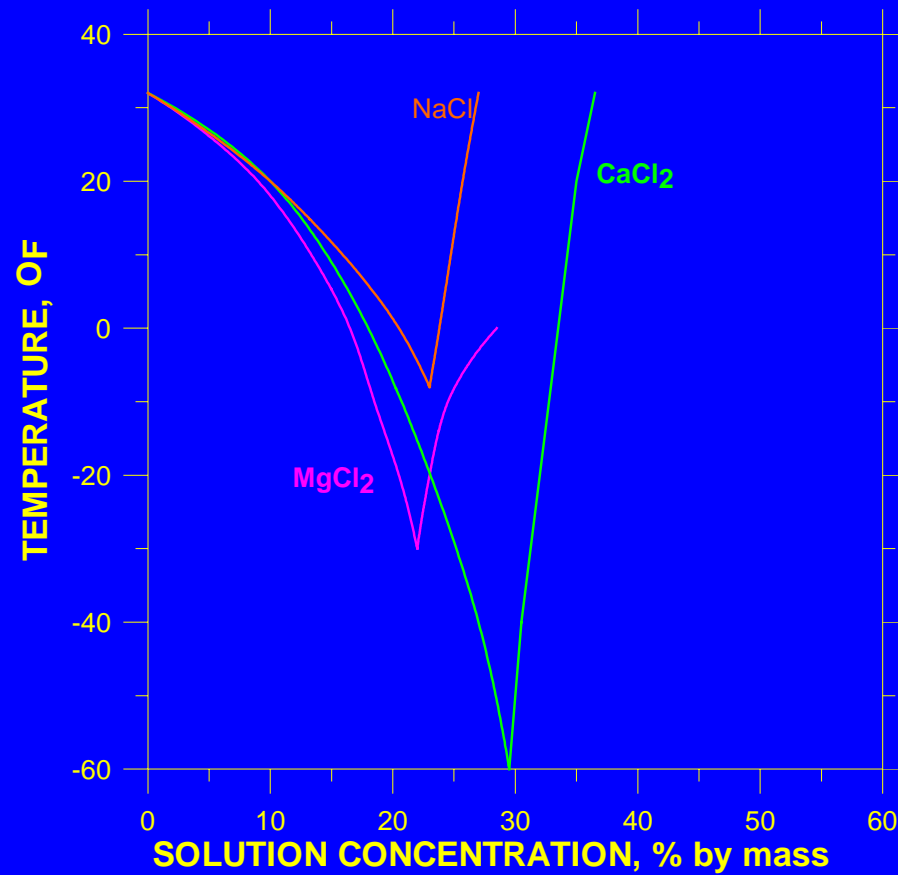
# CHEMICAL CRITERIA



# HIGHWAY DEICING & ANTI-ICING

- Disadvantages of Salt
  - Environmental
  - Corrosion
  - Ineffective at low temperatures
- Introduction of other chemicals

# CHEMICAL PHASE DIAGRAMS



# DESIRED MODEL CHARACTERISTICS

- Predict Chemical Concentration
  - over time
  - as a function of dilution, traffic, ...
- Complex Interactions
- Many Factors
- Must be Flexible Enough to Evolve

# MODEL FORM SELECTION

- Flexible
  - Add new parameters as needed
  - Add new parameters as knowledge improves
  - Easily modify parameters as learn more
  - As simple or complex as knowledge and needs warrant
- Simple Concept
- Easy to Program

# MODEL FORM

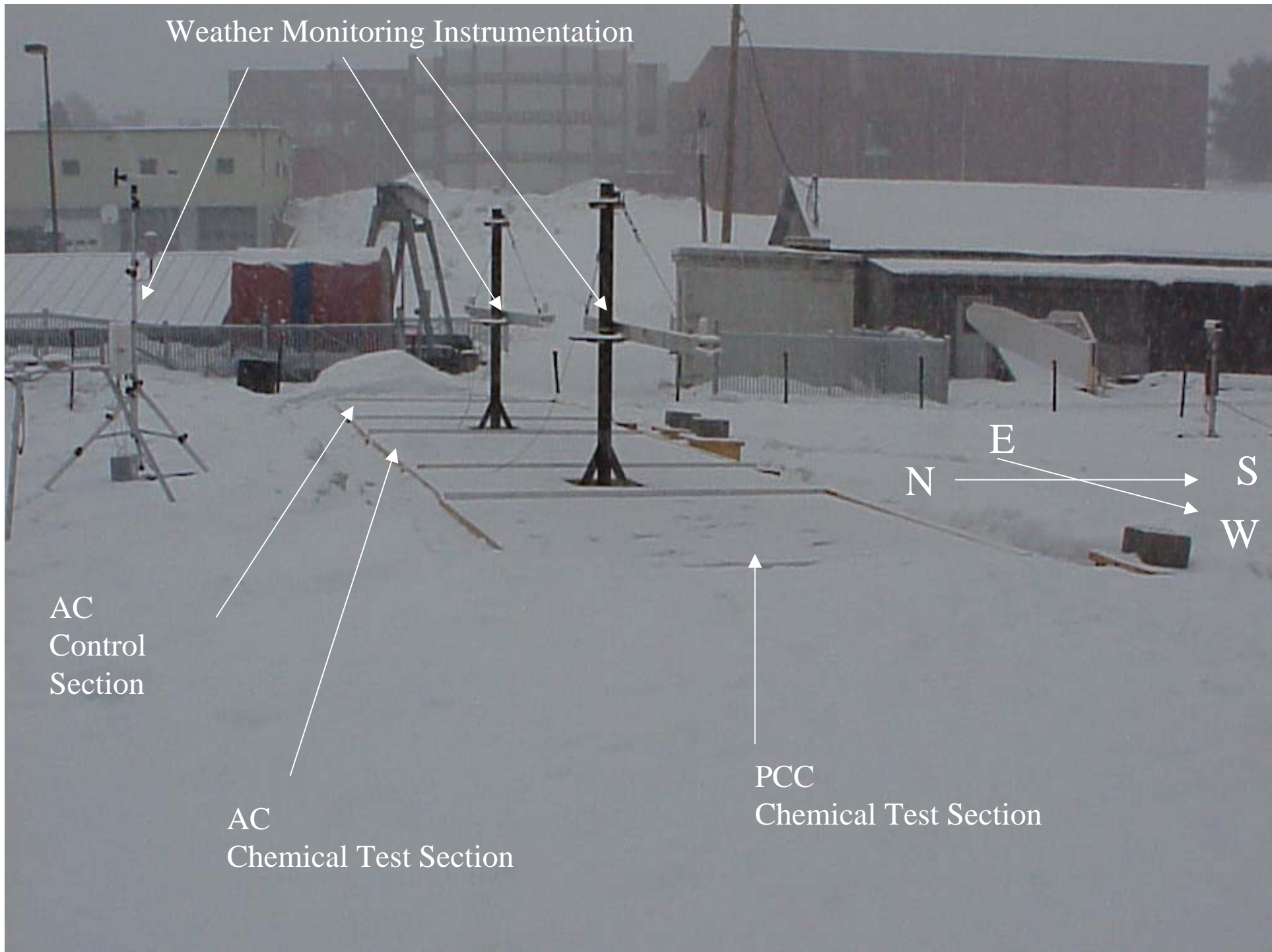
- $C_{(i+1)} = I C_i + S$ 
  - $C_i$  = Concentration at time step  $i$
  - $C_{(i+1)}$  = Concentration at time step  $i+1$
  - $S$  = addition of chemical during time step
  - $I$  = Influence Factor
  - $I = 1 - I_{\text{dilution}} - I_{\text{traffic}} - I_{\text{grade}} \dots\dots$

# POTENTIAL FACTORS

- Pavement Temperature
- Chemical type, rate, distribution
- Traffic
- Precipitation
- Transverse slope (crown)
- Longitudinal grade
- Other

# Pavement Test Sections

- Construct test sections (Fall 2001)
  - 3 @ 10 ft x 10 ft
  - Asphalt control
  - Asphalt for chemical application
  - Portland cement concrete for chemical application



Weather Monitoring Instrumentation

AC  
Control  
Section

AC  
Chemical Test Section

PCC  
Chemical Test Section

N E S  
W

# Pavement Test Sections (cont.)

- Monitoring
  - Chemical application type and rate
  - Air and pavement temperature
  - Precipitation type and rate
  - Runoff quantity and rate
  - Chemical concentration – runoff, pavement



# Results to Date

- Uncooperative winter
  - Minimal winter storms
- System is working
- Initial data shows correct trends

# New Hampshire Winter 2002



# FUTURE PLANS

- Longevity of anti-icing chemical
  - Michigan Tech lab study
- Dilution on pavement
  - CRREL test section
- RESULT = 1<sup>st</sup> Generation Model

Winter 2003?!!!

