Laura Sevcik

Minnesota Technical Assistance Program

Morning Speaker August 1

How Industry Can Identify and Minimize Chloride Use to Reduce Costs and Prevent Pollution

SALT SYMPOSIUM

Reducing Chloride Use in Industry

Laura Sevcik, Associate Engineer

August 1st, 2023

Minnesota Technical Assistance Program

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Minnesota Technical Assistance Program

Strengthening Minnesota businesses by improving efficiency while saving money through energy, water, and waste prevention.

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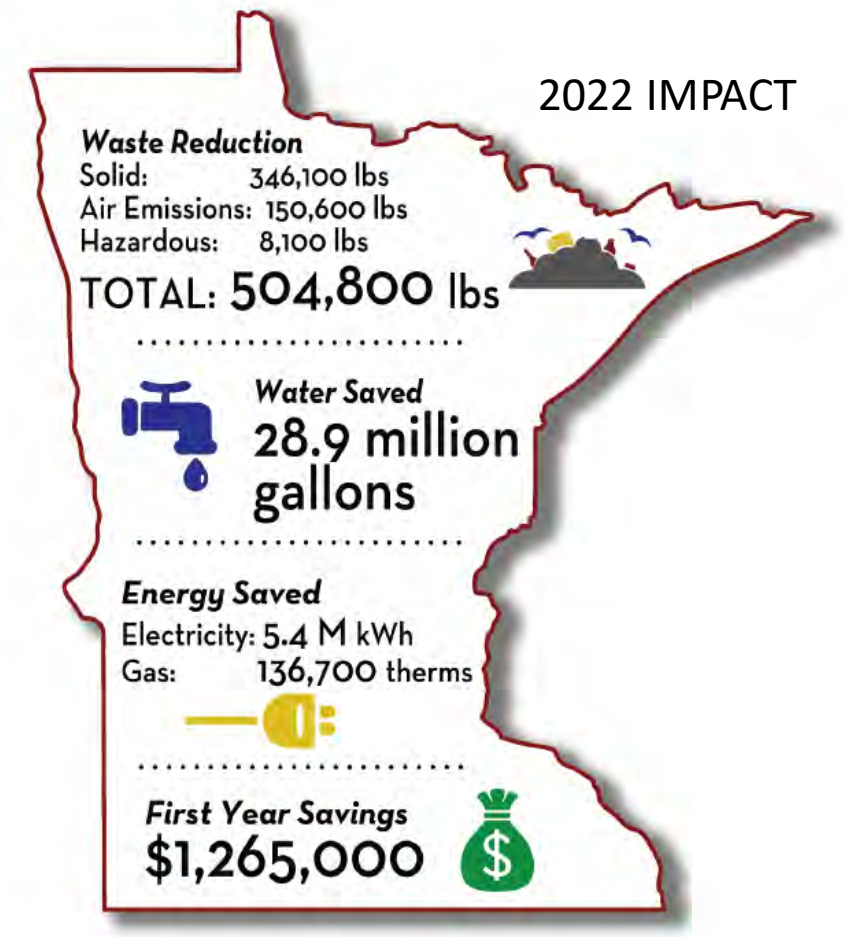
Minnesota Technical Assistance Program - MnTAP

- University of Minnesota
- Confidential, no cost, non-regulatory
- Engineering technical assistance for MN businesses
- Minnesota Materials Exchange
- Intern program



Chloride sources at MN WWTPs

- **Household water softening – 49%**
- **Industrial (water softening and other use) – 21%**
- **Commercial water softening – 16%**
- **The remaining 14%**
  - Drinking water source
  - Human excreta
  - Commercial products
  - Drinking water chlorination
  - Household products
  - Wastewater chlorination

Overbo et al. Science of the Total Environment 764 (2021) 144179

Chloride Use in Industry

Water Softening

Process Aid

Ingredient

Strategies for Conservation

Map

Identify and quantify resource use

Maintain

Repair existing processes

Manage

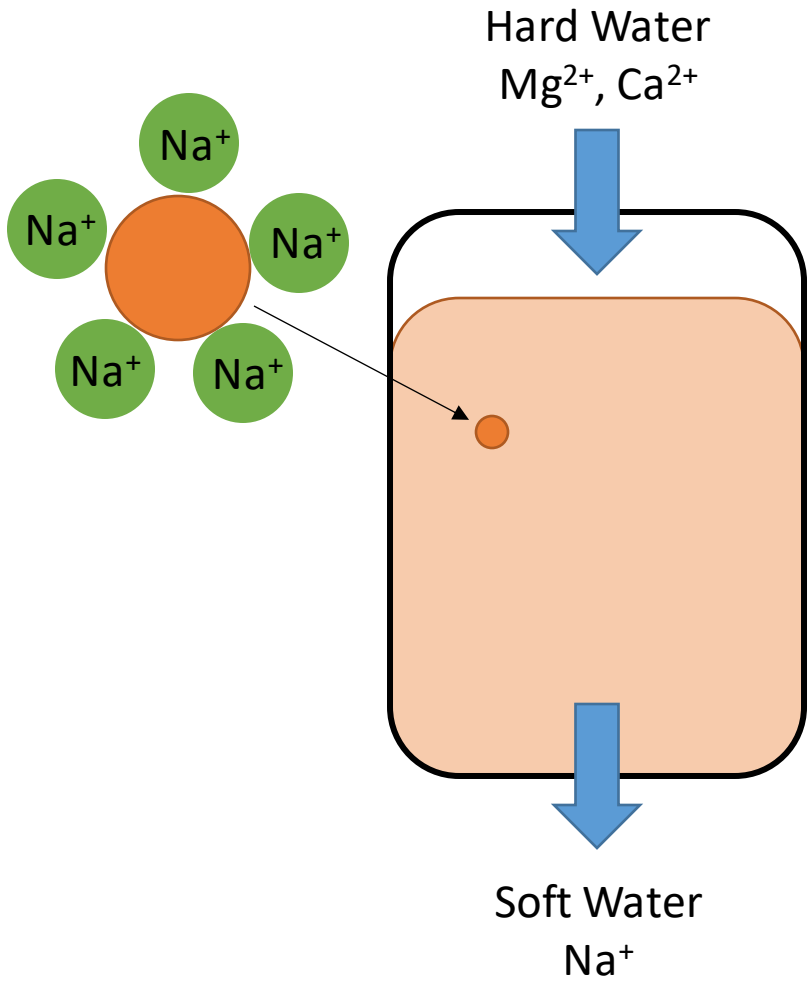
Optimize existing processes and equipment

Modify

Change process or equipment to improve

Water Softening

- **Avoid impacts of hard water such as scaling**
- **Ion exchange systems**
  - Resin beads with ion-exchange sites
  - Initially, contains sodium (Na) or potassium (K)
  - Sodium exchanges with calcium (Ca) and magnesium (Mg)
  - Once the sodium is depleted, a brine solution (NaCl or KCl) is used to regenerate the resin



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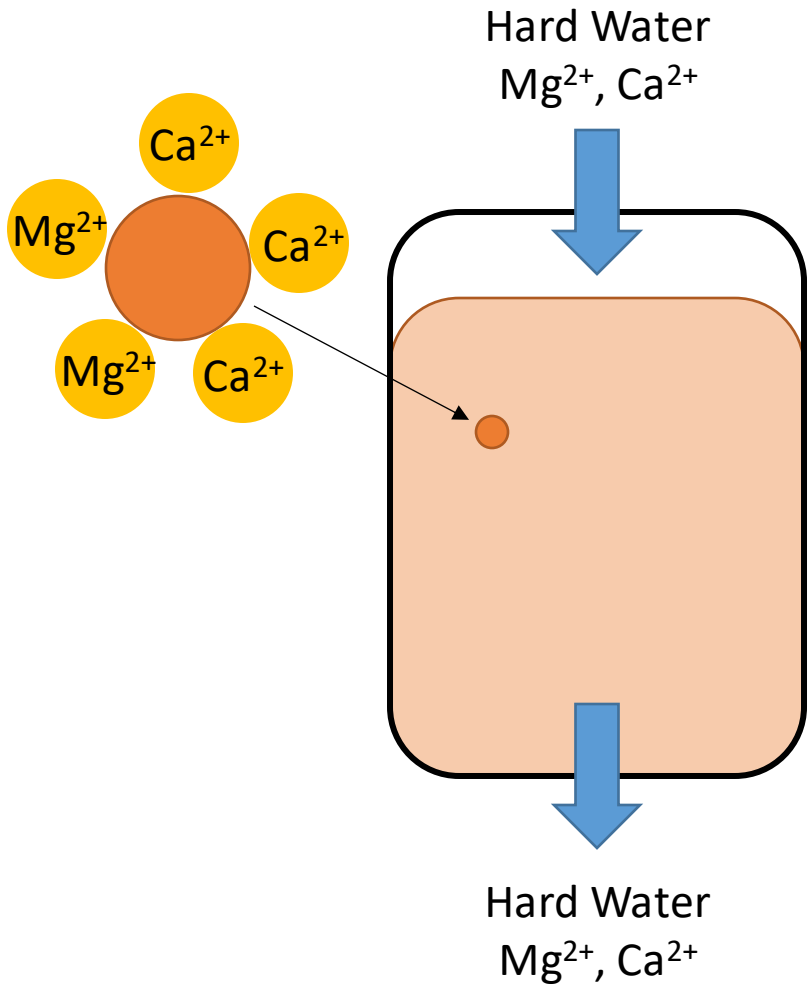

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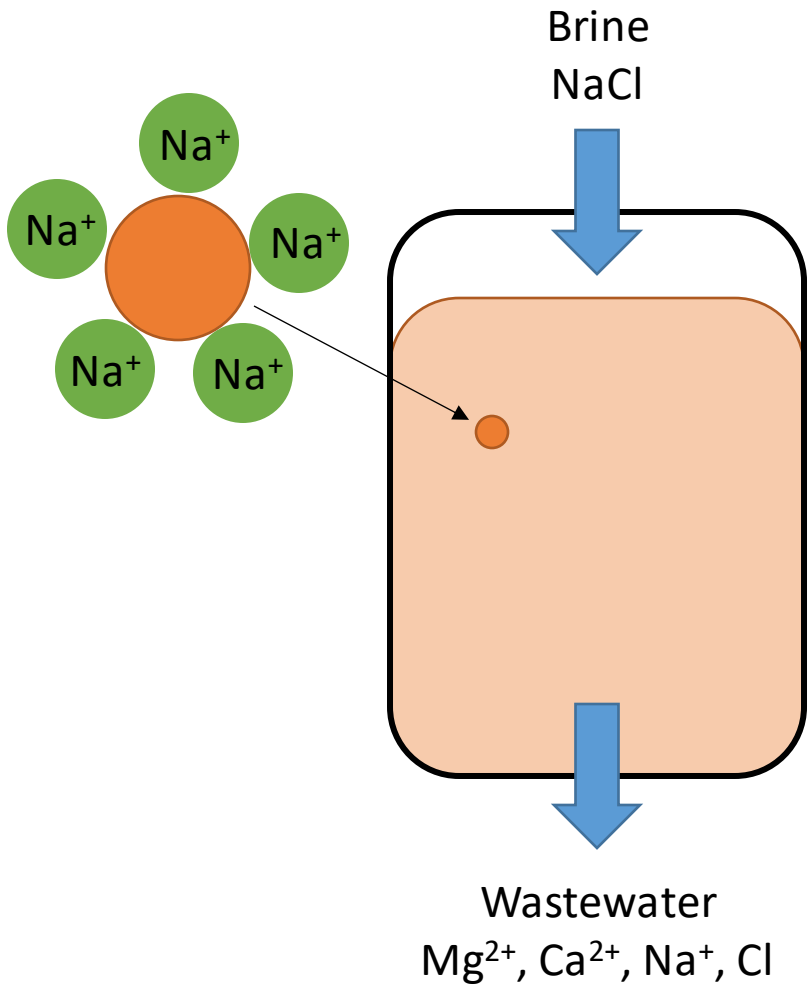
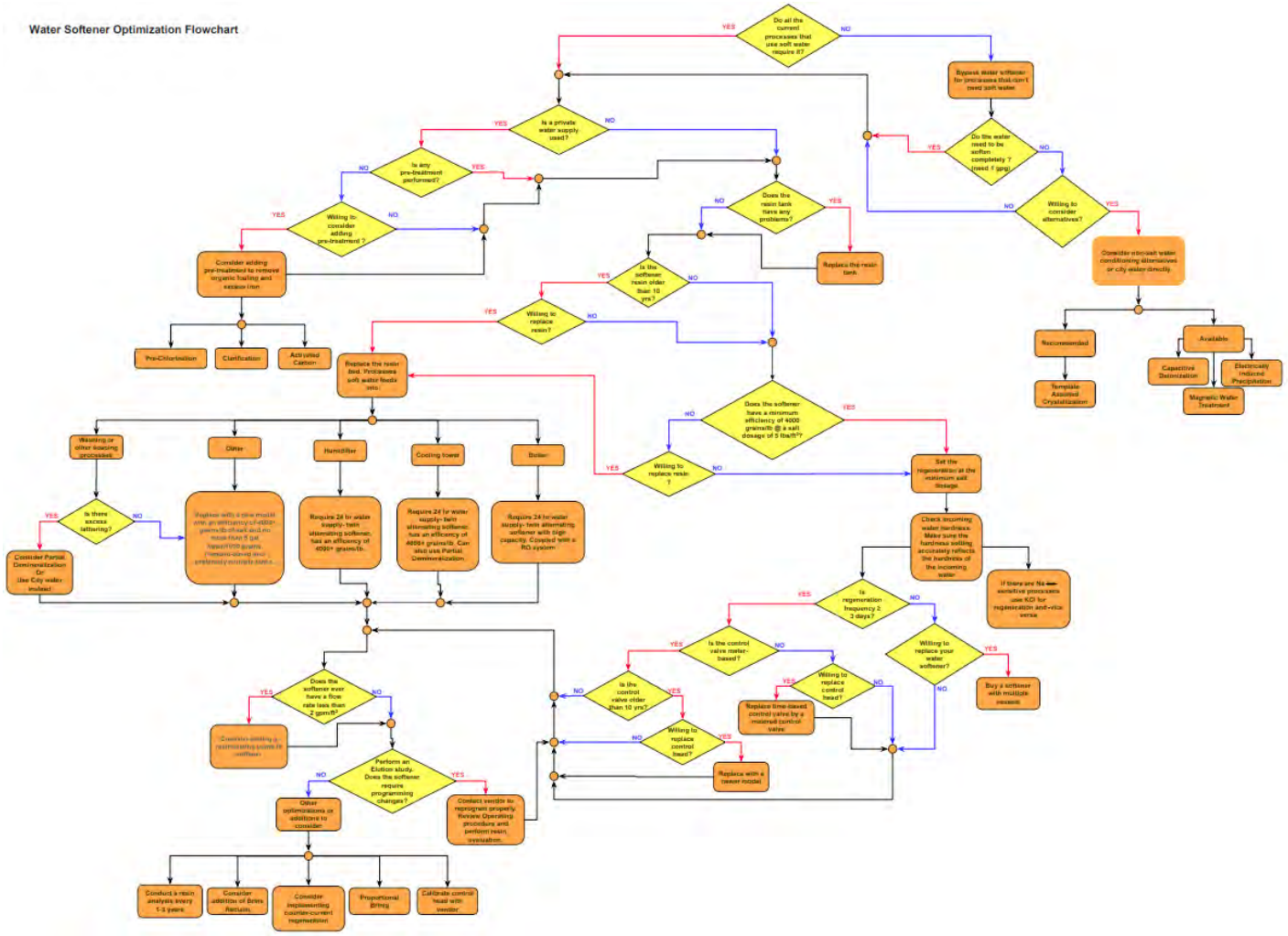


Industrial Water Softening BMPs

- **2021 MnTAP Intern Sidharth Laxminarayan**
- **Identified Best Management Practices (BMPs) for industrial water softening**
- **Developed resources:**
  - Report
  - Flowchart: Identify optimization for your softeners
  - Coming soon: MnTAP water softening calculator

http://www.mntap.umn.edu/resources/tools-calculators/chloride-reduction-tool/

Water Softener Optimization Flowchart



Water Softener Optimization Calculator

Original Programmed Settings		
Annual water softened		gal
Annual salt use		lbs
Age of softener		years
Resin volume		ft^3
Feedwater hardness setting		gpg
Unit capacity		grains
Reserve capacity (optional)		%
Backwash time		min
Brine and slow rinse time		min
Brine time		min
Slow rinse time		min
Rapid Rinse time		min
Brine tank fill (Refill) time		min
Backwash flowrate		gpm
Brine and slow rinse flowrate		gpm
Brine flow rate		gpm
Slow rinse flow rate		gpm
Rapid rinse flowrate		gpm
Brine tank fill (Refill) flowrate		gpm
Salt dosage		lbs/ft^3
Operating capacity		$grains/ft^3$
Cost		
Salt cost		$/lb
Water cost		$/gal
Calculated Values		
Annual regenerations		
Salt use per regeneration		lbs/regen
Annual salt use		lbs
Brine refill		gal
Regeneration water use		gal/regen
Annual regeneration water use		gal
Efficiency		grains/lb

Optimization				
Change Hardness Setting				
Feedwater hardness setting		gpg		
Change Salt Dosage				
Salt dosage setting		lbs/ft^3		
Operating capacity		gr/ft^3		
Replace Resin Bed				
Cost of new resin bed		$		
Reserve capacity		%		
New Operation				
Assuming 1% Resin Volume Loss Per Year			**Assuming 3% Resin Volume Loss Per Year**	
Remaining resin volume		ft^3		ft^3
New unit capacity		grains		grains
Brine refill quantity		gal		gal
Regeneration water use		gal		gal
Annual regenerations				
Annual regeneration water use		gal		gal
Salt use per regeneration		lbs		lbs
Annual salt use		lbs		lbs
Efficiency		grains/lb		grains/lb
New Settings				
New unit capacity		grains		grains
Brine and slow rinse time		min		min
Brine refill time		min		min
Savings				
Annual salt savings		**lbs**		**lbs**
Annual water savings		**gal**		**gal**
Annual cost savings				
Payback period		**yrs**		**yrs**

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Common BMPs

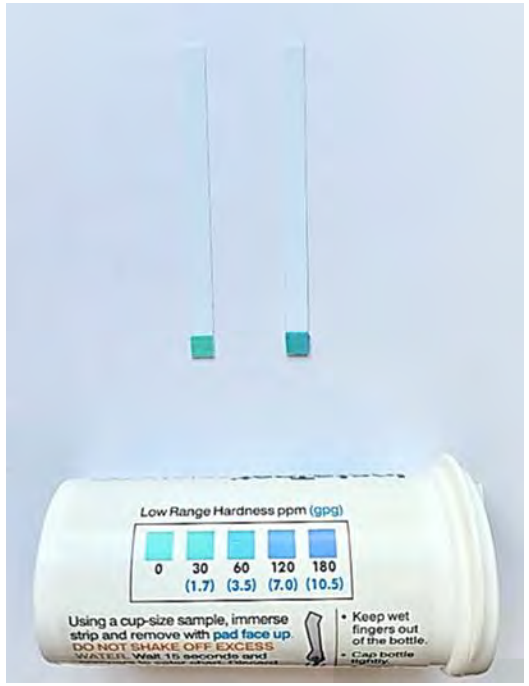
- Track salt and water use
- Adjust hardness setting
- Reduce salt dosage
- Replace resin bed

Track Salt and Water Use

- Track salt purchases and/or salt additions to brine tank
- Add submetering to track how much water is softened
- Use soft water only when necessary
- Quantify savings opportunities with data

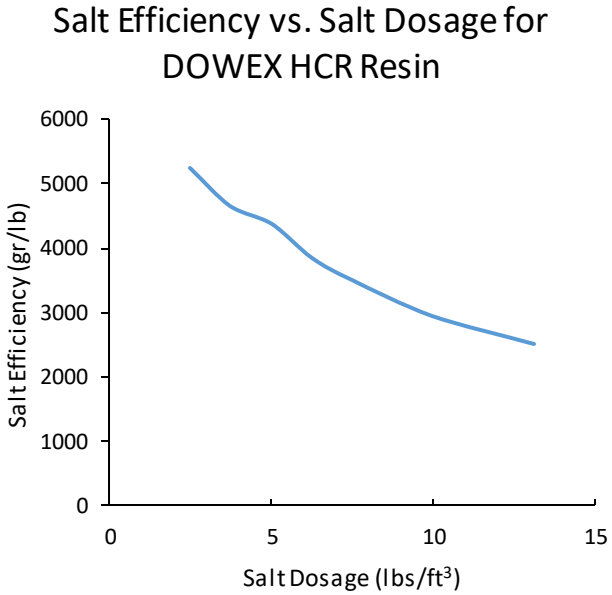
Adjust Hardness Setting

- **Check hardness setting on softener**
  - Check user manual for how to access or check with service provider
- **Check incoming water hardness**
  - Use test strips
  - Check with water utility
  - Send to a lab for testing
- **Match the hardness setting with the incoming water hardness**



Reduce Salt Dosage

- **Salt efficiency is the grains of hardness removed per pound of salt**
- **Salt dosage is the amount of salt used per cubic foot of resin during regeneration**
- **Reducing the salt dosage:**
  - Reduces salt use
  - Increases annual regenerations
  - Increases water use
- **BMP: minimum salt efficiency of 4,000 grains/lb at a minimum salt dosage of 5 lbs/ft^3**



DuPont de Nemours Inc., "TapTec HCR Softening Resin Product Information," 1999.

Replace Resin Bed

- Softeners lose 1-3% of the resin bed volume annually
- Reduced volume decreases softening capacity
- Replacing the resin bed returns the softener to its original capacity
- Recommended every 10 years
- Service provider can test the resin bed to see how degraded it is

2021 Intern Project Recommendations

Company	Recommendation	Annual Reduction	Annual Savings
A	Change Salt Dosage and Hardness Settings	Salt: 90,000 lbs Water: 252,000 gal	$12,000
B	Change Salt Dosage and Hardness Settings	Salt: 13,000 lbs Water: 10,500 gal	$1,200
C	Change Salt Dosage setting	Salt: 29,000 lbs Water: 41,700 gal	$2,800

Process Aids and Ingredients

Industry	Process/Use
Cheese	Brining
Pickles	Brining
Meat Processing	Curing, dehydrating, flavoring, brining, preserving
Rendering	Preservation, brining, pickling
Leather Tanning	Hide preservation, curing
Brewing	Additives for flavor and hardness
Ethanol	Cooling towers
Metal Fabrication	Salt baths, chemical mixing
Industrial drilling	Drilling fluid

2013 Intern Project – Gedney Foods

Goals:

- **Reduce water use**
- **Operate within wastewater capacity**
- **Reduce wastewater impact**
- **Save on salt costs**

Recommendation	Reduction	Annual Savings
Reroute pasteurizer overflow	22,000 therms 3,085,000 gallons water	$10,600
Reuse fermentation tank brine	213,000 lbs salt 214,500 gallons water	$21,300
Reduce salt storage level	364,500 lbs salt 383,000 gallons water	$36,450
Reduce fermentation and salt storage level	460,500 lbs salt 543,200 gallons water	$46,500
Fix water leaks	2,220,400 gallons water 790 therms	$380

http://www.mntap.umn.edu/wp-content/uploads/simple-file-list/Intern/2010-2019/2013/Ryan-Venteicher-Gedney-Foods-summary.pdf

Thank you!

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www.mnexchange.org

MnTAP Intern Symposium

August 16, 2023

In-person and virtual

Register now!

www.mntap.umn.edu/interns/symposium