CORROSION MITIGATION - LESSONS FROM UTAH AND OTHER STATE DOTS

CORROSION PROTECTION TECHNOLOGY (CPT) FOR WINTER MAINTENANCE CONFERENCE
UC-DAVIS, DAVIS, CA
PRESENTATION OVERVIEW

- Multi-DOT practitioner's viewpoint
  - Findings / Research from Utah DOT project
  - Comparative DOT Observations
    - Illinois
    - Missouri
    - WSHEMA Scan Tour
- Other Comments / Observations
2015 Equipment Lifecycle Analysis project
Examined 500-unit Class 8 snowplow fleet

Key Objectives:
- Identify optimal lifecycle replacement criteria
- Identify funding needs target replacement scenario
- Recommend how to address frame-cracking issues associated with corrosion damage
UTAH DOT PROJECT – END RESULTS

- **Recommendations**
  - Reduced replacement criteria
  - Implemented an equipment corrosion assessment program
  - Prioritized replacement of corrosion-impacted units

- **Outcome**
  - Recommended replacement standard adopted
  - Corrosion assessment program implemented
  - UDOT used the results of condition assessment program and report to secure a 50% increase in replacement funding
UDOT was experiencing corrosion-related frame cracking
- Attributed to double “C”-channel frame design
- 197 total units with this design
- 59 units had experienced significant frame cracking

Other corrosion issues also being experienced plow trucks
- Oil pans, differential cases and covers, brake shoes and lines, cab floors, firewall and doors, windshield frames, etc.
- Electrical connections, steel hydraulic connectors, battery cases, dump body, etc.
FRAME CRACKING*
- Performed literature review on winter maintenance practices and relationship to equipment corrosion
- Surveyed fourteen (14) peer public sector entities
  - 44-question survey
  - Covered changes in winter maintenance practices and impacts
  - Reviewed corrosion damage experience and mitigation efforts
    - Specification changes
    - Equipment storage and cleaning
    - Results / outcomes
Much of the highly relevant research originated with Washington State DOT (WSDOT) sponsored studies

- Contractor was Western Transportation Institute at Montana State University
- MnDOT and sponsored and published an update of this research in 2015

Major findings:
- Use of wet-type roadway chemicals have significantly increased corrosion
- Roadway chemical types vary in terms of impact on equipment
- Specification changes have reduced (but not eliminated) corrosion damage
- Stringent cleaning of units post-storm events reduces deterioration
Most DOTs (8 of 12) respondents reported changing roadway treatment approach in last few years

- Most moved to abrasives to granular/liquid chemicals
- Provided better road clearance and less clean-up
- Salt was primary treatment, following by Magnesium Chloride, Redmond Materials Salt/Ice Slicer ® and brine
11 of 12 fleets reported increased corrosion with change
- Magnesium chloride identified as most corrosive
- Redmond Material Salt/Ice Slicer next
10 fleets indicate mitigation efforts (specification changes, revised policies, etc.) where at least somewhat effective
- 4 fleets indicated around 50% workforce compliance with changes
- 4 fleets reported that at least one of their changes did not work
10 fleets implemented changes to mitigate impacts
- Post-storm washing
- Use of neutralizing chemicals, soaps and/or coatings
- Increased PM cycle frequency

Post-event washing practices
- Only 3 fleets had undercarriage washing racks
  - Significant interest in expanding but limited by cost/environmental issues
- Most fleets report using fire hoses/pressure washers for cleaning*
Specification changes – 11 fleets reported positive impact
- Use of stainless steel bodies
- Upgraded wiring workmanship requirements
- Defined locations of electrical junction boxes
- Movement to single rail frame

Some changes reported as ineffective or poor cost/benefit
- Stainless bodies (Oregon - “just moved rust to chassis”)
- Powder coating (Idaho and Colorado)
- Special paint (Idaho)
Frame corrosion linked to gaps in double “C” frames
- Prioritized the replacing vehicles with nested frame design
- Shift to single rail design mostly addressed frame cracking

Changed specs of oil pans and differential covers to non-rusting / rust-resistant materials

Improved electrical connector specs and junction box location

Implemented corrosion assessment program and include the calculated score as part of the replacement prioritization
General lack of wash bays or commercial washing facilities

Extreme weather encourages maintenance forces to park vehicles indoors
- Thawed snow/ice + chemicals = corrosion

Reluctance to push maintenance forces wash vehicles post event

Lack of facilities to gather/treat vehicle wash run-off
ILLINOIS AND MISSOURI DOTS – COMPARISON TO UDOT

Similarities

- Large winter maintenance operations
- Heavy snowfall states
- Similar equipment makes/models

Differences

- Significant summer maintenance vehicle use*
- Few mountains, much lower elevation
- Trucks less heavily spec’ed for plow duty and more Class 7/single axle units
- Unclear as to differences in chemical application types or rates

*Note: The significance of summer maintenance vehicle use is marked with an asterisk to indicate a notable difference.
Illinois DOT (IDOT)
- Visited four (4) IDOT maintenance yards at locations across the state
- Plow trucks generally older than UDOT’s
- Many with nested frame design
- Vehicles mostly parked in unheated sheds without doors
- Less corrosion damage noted than at UDOT

Missouri DOT (MoDOT)
- Only visited main shop and auction yard
- Observed plow trucks were similar age to UDOT (mostly younger than IDOT)
- Corrosion damage tended to be worse than IDOT but less than UDOT
COMPARATIVE OBSERVATIONS

- Differences in observed corrosion impact at UDOT, IDOT and MoDOT point out the challenge of providing ‘one size fits all’ recommendations
- Laboratory research allows controlling for single factor analysis and most reliable findings
- Real world experience still can vary because of the near-infinite number of variables
WSHEMA SCAN TOUR

- WSHEMA members performed scan tour of four (4) DOT to compare winter equipment maintenance practices
  - Targeted DOTs in other EMTSP Partnership Regions that have winter highway maintenance equipment fleets and operating environments similar to WSHEMA members
    - Minnesota, Michigan, Ohio, and Pennsylvania visited
  - Conducted in June 2017
  - Information gathered was generally consistent with UDOT project
  - Report available from EMTSP website
    - Includes links to various support documents, videos, etc.
TREATMENT CHOICE AND APPLICATION - SUMMARY

- Major variables in corrosion impact
  - Transportation infrastructure – impacts in bridges, concrete rebar, etc.
  - Environmental impacts – water, soil, plants and animals
  - DOT Equipment
  - Commercial and private vehicles

- Recent research suggests some potential practice changes
  - Challenges some existing treatment practices
  - Identifies new additive options for reducing corrosion and environmental impact
  - See presentation notes for details
Maintenance forces typically perform post-event equipment cleaning

Having appropriate wash facilities encourages maintenance forces to engage in cleaning activities
  - Invest in facilities and mitigation or replace equipment more frequently

Best practice guidance discourages cleaning practices that can push materials into small areas and encourage corrosion

Excellent MnDOT video on recommended washing practices
QUESTIONS AND CONTACT INFO

Henry Canipe
336.210.7015
hcanipe@kerchergroup.com