CORROSION MITIGATION - LESSONS FROM UTAH AND OTHER STATE DOTS

CORROSION PROTECTION TECHNOLOGY(CPT) FOR WINTER MAINTENANCE CONFERENCE

UC-DAVIS, DAVIS, CA

April 5, 2018

PRESENTATION OVERVIEW

- Multi-DOT practitioner's viewpoint
  - Findings / Research from Utah DOT project
  - Comparative DOT Observations
    - Illinois
    - Missouri
    - WSHEMA Scan Tour
  - Other Comments / Observations

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UTAH DOT PROJECT - OVERVIEW

- 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

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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

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UTAH DOT PROJECT – CORROSION

- 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.

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FRAME CRACKING*

*Picture provided by UDOT

FRAME – SIDE VIEW*

*Picture provided by UDOT

UTAH DOT PROJECT – RESEARCH AND OUTREACH

- 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

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UTAH DOT PROJECT – CORROSION LITERATURE REVIEW

- 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

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UTAH DOT PROJECT – SURVEY

- 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

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UTAH DOT PROJECT – SURVEY (CONTINUED)

- 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

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UTAH DOT PROJECT – SURVEY (CONTINUED)

- 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*

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UTAH DOT PROJECT – SURVEY (CONTINUED)

- 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)

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UTAH DOT PROJECT – POSITIVE CHANGES

- 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

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UTAH DOT PROJECT – UNRESOLVED ISSUES

- 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

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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

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ILLINOIS AND MISSOURI (CONTINUED)

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

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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

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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.

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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

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EQUIPMENT CLEANING / WASHING - SUMMARY

- 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

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QUESTIONS AND CONTACT INFO

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