

Supplementary Materials for “Laboratory Study on Non-Destructive Evaluation of Polyethylene Liquid Storage Tanks by Thermographic and Ultrasonic Methods” by Amir Behravan, Matthew M. deJong, and Alexander S. Brand

Below is the questionnaire sent to State Departments of Transportation in the United States to gain additional information about the trends and uses of deicing chemicals and above ground storage tanks.

Name of Agency: Respondent / Job Title: Date:
Question
1. Does your agency apply liquid anti-ice and de-icing treatments to the highway during winter operations? If YES , please provide the type of solution(s) applied and its concentration.
2. Does your agency use above-ground storage tanks for liquid brine, other liquid deicing chemicals, or other general liquid storage purposes? If YES , please provide the following information. If NO , your survey is complete and there is no need to complete the remainder of the questionnaire; thank you for your time. (a) How many above-ground tanks are currently in service for your DOT? (b) What is the tanks' typical capacity? (c) Can you identify the tank manufacturer? (d) Are the tanks used are single-walled? double-walled? Or both? (e) <i>[If both single- and double-walled tanks are used]</i> What percentage of tanks are double-walled?
3. Approximately what percentage of your agency's in-service above ground tanks are in each of these age categories? <ul style="list-style-type: none"> • Less than 5 years • 5-9 years • 10-14 years • 15-19 years • 20 years or more
4. What type of material are the above-ground brine and other liquid deicing chemical tanks that you use manufactured out of? (e.g., polyethylene tanks are commonly used in Virginia).

5. What is the typical thickness(es) of the above-ground brine and other liquid deicing chemical tank wall? If the thickness of the top and bottom is different, then please provide any available information on both thicknesses and the capacity of the tank.
6. Has your agency experienced any sudden or unexpected above-ground brine or other liquid deicing chemical tank failures? If YES , please briefly describe the failure mode(s) such as: <ul style="list-style-type: none"> • permanent (plastic) deformation, • yielding, • fracture, such as a leak or break in the tank body or a leak or break in the tank outlet pipe or fittings, • manufacturing flaw or defect, • ultraviolet-induced embrittlement, or • accidental damage.
7. If your DOT has removed any tanks from service, what factors are used to make that decision? What was the typical age of most tanks removed from service?
8. At what location(s) on the tanks have defects or failure points been detected most often? For example, floor, roof, around fittings, manufacturing seems, or at a certain height.
9. How many times per year does your DOT fill the tanks with brine and other liquid deicing chemical solution?
10. Are the tanks fully or partially emptied after the winter maintenance season?
11. What are the routine inspection practices for your agency's brine and other liquid deicing chemical tanks? <i>Please either 1) send us a copy or a link to your inspection procedures or 2) respond to the following questions.</i> <p>(a) How frequently are the tanks inspected?</p> <p>(b) What inspection techniques are most frequently used (<i>e.g.</i>, visual inspection, dye penetration, candling, non-destructive testing)?</p> <p>(c) Are any other non-destructive tank evaluation techniques permitted but less frequently used?</p>
12. Does your agency ever use any advanced non-destructive testing (NDT) technologies for brine tank and other liquid deicing chemical inspection, such as <ul style="list-style-type: none"> • ultrasonic methods, • thermography or thermal imaging, • radar, • lidar, or • X-ray or gamma-ray radiographic imaging?

If YES , please discuss.
13. How are scratches, crazing, and cracks distinguished in your agency's routine tank inspections?
14. Has your agency repaired any of its brine or other liquid deicing chemical tanks? If YES , please provide details about the type of defect(s) found and what repair procedures were used.
15. Are you interested in any follow-up discussions of above-ground brine storage tank facilities and states' inspection practices for them as our research progresses? If so, please provide your contact details and what aspects of the research you are interested in.