Bounce and Scatter 2012

MDOT 2012 SALT BOUNCE & SCATTER STUDY

Operations Field Services Division — MDOT Michigan Department of Transportation — Southwest Region – June 2012

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Presenters

Tim Croze, P.E. Region Support Engineer

Matt Pratt, Roadway Operations Coordinator

Justin Droste, P.E. Roadway Operations Engineer

Rich Hassenzahl, Maintenance Superintendent

Todd Rowley, Roadside Operations Coordinator

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Agenda

- Introduction
- Test Methodology
- Data Analysis
- Region Implementation
- Conclusions & Recommendations
- Poster Display

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MDOT Statistics

- 31,791 lane miles
- 350 snowplows
- Average winter expense is $100 MILLION
- Average salt usage is 550,000 Tons
- Average price of salt is $60/ton

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MDOT Policy on Application Speed

"To help keep the salt from bouncing onto the shoulder or into the ditch, the truck's speed should never exceed 35 mph while applying."

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2012 Bounce and Scatter Study Objectives

- Determine how much salt stays on the road
- Determine the speeds at which we can effectively and efficiently apply salt
- Determine if there is a difference in salt delivery systems
- Compare treated salt vs. untreated salt
- Expand on MDOT research from the 1970's

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2012 Bounce and Scatter Study Goals

- Compare bounce and scatter at three different ***application speeds***
- Compare bounce and scatter of ***treated salt vs untreated salt***
- Compare the two most common ***delivery systems***

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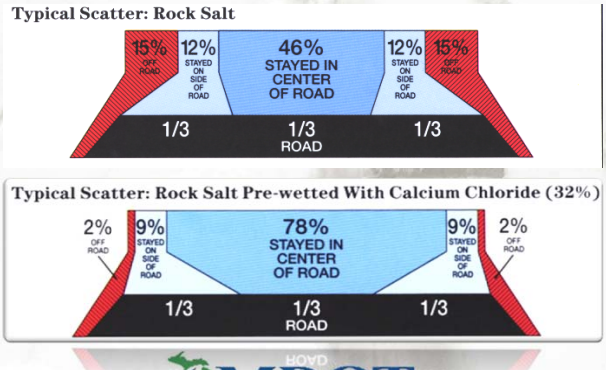
1974 -1975 Pre-wetted Salt Report

- 3 year study on use of pre-wetted salt
- Concluded that 32% more salt stays in target area when pre-wet



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Considerations….

- Repeated each test scenario 3 times to obtain an average
- All testing performed during the summer months without traffic
- Hottest day of year!

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SALT BOUNCE & SCATTER TEST "Set Up"

Matt Pratt, Roadway Operations Coordinator

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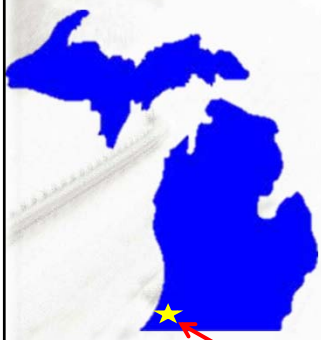
Test Location



US-31 in Berrien Springs, Michigan

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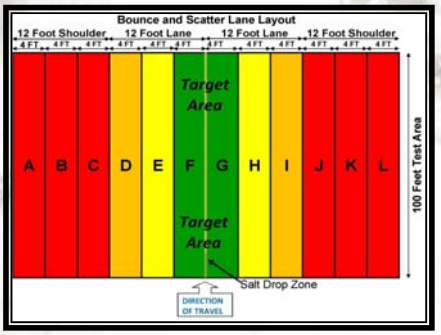
Test Grid Layout



Grid Layout Concept

Actual Grid Layout

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Delivery Systems Tested

Y-Chute

Rear Cross Conveyer

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How Salt was Applied

Y-Chute

Rear Cross Conveyer

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How The Salt Was Collected

Close Up of Collection Lanes

Complete Group Effort

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How Salt was Weighed and Recorded

Bucket Being Weighed

Weight Being Recorded

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Salt Collection Buckets

Untreated Salt

Treated Salt

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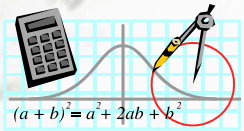
Data Analysis

Justin Droste, P.E. Roadway Operations Engineer



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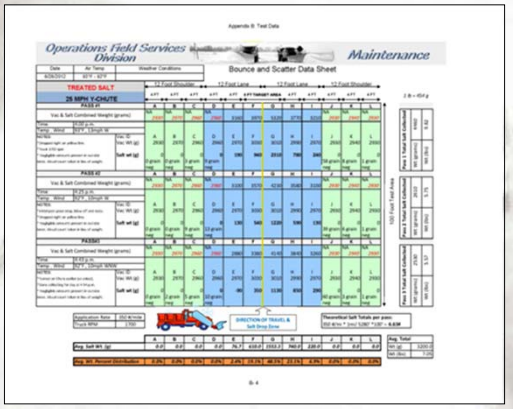
Data Sheets



- 3 passes made for each test and averaged
- Weights were recorded in grams
- Empty Vacuum bucket weights subtracted
- Outlying lanes at slower speed not weighed (negligible salt present)
- At higher speeds some salt landed outside of grid
- Expected Total Weight collected at 350 lb rate is 6.63 lbs per pass

Theoretical Weight = $350 \frac{lbs}{mi} \; x \; \frac{1\,mi}{5280\,ft} * 100\,ft = 6.63 lbs * 454 \frac{grams}{lbs} = 3010\,grams$

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Data Processing

Wt. Comparisons

- Average Total Weight collected from the 12 tests varied from the theoretical value and each other
- Comparisons based strictly on collected weights could be misleading

- Direct comparisons of the 12 tests can be made by calculating percent weight distributions. *"Apples to Apples"*

Avg Wt. Percent Distribution = $\frac{Average\ "lane"\ Salt\ Wt.Collected}{Average\ "Total"\ Salt\ Wt.Collected}$

Wt. % Comparisons

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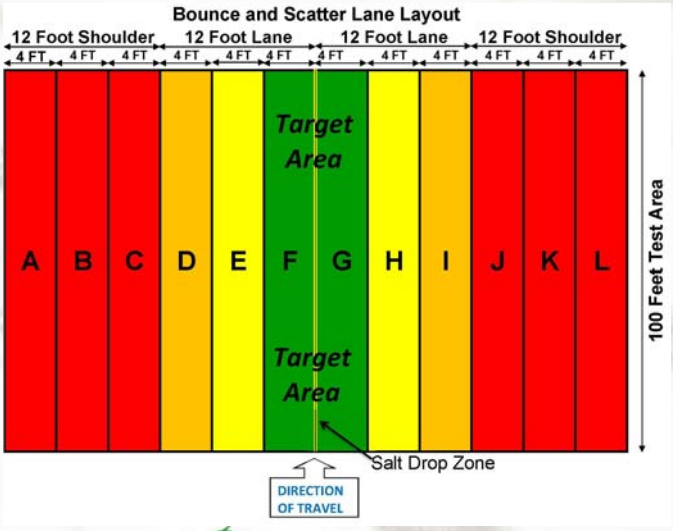
Grid Layout



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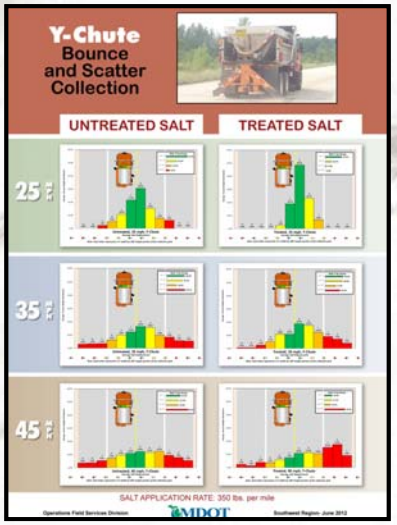
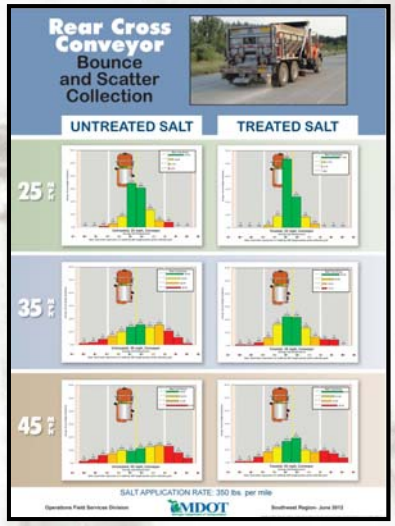
Graphical Results





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Summary Data Tables

Table 1: Salt Concentrations per Group

Highest Total Percent in Target Area (Green):	
77.8%	**Treated, 25 mph, Conveyor**
67.5%	Treated, 25 mph, Y-Chute
65.2%	Untreated, 25 mph, Conveyor
52.4%	Untreated, 25 mph, Y-Chute
44.3%	Treated, 35 mph, Conveyor
Highest Total Percent in Intermediate Area (Yellow):	
30.2%	**Treated, 35 mph, Conveyor**
28.3%	Treated, 35 mph, Y-Chute
25.9%	Untreated, 25 mph, Y-Chute
25.5%	Treated, 25 mph, Y-Chute
25.5%	Untreated, 35 mph, Y-Chute
Highest Total Percent in Intermediate Area (Orange):	
22.0%	**Untreated, 35 mph, Conveyor**
21.0%	Untreated, 45 mph, Conveyor
19.8%	Untreated, 45 mph, Y-Chute
17.4%	Treated, 35 mph, Y-Chute
16.4%	Treated, 45 mph, Conveyor
Highest Total Percent in Outlying Area (Red):	
49.9%	***Treated, 45 mph, Y-Chute****
35.8%	**Untreated, 45 mph, Y-Chute**
35.4%	Untreated, 45 mph, Conveyor
29.7%	Treated, 35 mph, Y-Chute
26.4%	Treated, 45 mph, Conveyor

** data trends do not correlate with other test info.*

Table 2: Retained Salt (Cumulative)

Total Percent Retained ± 8' (Green + Yellow):	
95.3%	**Treated, 25 mph, Conveyor**
93.1%	Treated, 25 mph, Y-Chute
87.2%	Untreated, 25 mph, Conveyor
78.3%	Untreated, 25 mph, Y-Chute
74.4%	Treated, 35, Conveyor
58.2%	Treated, 35 mph, Y-Chute
57.3%	Treated, 45, Conveyor
54.3%	Untreated, 35 mph, Y-Chute
53.0%	Untreated, 35 mph, Conveyor
44.4%	Untreated, 45 mph, Y-Chute
43.5%	Untreated, 45 mph, Conveyor
35.7%	*Treated, 45 mph, Y-Chute**
Total Percent Retained ± 12' (Green + Yellow + Orange):	
100.0%	**Treated, 25 mph, Conveyor**
100.0%	**Treated, 25 mph, Y-Chute**
95.2%	Untreated, 25 mph, Conveyor
91.5%	Untreated, 25 mph, Y-Chute
86.9%	Treated, 35, Conveyor
75.6%	Treated, 35 mph, Y-Chute
75.1%	Untreated, 35 mph, Conveyor
73.7%	Treated, 45, Conveyor
70.3%	Untreated, 35 mph, Y-Chute
64.6%	Untreated, 45 mph, Conveyor
64.2%	Untreated, 45 mph, Y-Chute
50.1%	*Treated, 45 mph, Y-Chute**

** data trends do not correlate with other test info.*

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Discoveries

- **Speed is the biggest factor effecting Salt Bounce and Scatter** *(25 mph speeds retain the most salt in target zone by far)*
- **Treated salt scatters less than untreated salt** *(Confirms the 1970's study)*
- **Rear cross conveyors slightly outperform Y-chute delivery systems** *(Least distinctive variable)*

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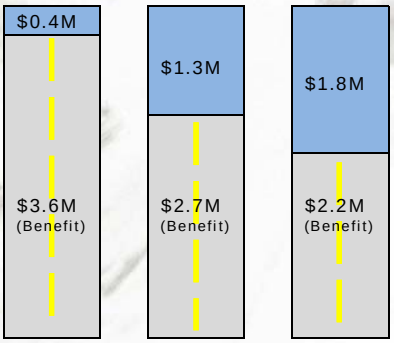
Potential Cost Savings

Example Cost Analysis for MDOT's Southwest Region:
(Annual Use 66,000 Tons @ $60.00 per ton)



(Treated Salt; Rear Cross Conveyor)

- **Assumptions**
- **Benefit Cost vs. Waste Cost**
- **Slower speeds yield more savings, based on salt effectiveness**
- **Use of treated salt can also save money**
- **Other parameters should play a role when setting policies *(safety, mobility, shift length, staffing, etc)***

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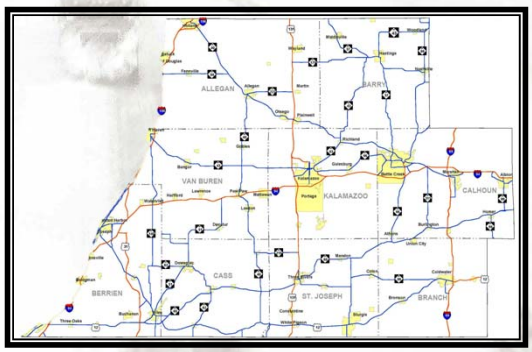
Southwest Region

Rich Hassenzahl, Maintenance Superintendent



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Changes Over Time

- Truck capabilities
- Truck size
- Wings
- Route length
- Speeds

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Truck Capabilities

1980's MDOT Truck
(210-230 HP, 7 Tons)

Current MDOT Truck
(370-430 HP, 10-12 Tons)

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Truck Size

Early 80's MDOT Fleet
(210-230 HP, 7 Tons)

Current MDOT Fleet
(370-430 HP, 10-12 Tons)

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Addition of Wings

Left Wing

Right Wing

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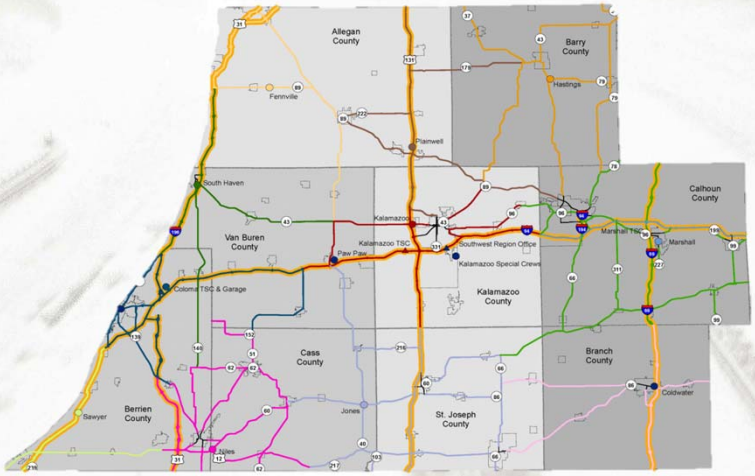
Length of Routes



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Salting Speed

- Just because your truck can put salt out at 50 mph does not mean you should!!!!
- Salting at a slower speed keeps more salt on the roadway
- Salting at 25 mph keeps more salt in the target area

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Slower Speeds Equals $avings

When salting; slower is faster for meeting LOS goals

Truck Speed	No. of Trips	Route Time	Truck Miles	Salt Used
25 mph	1	1 Hr 45 Mins	40 Miles	12 Tons
35 mph	2	2 Hr 30 Mins	80 Miles	24 Tons

(Average route length in the Southwest Region is 40 miles)

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Winter 2011 - 2012

- Why we lowered the salting speeds in the Southwest Region
- Accident information
- Operator's concerns / safety
- Proposed 2012 - 2013 speed changes

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Conclusions

Factors that effect the bounce and scatter

1. Speed
2. Material type
3. Distribution systems

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Recommendations

- Salt needs to be applied at speeds as slow as possible (35 mph is MAX!)
- All salt should be treated
- Testing of additional distribution systems and chute heights
- Training / operator awareness

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Access to Findings

A copy of the Salt Bounce and Scatter Study will be available soon

www.michigan.gov/MDOT

or

Email Tim Croze at

Crozet@michigan.gov

or

Call Operations Field Services

(517) 322-3300

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Acknowledgements

- The Operations Field Service Staff
- The Southwest Region Staff
- The Coloma Maintenance Garage
- The Paw Paw Central Repair Facility
- The University Region YDMP Students

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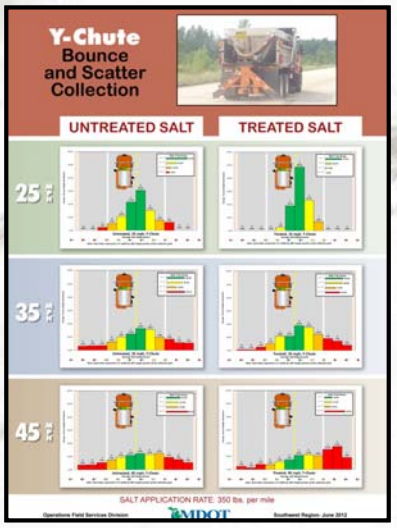
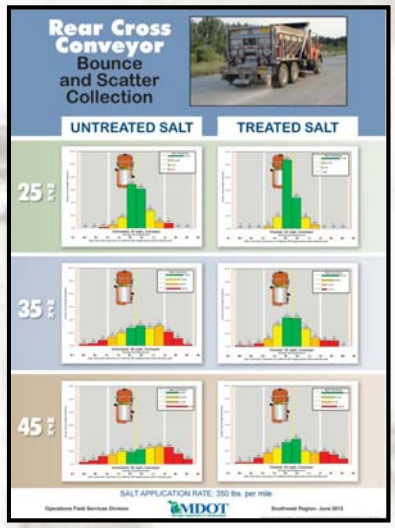
Posters





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Questions?

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