

MnDOT'S EXPERIENCE

Micro Milling with Surface Treatments

Introduction

The Minnesota Department of Transportation (MnDOT) began investigating the performance of micro milling with surface treatments in 2013. Pavement Interactive defines micro milling as follows:



“Micro-milling is providing an innovative way for contractors to rehabilitate asphalt pavements. Also known as surface planing or fine milling, micro milling uses a milling drum with more teeth and a tighter lacing pattern to create a smoother surface than the traditional milling process. This smoother surface can be opened to traffic with no further treatment and also provides a better surface for overlays, particularly thin and porous lifts.”

Figure 1 – Finished Micro Mill Texture of TH 89

The goal of this investigation is to use data gathered by MnDOT personnel to determine the effectiveness of Micro Milling with surface treatments at improving ride quality. For the purposes of this investigation, the ride quality data is an average of the left and right wheel paths. This is to keep the data concise due to multiple projects being investigated for each treatment type.

The surface treatments placed in conjunction with a micro mill include Chip Seal, Micro Surface, and Ultra-Thin Bonded Wear Course (UTBWC). There have been several projects that have incorporated each different surface treatment with a Micro Mill. This investigation will combine the findings of these projects.

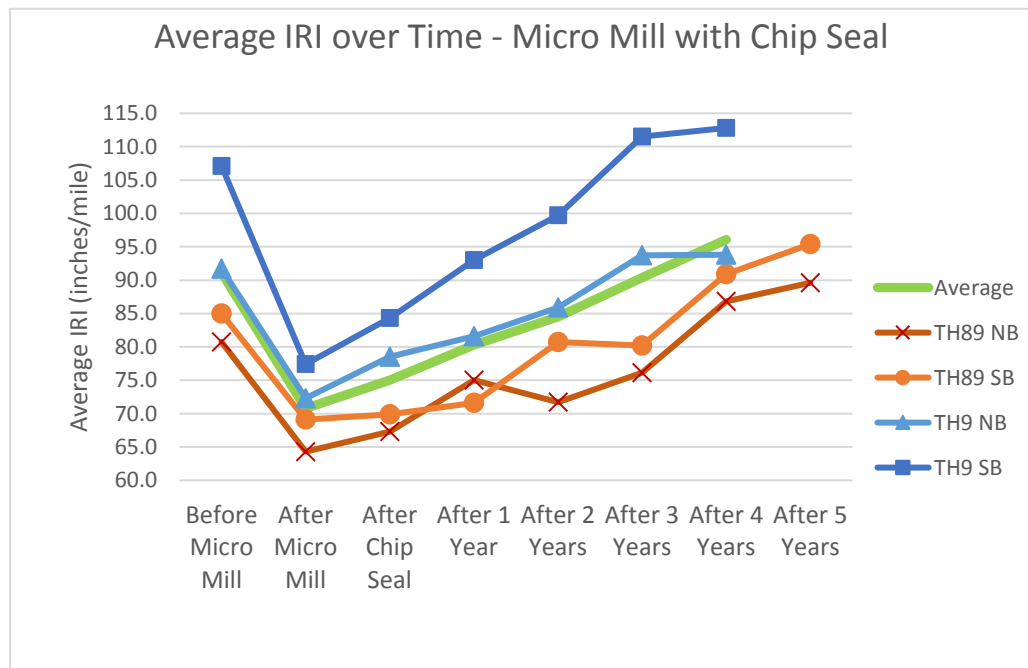
Treatment #1: Micro Mill with Chip Seal

IRI (International Roughness Index) data has been collected on two different Micro Mill and Chip Seal projects for this investigation. The data is outlined in the table and chart below. From the data, it appears there is a significant improvement to IRI over the first several years. By the third or fourth year following treatment, the IRI appears to return to approximately the same value as before the treatment. This means that, for a relatively small cost, the ride quality of a pavement can be improved for several years by Micro-Milling and Chip Sealing, thus extending the service life of that pavement.



Figure 2 - TH 89 after Placement of Chip Seal

Performance of Micro Milling with Chip Seal															
	Before Micro Mill	After Micro Mill		After Chip Seal		After 1 Year		After 2 Years		After 3 Years		After 4 Years		After 5 Years	
	Avg. IRI (in/mi)	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved
TH89 Nothbound (2013)	80.7	64.3	20%	67.3	17%	75	7%	71.7	11%	76.1	6%	86.8	-8%	89.6	-11%
TH89 Southbound (2013)	85.0	69.1	19%	69.9	18%	71.6	16%	80.7	5%	80.2	6%	90.9	-7%	95.4	-12%
TH89 Northbound Crack Seal (2018)	-	-	-	-	-	-	-	-	-	-	-	-	-	85.7	-6%
TH89 Southbound Crack Seal (2018)	-	-	-	-	-	-	-	-	-	-	-	-	-	99.9	-18%
TH9 Northbound (2014)	91.7	72.3	21%	78.5	14%	81.6	11%	85.9	6%	93.7	-2%	93.8	-2%	-	-
TH9 Southbound (2014)	107.1	77.4	28%	84.3	21%	93.0	13%	99.7	7%	111.5	-4%	112.8	-5%	-	-
Averages	91.1	70.8	22.0%	75.0	17.5%	80.3	11.8%	84.5	7.4%	90.4	1.3%	96.1	-5.5%	92.7	-11.7%



It should be noted that a section of TH 89 was crack sealed in 2018. This section has slightly different performance than the rest of the project. Also of note: TH 89 included a control section, which was Chip Sealed without Micro-Milling. Without the smoothing benefits of Micro-Milling, this section showed a continued degradation in ride quality over time. This data is displayed below.

Figure 3 – Micro Mill with Chip Seal Chart

Performance of TH89 Chip Seal Without Micro Mill													
	Before Chip Seal	After Chip Seal		After 1 Year		After 2 Years		After 3 Years		After 4 Years		After 5 Years	
	Avg. IRI (in/mi)	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved
TH89 Nothbound (2013)	95.7	95.9	0%	110	-15%	101.2	-6%	104.7	-9%	115.3	-20%	118.2	-24%
TH89 Southbound (2013)	80.1	78.3	2%	85.5	-7%	79.7	0%	89.9	-12%	104.2	-30%	103.0	-29%
Averages	87.9	87.1	1.0%	97.8	-10.8%	90.5	-2.6%	97.3	-10.8%	109.75	-25.3%	110.6	-26.1%

At approximately \$17,000 per lane mile, Micro Milling with Chip Sealing can improve the ride and extend the life of a pavement for several years.

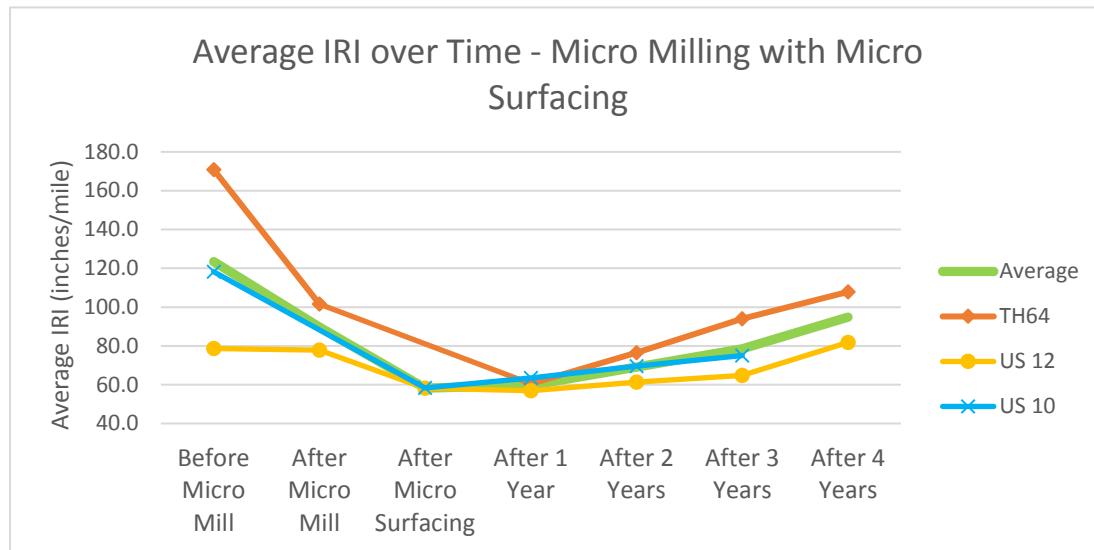
Treatment #2: Micro Milling with Micro Surfacing

Three Micro Mill with Micro Surfacing projects and their respective IRI data have been analyzed for this investigation. From this data, there appears to be a significant improvement to ride quality when compared to the original surface. It should be noted that the US 12 micro surface was placed on a bituminous overlay over concrete. More data on these projects will need to be collected to determine the longevity of the improvements in ride quality.



Figure 4 - TH 64 After 1 Year

Performance of Micro Milling with Micro Surfacing													
	Before Micro Mill	After Micro Mill		After Micro Surfacing		After 1 Year		After 2 Years		After 3 Years		After 4 Years	
	Avg. IRI (in/mi)	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved
TH 64 Northbound (2014)	166.3	99.6	40%	-	-	61.4	63%	77.3	54%	92.5	44%	104.5	37%
TH 64 Southbound (2014)	175.4	103.5	41%	-	-	59.6	66%	75.8	57%	95.5	46%	111.1	37%
US 12 Eastbound (2014)	77.7	76.2	2%	58.2	25%	57.2	26%	62.9	19%	65.6	16%	85.3	-10%
US 12 Westbound (2014)	79.7	79.5	0%	58.2	27%	56.6	29%	59.7	25%	63.9	20%	78.3	2%
US 10 Eastbound Driving Lane (2015)	118.2	-	-	58.3	51%	63.4	46%	69.6	41%	75.1	36%	-	-
Averages	123.5	89.7	21%	58.2	34%	59.6	46%	69.1	39%	78.5	32%	94.8	16%



At approximately \$30,000 per lane mile, Micro Milling with Micro Surfacing can greatly improve the ride and service life of a bituminous pavement.

Figure 5 – Micro Milling with Micro Surfacing Chart

Treatment #3: Micro Mill with UTBWC

This investigation analyzed the ride data on two different Micro Mill with UTBWC projects. The data shows that ride quality can be significantly improved compared to the original surface. After 4 years, an average improvement of 38% is shown. As with Micro Surfacing, more ride data will need to be collected in subsequent years since the sections in question have not yet returned to their pre-treatment IRI values. Additional ride quality data will provide further insight into the effectiveness of Micro Surfacing with UTBWC at improving ride and preserving pavement condition.



Figure 6 – US 10 After 1 Year

Performance of Micro Milling with UTBWC													
	Before Micro Mill	After Micro Mill		After UTBWC		After 1 Year		After 2 Years		After 3 Years		After 4 Years	
	Avg. IRI (in/mi)	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved	Avg. IRI (in/mi)	% Improved
TH10 Eastbound Driving Lane (2014)	105.9	-	-	42.0	60%	46.2	56%	57.6	46%	67.1	37%	70.0	34%
TH10 Eastbound Passing Lane (2014)	109.0	90.4	17%	41.2	62%	45.1	59%	54.1	50%	64.0	41%	64.4	41%
TH10 Westbound Driving Lane (2014)	109.4	-	-	39.4	64%	44.0	60%	54.8	50%	64.9	41%	67.6	38%
TH10 Westbound Passing Lane (2014)	110.8	86.5	22%	40.2	64%	45.6	59%	52.2	53%	65.6	41%	68.9	38%
I-394 Eastbound Driving Lane (2016)	93.1	-	-	43.9	53%	46.2	50%	48.2	48%	-	-	-	-
I-394 Eastbound Passing Lane (2016)	105.8	-	-	41.5	61%	44.6	58%	48.7	54%	-	-	-	-
I-394 Westbound Driving Lane (2016)	97.9	99.5	-2%	42.8	56%	45.3	54%	49.0	50%	-	-	-	-
I-394 Westbound Passing Lane (2016)	113.3	-	-	43.1	62%	44.9	60%	50.9	55%	-	-	-	-
Averages	105.7	92.1	12%	41.8	60%	45.2	57%	51.9	51%	65.4	40%	67.7	38%

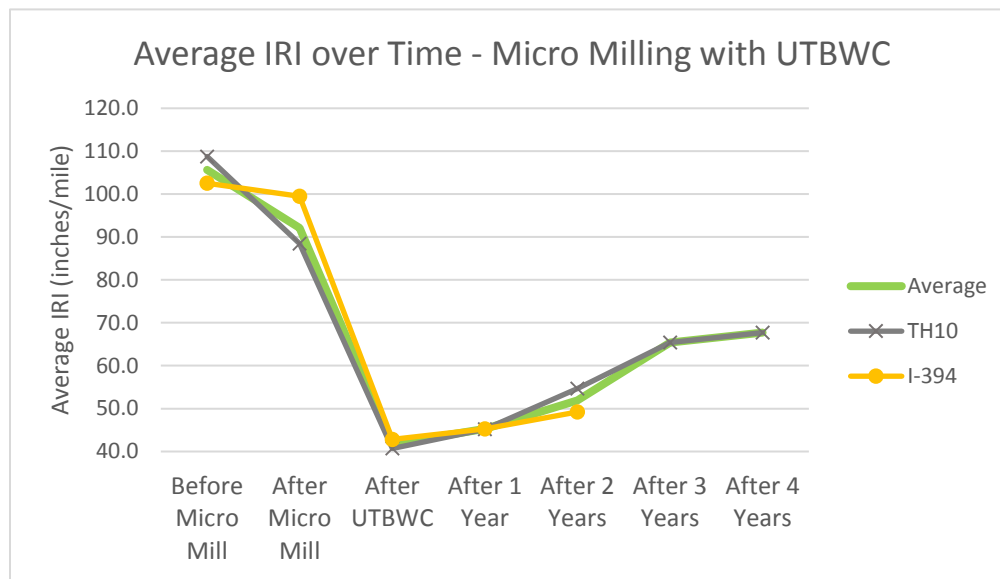


Figure 7 – Micro Mill with UTBWC Chart

At approximately \$43,000 per lane mile, Micro Milling with UTBWC has shown the best results at improving ride quality within the scope of this investigation, but has the highest initial cost of the three treatments detailed herein.

Conclusions

As discussed above, since the IRI of the Micro Surface and UTBWC sections have not yet returned to the original values, additional IRI data will need to be collected in subsequent years to provide a true comparison of cost/benefit ratio and longevity of the different treatments. Based on the available data, it is clear that Micro Milling combined with surface treatments has the potential to greatly improve ride quality of a bituminous pavement.

Please see the [MnDOT Pavement Preservation Manual](#) for more information on preventive maintenance surface treatments.

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Reference

“Micro-Milling - The Finer Side of Milling.” Pavement Interactive, 14 Sept. 2018, www.pavementinteractive.org/micro-milling-the-finer-side-of-milling/