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Recycling Pavements Constructed with Non Woven Paving Fabrics

The question “can paving fabrics be milled and recycled in asphalt hot mix” is a concern for pavement reconstruction and rehabilitation by some agencies. It is important to address this issue as over one billion square yards of paving fabrics have been installed in the US since the 1975. The purpose of this paper is to respond to this question and provide information that has been developed.

In the early 1980s as the use of paving fabrics became a significant strategy in the design of pavement with an asphalt overlays. Several state agencies demanded that recycling of payments constructed with a paving fabric be investigated. Phillips Fibers Corporation, then a subsidiary of Phillips Petroleum Company, carried out the initial recycling investigation. Asphalt Technology completed a compressive study 1984 in the colder region of Colorado. Subsequent investigation of recycling of paving fabrics were made in 1990 by TenCate. The result of all investigations concluded that non woven paving fabrics can be milled, recycled and placed in asphalt hotmix with acceptable results. Tencate also concluded that by-product of milling polypropylene and polyester paving fabric do not present potential health issues.

Since the first installation of fabric in 1975 significant quantities of asphalt pavement containing paving fabrics have been milled. A smaller percentage of fabric milled has been recycled and place in hot mix without adverse effects. States that have a considerable amount of fabric installed including Texas, California & Illinois and confirm this finding..Cold in-place recyclers have successfully processed asphalt hot mix asphalt containing non woven paving fabrics.

Investigations

Phillips Fibers Corporation Study

The Phillips study demonstrated that a pavement containing polypropylene fabric could be milled with the millings deposited into recycled mix, with the recycled mix containing paving fabric installed as a pavement overlay. This study also concluded that this process could be accomplished within the perimeters of hot mix design plant operating systems and meeting the mix design objectives of the hot mix asphalt. Study was reported "Recycling Asphalt Pavement Containing a Nonwoven Polypropylene Fabric," J.W. Dykes Proceeding Association of Asphalt Paving Technologist,

TABLE 2
TEST PROPERTIES OF RECYCLED BITUMINOUS CONCRETE MIXTURES WITH AND WITHOUT PETROMAT

Sieve Size	NYDOT Type 6 % Passing	CONTROL SECTION Recycled Mixture 50-50 Blend No Petromat (% Passing Average 3 Tests)					TEST SECTION Recycled Mixture 50-50 Blend Petromat (% Passing Average 3 Tests)				
					\bar{x}	S				\bar{x}	S
#200	3-6	6.3	6.0	7.0	6.43	.51	8	6	7	7	1.0
#80	4-16	8	8	10	8.7	1.15	11	8	10	9.7	1.53
#40	8-27	12	12	14	12.7	1.15	15	12	15	14.0	1.73
#20	15-39	17	17	21	19.0	2.83	22	18	21	20.3	2.08
1/8"	36-65	48	49	55	50.7	3.78	55	52	58	55	3.00
1/4"	65-85	77	78	81	78.7	2.08	76	80	84	80	4.00
1/2"	95-100	98	98	99	98.3	.58	99	98	98	98.3	.58
1"	100	100	100	100	100	0	100	100	100	100	0
% Bit. Content	5.8-7.0	4.9	5.2	5.7	5.3	.40	5.7	5.9	5.8	5.8	.10
% Moisture		0	0	0			0	0	0		
Coating (Ross Count)		100	100	100			100	100	100		
% Petromat		-	-	-			0.056	0.009	0.014		
Abson Absolute Viscosity at 140°F, poises		6043	6272	4570			4390	4940	3937		
Abson, Duct. at 77°F, cm		100+	100+	100+			100+	100+	100+		
Abson pen. at 77°F, dmm		38	38	43			46	45	47		
Mixture Temp, °F		290	315	290			285	280	275		
Cold Feed Calibrations		OK	OK	OK			OK	OK	OK		
Moisture Meter		N/A	N/A	N/A			N/A	N/A	N/A		
Asphalt & Aggreg. Scales		OK	OK	OK			OK	OK	OK		
Stockpile Contamination		OK	OK	OK			OK	OK	OK		
Marshall Voids, %		7.00	5.36	2.76			1.23	3.01	2.812		
Marshall Flow, inches		.10	.10	.15			.19	.15	.11		
Marshall Stability, lbs.		1589	1765	2213			1950	1652	1885		
Theoretical Gravity		2.499	2.483	2.465			2.444	2.457	2.454		
Actual Gravity		2.324	2.350	2.397			2.414	2.373	2.385		

The following was also confirmed in the Phillip's study:

- a) Milling Asphalt concrete in both field and laboratory studies using nonwoven polypropylene fabric poses no serious problems to the milling operations.
- b) There are no apparent difference observed in recycled drum-mix properties with or without fabric.
- c) There are no visible differences in stack opacity with or without the fabric recycled at a 50-50 ratio.
- d) Material conformed to the New York Department of Transportation mix design properties
- e) Increase in percentages of paving fabric also increased the % of liquid asphalt in the mix.

Asphalt Technology completed a compressive study 1984

This study concluded that polyester paving fabrics could be combined with a mix containing both recycled asphalt concrete and 70% new aggregate and asphalt and produced a mix that met the project specifications. The overlay performed satisfactorily and met the Marshal compaction, stability and flow for the project. John E. Boring, Asphalt Technology Arvada, Colorado

The following charts showing the recycled mix containing polyester fabric is taken from Asphalt Technology study.

Nuclear Density of Compacted Recycled Mix		
Test Location	Density pcf	Compaction
Thru-Lane 80' N. of Ralston Rd	132.9	93.6
Thru-Lane 175' N. of Ralston Rd	134.1	94.4
Rt.-turn Lane 35' N. of Ralston Rd	140.0	98.9
Rt.-turn Lane 200' N. of Ralston Rd	133.6	94.1
Thru-Lane 215' N. of Ralston Rd	136.4	96.1
Average	135.5	95.4

Marshal Data of Recycled Mix			
Sample	Density pcf	Stability lbs	Flow, 0.01 in
Right Turn Pavers	142.2	1569	12
Through Lane Pavers	141.9	1371	9
Average	141.0	1470	11

Cores Removed From Existing Pavement			
Core No.	Density pcf	Core No.	Density pcf
1	143.4	4	139.7
8	144.0	5	142.0
9	142.3	23	143.6
Average	143.2	Average	141.8

The Asphalt Technology study reported satisfactory milling operations for paving fabrics and millings successfully fed through hot mix drum dryers of asphalt plants. In present day recycling activities, milled paving fabrics are included in stockpile material samples for asphalt extraction in order to determine mix requirements for new liquid asphalt.

TenCate Investigation

The goal of this study was to determine if a milled asphalt hot mix containing non woven paving fabric can be reused. The test section were covered with 40-50 mm of asphalt hot mix. After being exposed to traffic for some time the overly was milled with the following results:

- Milling of the section with fabric caused no problem.
- The fabric was cut to the same extent as the asphalt overly.
- This investigation has shown that the reuse of milled asphalt overly material is possible containing an interlayer with non woven paving fabric.
- Marshall specimens made from material showed no reduction in quality to standard mix. The melting point of the fabric processed through the asphalt plant melted and was distributed evenly through the mix

Study was constructed and supervised by Baulabor AG of Switzerland

Current Practices by Asphalt Producers an Recyclers

Processing of paving fabric in the hot mix recycle procedures in asphalt plants were observed and reported as follows

Reliable Contracting Co. Inc. in Millersville MD was visited for the purpose of examining the processing of Rap materials. Reliable is a major Recycler of asphalt and concrete products. This company recycles asphalt roofing shingles and produces both asphalt recycled mix and asphalt treated base mix.

Although reliable does not see a significant amount of paving fabric in recycled material, we did observe material rejected from scalping screen processor.



A secondary single deck-scalping screen vibrates debris and any visual pieces of fabric from the RAP entering the conveyor belt



Rejected material on the right contains a small amount of paving fabric approximately 6 “ long and will not proceed to the drum dryer

It is expected that by with the crushing systems used by this plant very little fabric pieces are actually make it in to the finished product. Any fabric would have to pass though $\frac{1}{2}$ - $\frac{3}{4}$ inch screen to be included in the asphalt-recycled mix

Fabric was not apparent in Reliable's mix testing facilities, what little if any asphalt saturated fabric could not be identified. They currently use the method of asphalt content burn off to determine asphalt content of the hot mix, because of this method the polymer saturated fabrics would be reported in their liquid state. Reliable consistently manufactures RAP meeting mix design requirement for customers with 14 – 15 % recycled material and adding 5.0 to 5.6 liquid asphalt to hot mix.

The Southern California represents a significant use of paving fabric they have been used in large quantities for the past 30 years and as a result many pavements that are now being recycled contain paving fabrics. A major supplier of asphalt and recycled hot mix allowed a tour of their facilities and discussed the processing of recycled materials . They have developed their own proprietary method for dispersing larger pieces of fabric and other debris. This facility accepts recycle asphalt pavement consisting of ripped up material and mill material from highways, county/city streets, parking lots and other paved surfaces.



Larger pieces of asphalt are broken up when dumped into the recycled bin and larger pieces of fabric are discarded during this operation



Stockpile material is dump into this large separator to eliminate chunks of asphalt and large fabric pieces from continuing on to primary crusher.



A secondary horizontal impact crusher is used to reduce material to pass through a $\frac{3}{4}$ inch screen. Fabric pieces that are greater than the $\frac{3}{4}$ inch screen are air blown in to the collar and into a debris pile

Other plants have been found to use a primary crusher only and a picker (An employee stationed prior to the entrance of the rap to the mixing drum) to remove any debris including wires, loops, large fabric pieces and other debris that may pass through the primary crusher

In-Place Recycling



Pavement Recycling Systems, Inc routinely encounter pavement which contain paving fabric in In-Place cold recycling projects. This firm has develop a process that provides recycled mix placemen contain paving without detrimental effective to the new pavement.

Practice Considerations

Milling Considerations:

- If possible mill above paving fabric to maintain water proofing benefits
- Mill ½ inch bellow fabric helps regulate size of milled fabric pieces
- Milling at a slower speed reduces fabric piece size
- Paving Fabric is easier to mill when milling machine is good condition

Recycling

- Adding a second scalping screen will remove milling teeth, utility casting, debris, joint sealers as well as fabric
- Closed loop/single pass crushing circuit automatically remove debris, joint sealers and larger pieces of paving fabric.

Conclusions and Recommendations

Pavements that contain non woven paving fabric can be milled, recycled and place in a new pavement without effecting the pavement performance. Paving fabric installed without sufficient quantities of liquid asphalt are more difficult to mill and recycle. Industry should develop paving fabric installer requirements Recommend that the industry develop paving fabrics interlayers that are easier to mill and recycle. Industry should develop a paving fabric composed from post consumer waste fibers. Agencies should develop a standard specification for allowing milled paving fabric in base stabilization fill materials.