



## SHINGLE RECYCLING IN ASPHALT MIXTURES: ISSUES AND OPPORTUNITIES

DAN HORTON, FOUNDER  
ASR SYSTEMS, LLC

LAS VEGAS, NV | MARCH 10-14, 2020



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### TOPICS

- State of the Asphalt Shingle Recycling Industry
- Recoverable Raw Materials
- Processing Methods
- RAS Refining
- RAS as Aggregates

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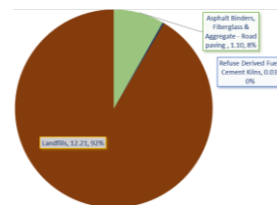
Asphalt Shingle Recycling (ASR) Systems

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### 2019 STATE OF THE INDUSTRY

- **13.34 M Annual Roof Waste Tons**
  - 157,500,000<sup>2</sup> squares
  - 43 squares per capita<sup>2</sup>
  - 71.4 lbs.<sup>1</sup> roof waste per capita
- **8% recycling rate**
  - 12.21M Landfilled
  - 1.1M Roof to Roads
- **Path to Increased Recycling Rate**
  - Beneficial Use to NAPA and DOT specifications
  - Technologically Advanced Processing Utilizing Raw Materials' Full Value
  - RAS/Gravel Sales



1. Estimated Asphalt Roofing Manufacturers Association (ARMA) quarterly market share reports and Canadian sales.  
2. 236.2M US Population and 23M Canadian population.  
3. Assumptions 220 lbs. per square, 75% repair and reroofing, single layer tear-off.

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### ASPHALT SHINGLE RAW MATERIALS

#### Key Raw Materials

##### Granules

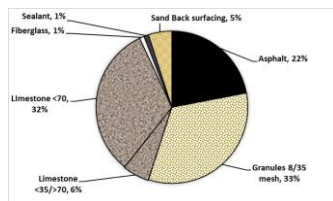
- 6.0-7.0 Molt's Mineral Scale and angular
- Gradation Distribution 8-35 mesh

##### Asphalt

- ~PG124 (255.4°F) Post Consumer
- ~PG109 (228.4°F) Factory Waste

##### Limestone

- 93-97% CaCO<sub>3</sub> (calcium carbonate)
- Gradation distribution
  - o 85-100% <70 mesh,
  - o 72-95% <100 mesh, 56-89% <150 mesh

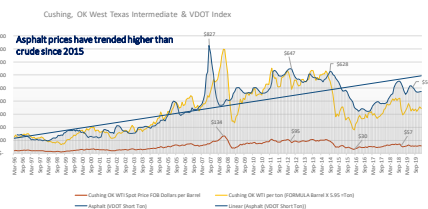


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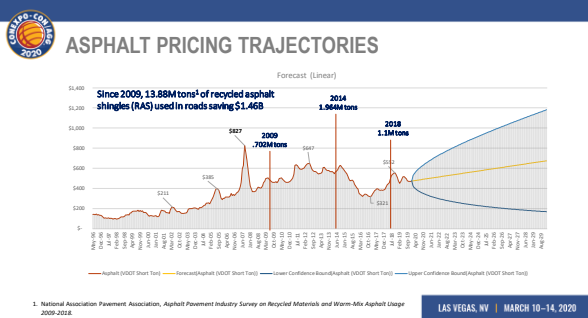


### ASPHALT PRICING COMPARED TO CRUDE



SOURCE: <https://www.enr.com>, WTI crude oil VDOT index <https://www.vdot.state.va.us/News/asp/MarketData/Business/CommodityIndex.asp#asphalt>

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### RAW MATERIAL VALUE \$1.6B LANDFILLED ANNUALLY

#### Asphalt Shingle Raw Material Value - North America

Annual Tons Landfilled<sup>1</sup> 12,210,000

Material	Value	%	Tons	Recovered	Total
Asphalt <sup>2</sup>	\$ 500.00	22%	2,686,200	\$ 110.00	\$ 1,343,100,000
Granules 8/35 mesh	\$ 55.00	33%	4,029,300	\$ 18.15	\$ 221,611,500
Limestone <35/>70	\$ 5.00	6%	695,970	\$ 0.29	\$ 3,479,850
Limestone <70	\$ 15.00	32%	3,943,830	\$ 4.85	\$ 59,157,450
Fiberglass	\$ -	1%	122,100	\$ -	\$ -
Sealant	\$ -	1%	122,100	\$ -	\$ -
Sand Back surfacing	\$ 10.00	5%	610,500	\$ 0.50	\$ 6,105,000
<b>Raw Material Value</b>				<b>\$ 133.78</b>	<b>\$ 1,633,453,800</b>

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### TIPPING FEE BY REGION

The Average Price to Landfill a Ton of MSW by Region and Year

	2010	2011	2012	2013	2014	2015	2016	2017 <sup>2</sup>	2016-17 Increase	Prediction 2020 <sup>2</sup>
Northeast	\$69.00	\$69.30	\$72.90	\$74.90	\$76.10	\$77.00	\$77.80	\$79.30	1.90%	\$94.92
Southeast	\$38.10	\$38.20	\$39.30	\$39.80	\$40.20	\$40.40	\$40.90	\$43.60	6.60%	\$52.19
Midwest	\$44.00	\$44.00	\$45.90	\$46.20	\$47.20	\$47.60	\$48.40	\$52.70	8.90%	\$63.08
Western	\$30.30	\$30.40	\$33.30	\$34.00	\$34.40	\$34.80	\$34.80	\$35.70	2.60%	\$42.73
Pacific	\$50.50	\$51.80	\$54.00	\$55.30	\$56.70	\$56.80	\$57.20	\$57.90	1.20%	\$69.31
Entire US	\$43.30	\$43.50	\$45.90	\$46.80	\$47.80	\$48.10	\$48.80	\$50.60	3.70%	\$60.57
								\$7.30	15.90%	\$9.76

Total increase since 2010: \$7.30, 15.90%

Source: Waste Business Journal, May 2017. Predictions by Dan Horton

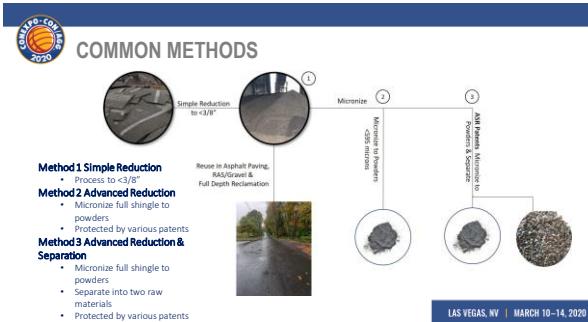
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### PROCESSING METHODS


REDUCTION, SEPARATION AND EXTRACTION

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### SIMPLE REDUCTION TO <3/8" RAS



- Full Shingle reduced to top size 3/8"
- Product specific equipment can process 25-80 tph
- Water cooling prevents blinding of screens
- Method most used when supplying the asphalt paving manufacturer

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### MICRONIZE ASPHALT ROOFING SHINGLE



- Full shingle reduced to <30 mesh (595 microns) or smaller
- Specialized processing equipment requiring license
  - 1) Consider material handling
  - 2) Develop end market before purchasing
  - 3) Patent holders will help with sales
- Mixes better with liquid asphalt for the following uses
  - 1) Asphalt paving
  - 2) Pavement seal coating
  - 3) Cold patch
  - 4) Roofing adhesives & sealants
- Will change aggregate and fiberglass size distribution

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### TECHNOLOGICALLY ADVANCED SEPARATION



**Patented Processing**

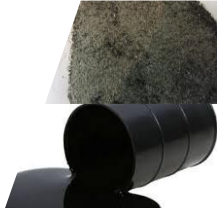
- Two raw material streams
  - 1) Powder
  - 2) Sand/granules
- Paving industry has not utilized but other industries have reviewed



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### LIQUID ASPHALT EXTRACTION



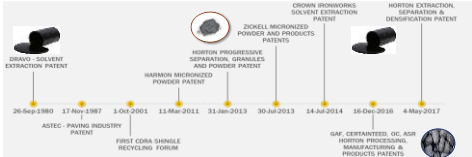
**Patented Processing**

- Patents held by Dravo, Crown Ironworks & Horton
  - 1) Material handling is a challenge
  - 2) Blends well with virgin liquids
  - 3) Does not change asphalt properties
- Complex but may be a path to more reliable use in the paving and other industries
  - 1) Virgin asphalt blend designs must be completed
  - 2) May be designed to blend with polymers

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### PATENTS BUT NO DOMINANT SOLUTION




**Asphalt Extraction Innovation**

- Soybean method
  - 1) Original by Crown Ironworks
  - 2) Commercialized by Resource Recovery Solutions. Now owned by KCH industries
- Petroteq Green Solvent
- Horton Small Scale Systems

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### TECHNOLOGICALLY ADVANCED SHINGLE RECYCLING



**Licensing Agreements**

- Shorten start-up
- Reduces costly mistakes
- Design/Build or EPCM services
- Commercializing expertise
- Customer acquisition

**Recycling Professionals Usually Needed**

**New Market Opportunities**

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## RAS AS AGGREGATES

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## <3/8" RAS MIXED WITH GRAVEL



Excerpt: R Project Published by New England Construction January 25, 2019

- Iowa DOT August 1997
- MN DOT June 2013
- VT Report March 2019

Source: <https://www.nacppds.com/articles/1244-excerpt-show-utilizes-recycled-shiping-to-stabilize-new-london-tourists>

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## INCREASING RECYCLING RATES WITH TECHNOLOGICALLY ADVANCED PROCESSING

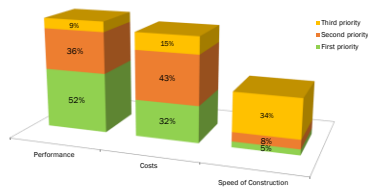
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Asphalt Shingle Recycling Systems

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## Top Three Priorities in Pavement-Type Selection Decisions





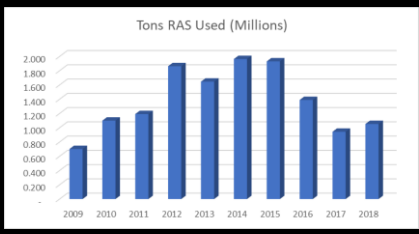
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### A Word of Warning



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### Are both trucks?




Year	Tons RAS Used (Millions)
2009	0.8
2010	1.2
2011	1.3
2012	1.9
2013	1.7
2014	2.0
2015	2.0
2016	1.5
2017	1.0
2018	1.1

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### RAS Usage



PG 76-22      Shingle Asphalt



**Memorandum**

U.S. Department of Transportation  
Federal Highway Administration

Subject: **ACTION:** Recycled Materials in Asphalt Pavements      Date: October 20, 2014

**How We Got Here...**

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- Protect our pavements
- Performance is king!
- We used to assume 100% of the asphalt binder ...
- We used to assume somewhere between 70 and 85% of the binder...
- New low temperature properties

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### Where We Are Today

- How do I make sure our pavements are going to perform?
  - Cracking test – Ideally!
  - Volumetrics properties – Hasn't worked so far!
  - Some kind of binder test – Let's give it a shot!

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### Where We Are Today



Complete hamstring avulsion

Why  $\Delta T_c$

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It's a Different Animal

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**Roadway Owners**

- I now have a surrogate cracking measure
- But how will I choose to implement this?
- Change in policy/testing capabilities?
  - Many states were moving away from doing chemical extractions
  - Do I put this on the contractors?

What Does This Change Mean to Me?


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What Does This Change Mean to Me?

- **Contractors**
  - MORE TESTING!!!
  - Change the way business is done and mixtures are created



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What Do I Have to Do?

**Asphalt Content**



Know Your RAS

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### Asphalt Binder Properties

92 hrs.

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Know Your RAS

- Tank binder properties
- RAP AC
- RAP binder properties
- Asphalt binder chemistry

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What else?

Aging

The Same,  
But Different

- Could we use a softer binder?
- Recycling agents
- Do I add more binder?
- What do I do?

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It Takes More Work ...

### Finding the Balance

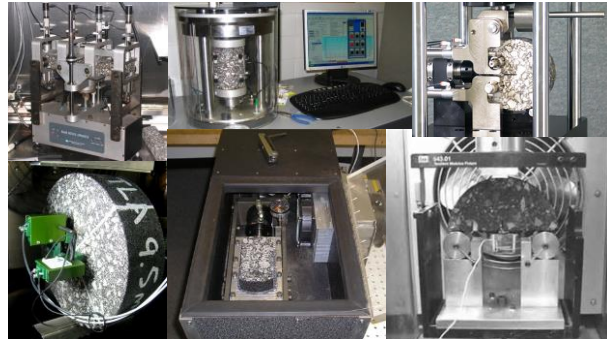
Complete hamstring avulsion

© MING 2011

## Durability (Cracking)



- Cracking is more challenging
- What type of cracking?
  - Thermal
  - Reflective
  - Top-down load related
  - Bottom-up Fatigue



- The freefall of RAS usage has seemingly stopped
- New methods of mix design will be what allow RAS to be used if it is a viable source material
- Ultimately, it is all about performance.
- RAS properties impact performance
  - Consistent and fine grind
  - Clean sources



Concluding Thoughts

**THANK YOU!**

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