NEAUPG ‘21 Cargill – Anova Asphalt Solutions

Oct 2021

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Cargill® Helping the world thrive

Discussion Today

- Thanks for sticking around during lunch!!
- Brief overview of Cargill's Anova Asphalt Solutions
- Let's talk:
  - Modifiers
    - Excellent dosage efficiency
  - WMA
    - Anova 1501: Non-Hazardous, amine free chemistry.
  - Rejuvenators
    - An Engineered Solution designed for the Asphalt

Virtual Display Table!!

It’s all there at:

www.asphaltsolutions.cargill.com

- DOT & Agencies
- Hot Mix Producer
- Refiners & Terminal Operators

Cargill's Role in Asphalt

Be the partner of choice and Industry leader in high-performance and sustainable asphalt additives.

- Rejuvenation
- Cold Mix
- Rheology
- Warm Mix
- Emulsions
- Stabilizers

State-of-the-art Asphalt Lab

- Customer custom formulation services
- Compositional and analytical evaluation
- Advanced rheology and thermal analysis

155,000 employees

Working in 70 countries

155 years of experience

$114.6 billion in annual revenue

Sustainable

Agriculture is how we will protect the planet and our shared future.

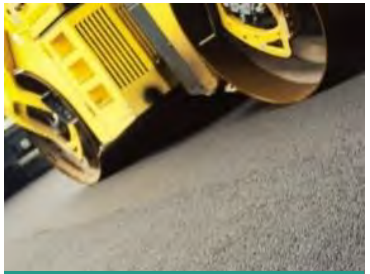
Climate change: Reducing supply chain emissions per ton of product 30% by 2030, and absolute operational emissions 10% by 2025

Water resources: Achieving sustainable water management in all priority watersheds by 2030

Land use: Eliminating deforestation in our supply chains by 2030

Anova® Asphalt Solutions address many common, yet tough-to-solve problems

With high-dosage efficiency and proven performance improvement



Workability

PG modification

Rutting resistance

Cracking resistance

Increase RAP/RAS

Preservation

Anova® Rheology Modifiers:
Upgrade problem binders.

Cargill Anova™ Rheology Modifiers

- Improving Performance
  - Ideal for modifying penetration for emulsion bases.
  - Offers high resistance to aging and thermal stability.
  - **Improves asphalt ΔTc with extended aging.**
- Creating Economic Value
  - **Highest dosage efficiency (2-3%).**
  - Can enhance Polymer blending efficiency.
- Reducing Environmental Impact
  - Developed from bio-based chemistries.
  - Low VOC's & Low Volatile Mass Loss.
- Enriching Communities
  - Renewable raw materials.
  - Work with farmers, government & industry groups to develop sustainable, innovative technologies.

Cargill Anova™ Rheology Modifiers

- *Anova 1005 & Anova 1006*
  - Offers long-term, high temperature stability.
  - Excellent polymer compatibilizer.
    - Can be added before or after modification.
      - Reduce SBS incorporation time.
      - Improved LT performance.
  - Ideal for modifying penetration grade for Emulsified Asphalts.
  - Ideal for improving low temperature performance grade and increasing penetration.

Anova® Warm Mix Additive (WMA)

Anova® WMA is dosage efficient and multi-functional

Anova WMA is a non-toxic liquid warm mix additive that is added at a 0.25-0.75% dosage to bitumen

Anova WMA allows up to 80ºF(27C) reduction in compaction temperature

Anova WMA does not significantly affect bitumen rheology and grade at the recommended dosages

Cargill Anova™ WMA

- Anova 1501
  - WMA with Anti-strip properties.
  - NEAUPG Approved in 2017.
  - NTPEP evaluation.
  - Reducing Environmental Impact
    - Non-hazardous, Non-toxic, low odor.
    - Amine free.
    - Made from Bio-based chemistries.
  - Delivery available in totes or bulk.
- www.asphaltsolutions.cargill.com

Cargill Anova™ Rejuvenators

- We start with a specific grade of Vegetable Oil
- We **chemically modify** the oil with a proprietary process specifically developed for asphalt application
  - Produced under strict quality protocols and full traceability.

- The chemical modification achieves:
  - Enhanced PG Useful Temperature Interval
  - Enhanced oxidative stability
  - High compatibility with asphalt hydrocarbons
  - Compaction aid and Warm mix abilities
- The result: Reliable performance against varying RAP material qualities

Recycling Agent / Criteria	Rebalancing Bitumen	Cracking Resistance	Rutting Resistance	Workability and Compaction	Durability and Aging	Safety and Handling Advantages
Cargill Anova Rejuvenator	▲▲▲	▲▲▲	▲▲▲	▲▲▲	▲▲▲	▲▲▲
Commodity Vegetable Oils	–	▲▲	–	–	▼	▲▲▲
Soft Asphalt / Flux	–	▲	▼▼	–	▼	▼
Modified Tall Oil-based	▲▲	▲▲	▼	–	–	▲▲▲
Tall Oil-based	–	▲	▼	–	▼▼▼	▼
Aromatic Oils	▲▲▲	▲	▼	–	▼	▼▼
Paraffinic Oils / REOB	▼▼▼	–	▼	–	▼▼▼	▼

▲ Positive Impact ▼ Negative Impact – No Impact

Cargill Anova™ Rejuvenators

- Anova 1815
  - High performance rejuvenator designed to increase recycled content in HMA / WMA.
  - Mix performance can be tuned with dosage.
  - Highly effective compaction aid.
- Anova 1845
  - Designed to meet Scrub Seal Emulsion specifications.
- Anova 1900
  - Spray on application.
  - Designed to replenish and restore properties of aged asphalt on surface of existing pavements.

- Delivery available by Rail, Bulk truck or Tote.

Product Portfolio Summary

Category	Description	Viscosity, cp at 25°C	Open cup flash point, °C
Rejuvenators			
Cargill Anova 1815 Rejuvenator	High-performance rejuvenator that increases recycled content in hot mix asphalt. Will also aid in compaction.	90-110	>270
Cargill Anova 1845 Rejuvenator	High-performance rejuvenator designed for use in scrub seal emulsions.	400-500	>270
Warm Mix Additive			
Cargill Anova 1501 Warm Mix Additive	High-performance, non-toxic, liquid warm mix additive. Designed to reduce pavement application temperatures and aid in compaction.	150-200	>200
Modifiers			
Cargill Anova 1005 Modifier	Rheology modifier with long-term, high-temperature stability. Increases polymer compatibility with asphalt. Ideal for modifying penetration grades for emulsified asphalts.	45-55	>270
Cargill Anova 1006 Modifier	Rheology modifier with high-temperature stability. Increases polymer compatibility with asphalt. Ideal for improving low temperature performance grade and penetration.	42-52	>220
Anti-Strip			
Cargill Anova 1410 Anti-Strip	High-performance, non-toxic liquid anti-strip that enhances asphalt-aggregate adhesion and reduces moisture damage in hot mix and warm mix asphalt.	1000-3000	> 120C
Emulsifiers			
Cargill Anova 1620 Emulsifier	High-performance emulsifier for use with quick and medium-setting asphalt emulsions.	2000-3500 (@40 °C)	> 212C
Cargill Anova 1650 Emulsifier	High-performance emulsifier for use with cationic, rapid setting chip seal emulsions.	100-150	>105C

NCAT Test Track using VDOT Design & VA Materials

Project Overview

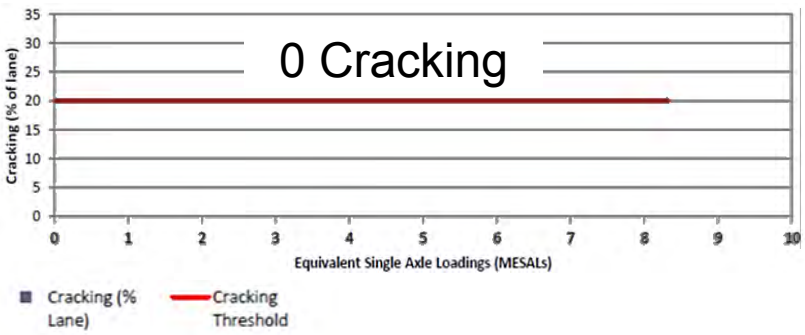
- Early 2018 Cargill partnered with NCAT to develop test sections for high RAP designs
- Design and process was done in close coordination with VDOT
  - Aggregates and RAP were shipped in from Virginia for the project
  - Designs were done using VDOT's proposed BMD system (IDEAL-CT, Contabro, and APA)
- Section subjected to ~10 Million ESALs of loading through early 2021
  - Loading will continue into a 2nd 3-year cycle for a total of ~20 Million ESALs

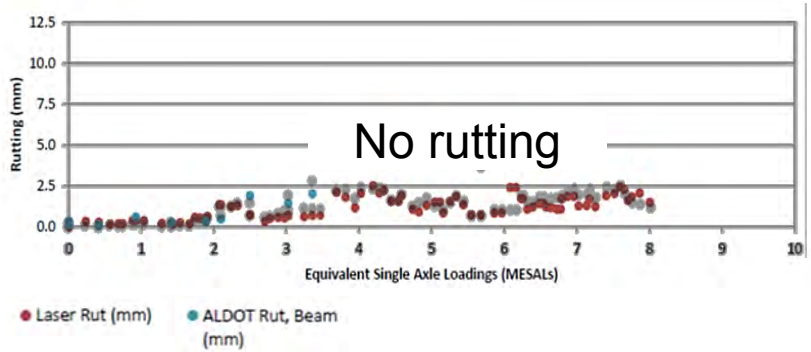
- Control VDOT mix:
  - PG64-22 Binder + Anova® 1501 Warm Mix Additive
  - 30% RAP (24% ABR)
- High RAP Mix:
  - PG64-22 Binder + Anova® 1815 Rejuvenator
  - 45% RAP (38% ABR)

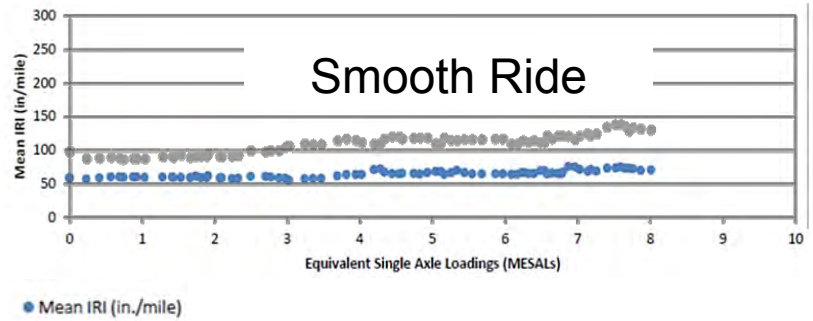
Cracked Area

Permanent Deformation

Ride Quality







Field Performance

45% RAP + Anova® Rejuvenator

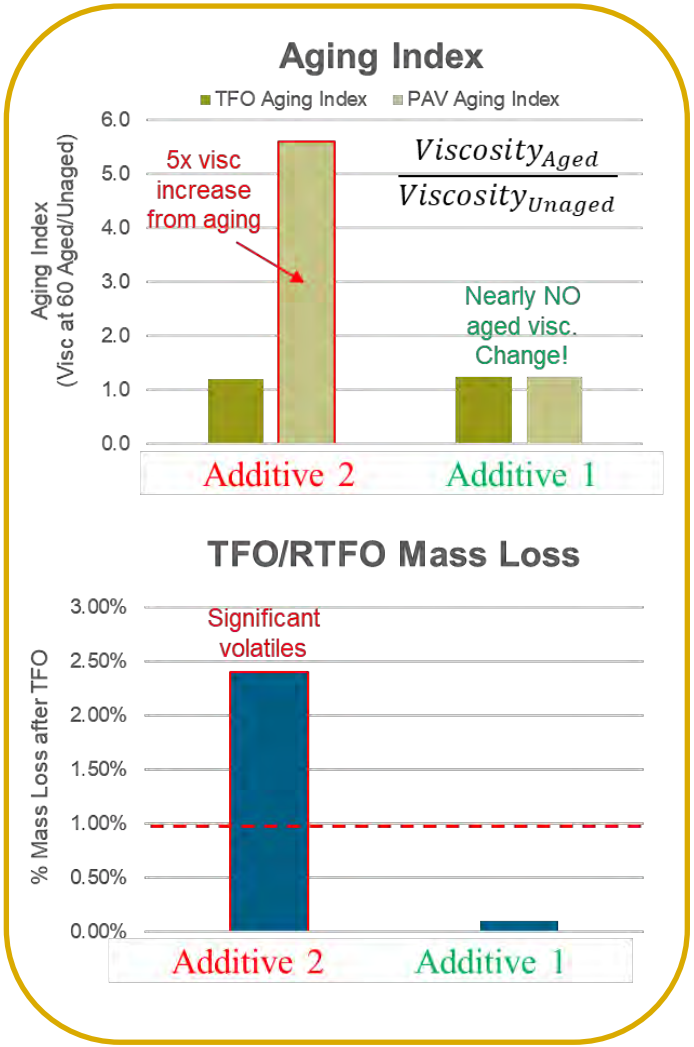
~10 Million Loadings: 0 cracking

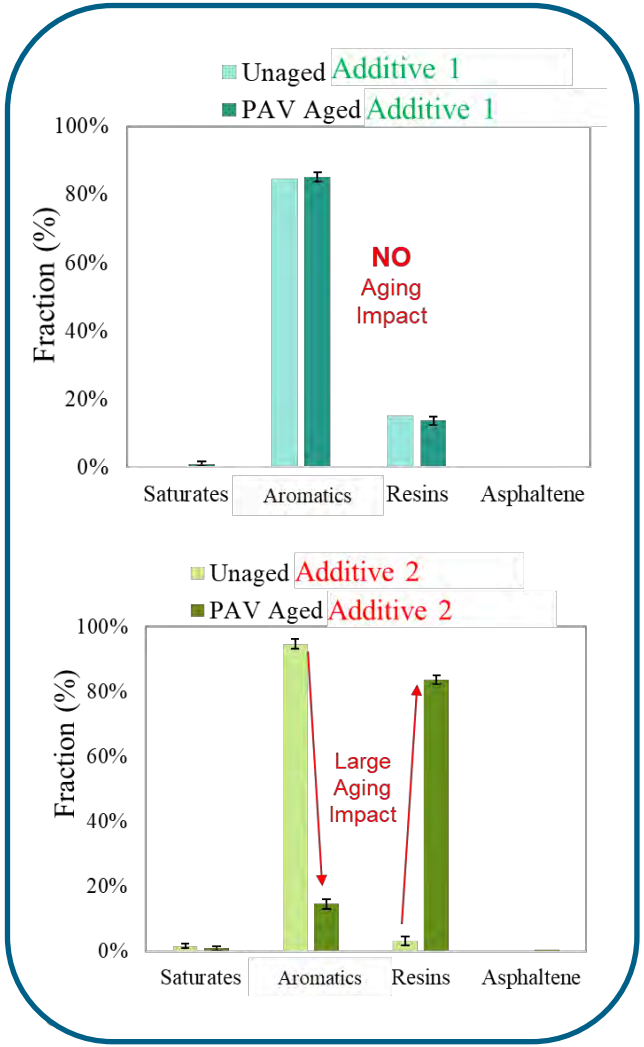
- No cracking observed in sections so far after nearly full cycle of loadings.
- Sections showing good rutting and smoothness
- Smoothness of the high RAP rejuvenated section looks especially good.

- Will continue into second 10 million ESAL 3-year cycle of loading.

Two "Vegetable Oil" Sourced Additives:

- Both additives would be considered "Vegetable-based" or "Fatty Acid / Triglyceride based.
- <u>They both soften relatively similarly.</u>
- However, they are not equal, especially in terms of aging and stability.





Thank You…Be Safe and Let's do this In Person in 2022

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