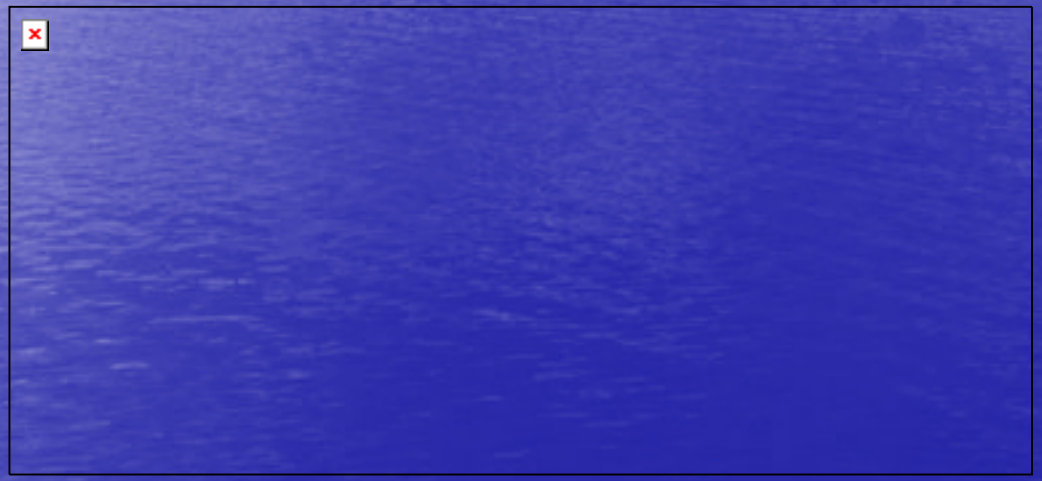
A CONTRACTOR'S PERSPECTIVE ON FOAMED WMA

Flexible Pavements OF OHIO

47th ANNUAL MEETING



Larry Shively

The Shelly Company

Oldcastle Materials

SHELLY Group

NOTE

It is not the intent of this presentation to recommend, promote, or endorse any particular WMA foaming system!

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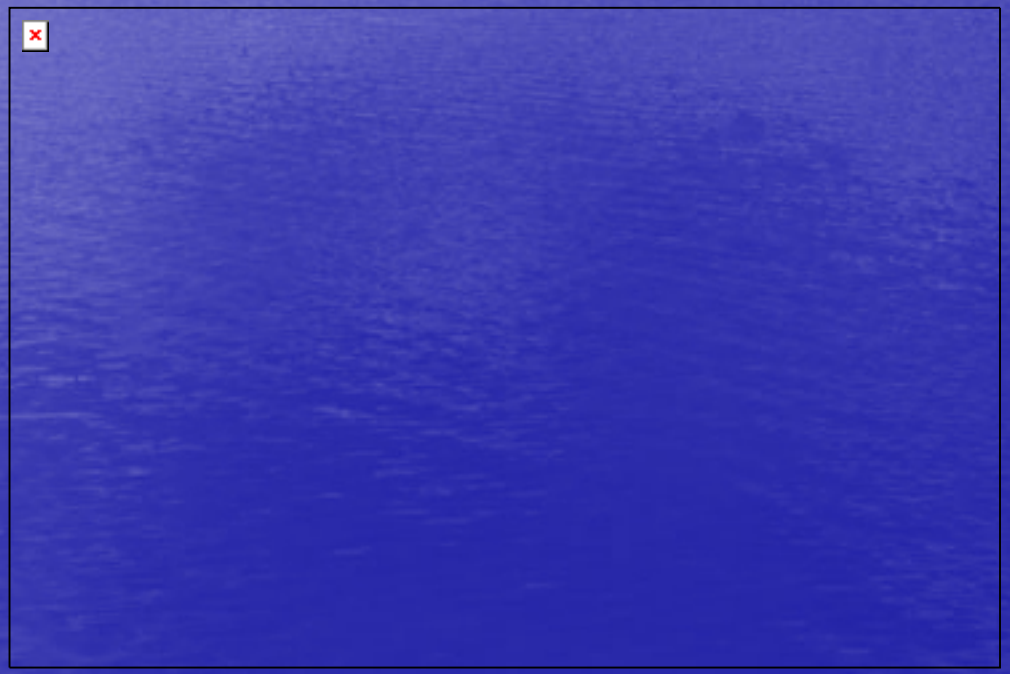
Why Foamed WMA?

- NO EXTRA ADDITIVES REQUIRED
- WATER-EASY TO HANDLE AND OBTAIN



- EASY CONCEPT TO UNDERSTAND

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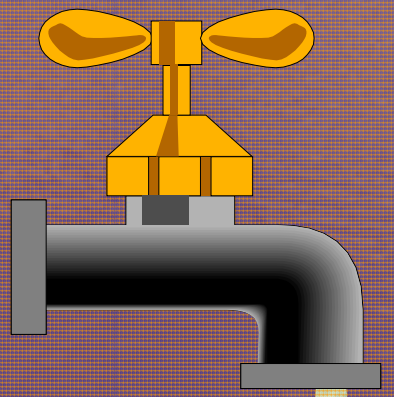
FOAMED WMA CONCEPT

- Mixes water and AC to create microscopic steam bubbles to foam the AC
- Water injection rate = less than 2% of AC flow rate (NOT 2% of mix!)
- Mix transported, placed and compacted using "normal" procedures.

Less than 2% of AC flow! So how much water?

- ✓ EXAMPLE: Mix has 6.0% Binder (virgin)
- ✓ ODOT specification max 1.8% water injection
- ✓ Based on 1 ton mix
- ✓ 6.0% * 2000 #=120 #
- ✓ 1.8% * 120 #= 2.16 # water
- ✓ Or approx. 0.25 gallons
- ✓ Or approx. 32 ounces PER TON OF MIX!!!



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THE FOAMING OF THE BINDER IS THE KEY NOT THE AMOUNT OF WATER

- MORE WATER MAY NOT IMPROVE THE FOAMING
- IN SOME CASES EXCESSIVE WATER MAY CAUSE "GUMMY" MIX
- IT IS IMPORTANT TO CONTROL THE WATER DUE TO THE SMALL AMOUNT USED
- IT IS A BEST FIT PROCESS!

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WMA

FOAMING OF LIQUID ASPHALT

THINK OF SHAVING CREAM

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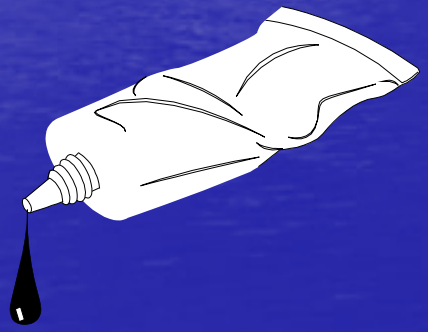
WHEN ASPHALT IS HOT IT ACTS AS A LUBRICANT & PROMOTES COATING

WHEN ASPHALT IS COLD IT ACTS AS A GLUE (CEMENT)



FOAMING ASPHALT HELPS THE LUBRICATION & COATING OF THE MIX AT A LOWER TEMPERATURE!

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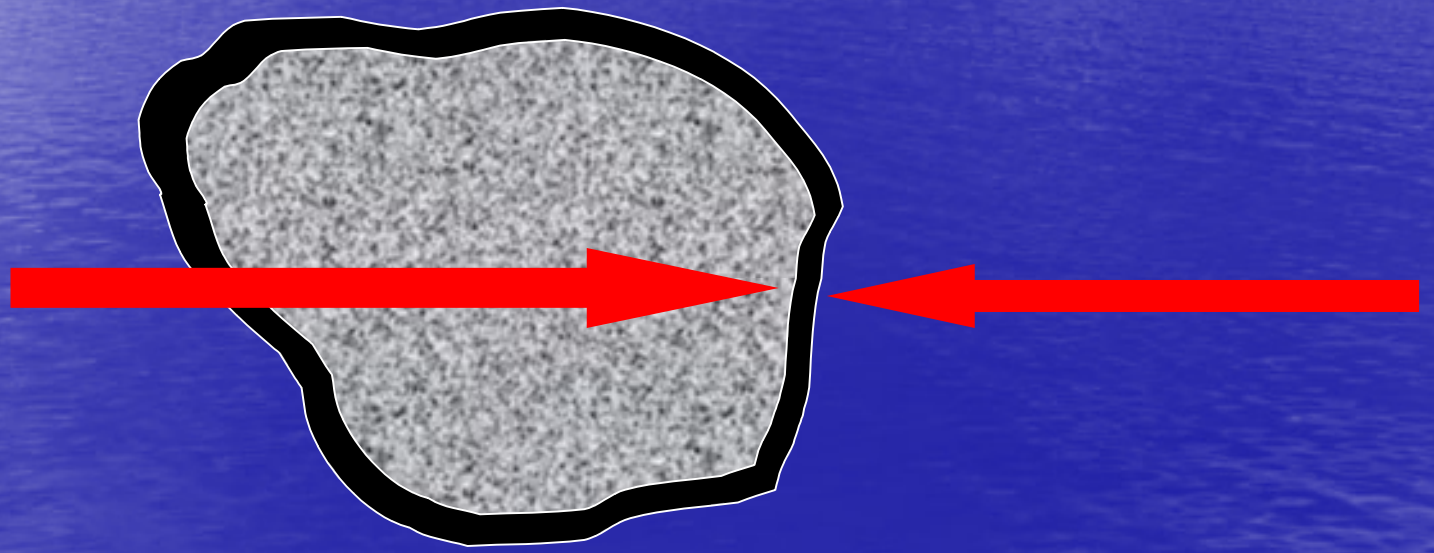
NORMAL ASPHALT BINDER THIN FILM THICKNESS

9 µm



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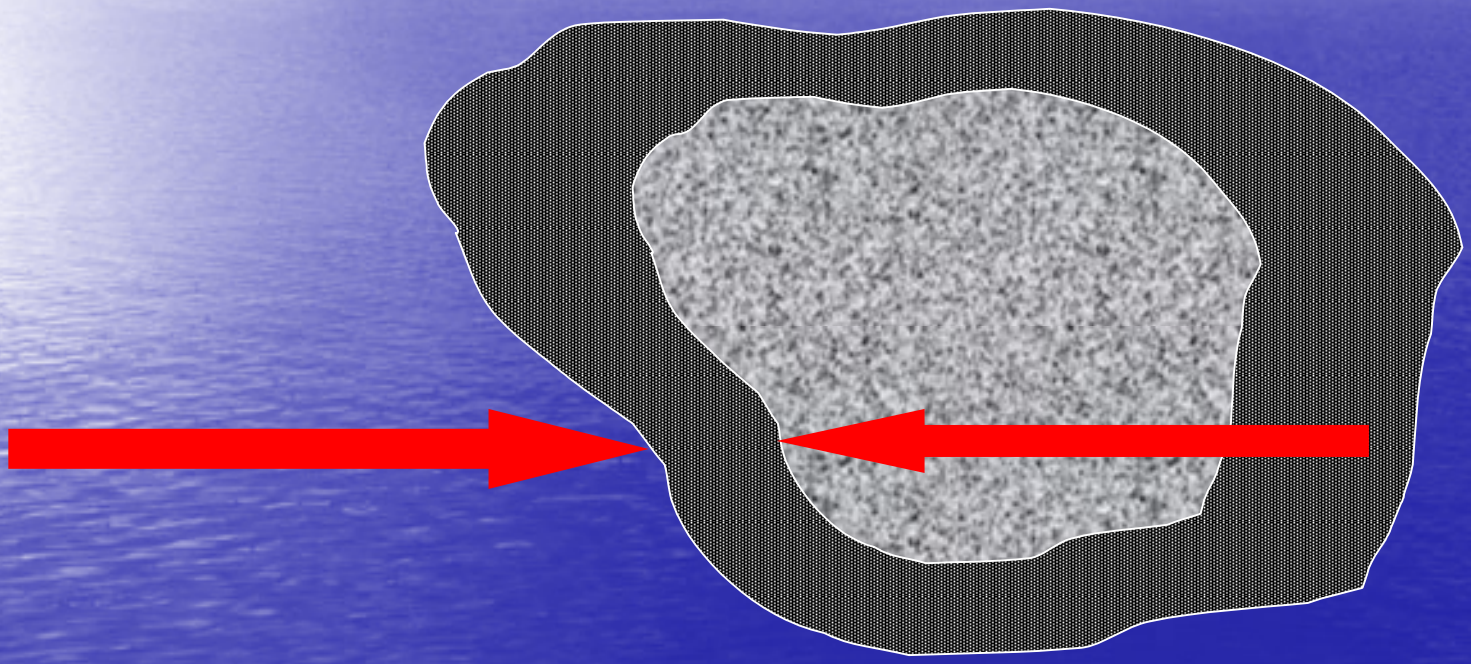
FOAMED ASPHALT BINDER THIN FILM THICKNESS=165 µm



APPROXIMATELY 18 TIMES VOLUME INCREASE

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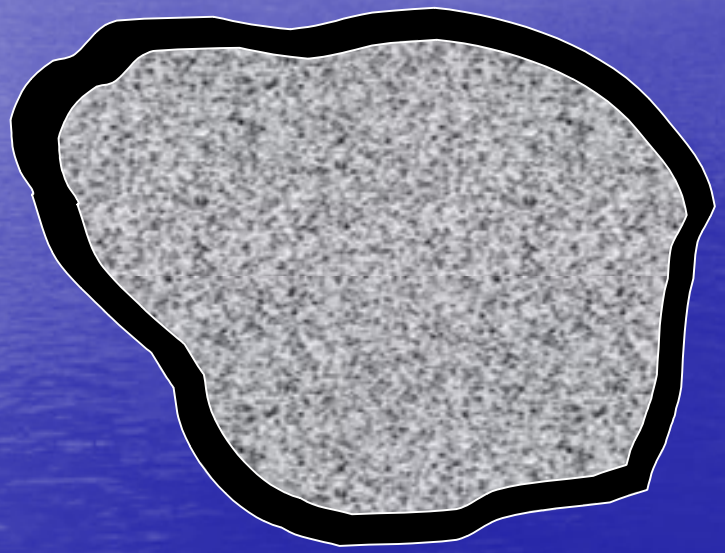
AFTER WATER LEAVES MIX BINDER THIN FILM THICKNESS=9 µm



WATER NORMALLY IS GONE BY THE TIME THE FIRST ROLLER IMPACTS THE MIX!

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WMA FOAMING OF BINDER

"MODIFYING THE BINDER SO IT TEMPORARILY LOWERS ITS OVERALL VISCOSITY AND INCREASES ITS VOLUME WITHOUT INCREASING TEMPERATURE"

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Why do we heat HMA?

- To remove moisture
- To coat the aggregate
- To provide for heat transfer to RAP
- To transport the mix
- To compact the mix!

Aggregate >212 F to remove H_2O

FOAMING ACCOMPLISHES THIS AT A LOWER TEMP!

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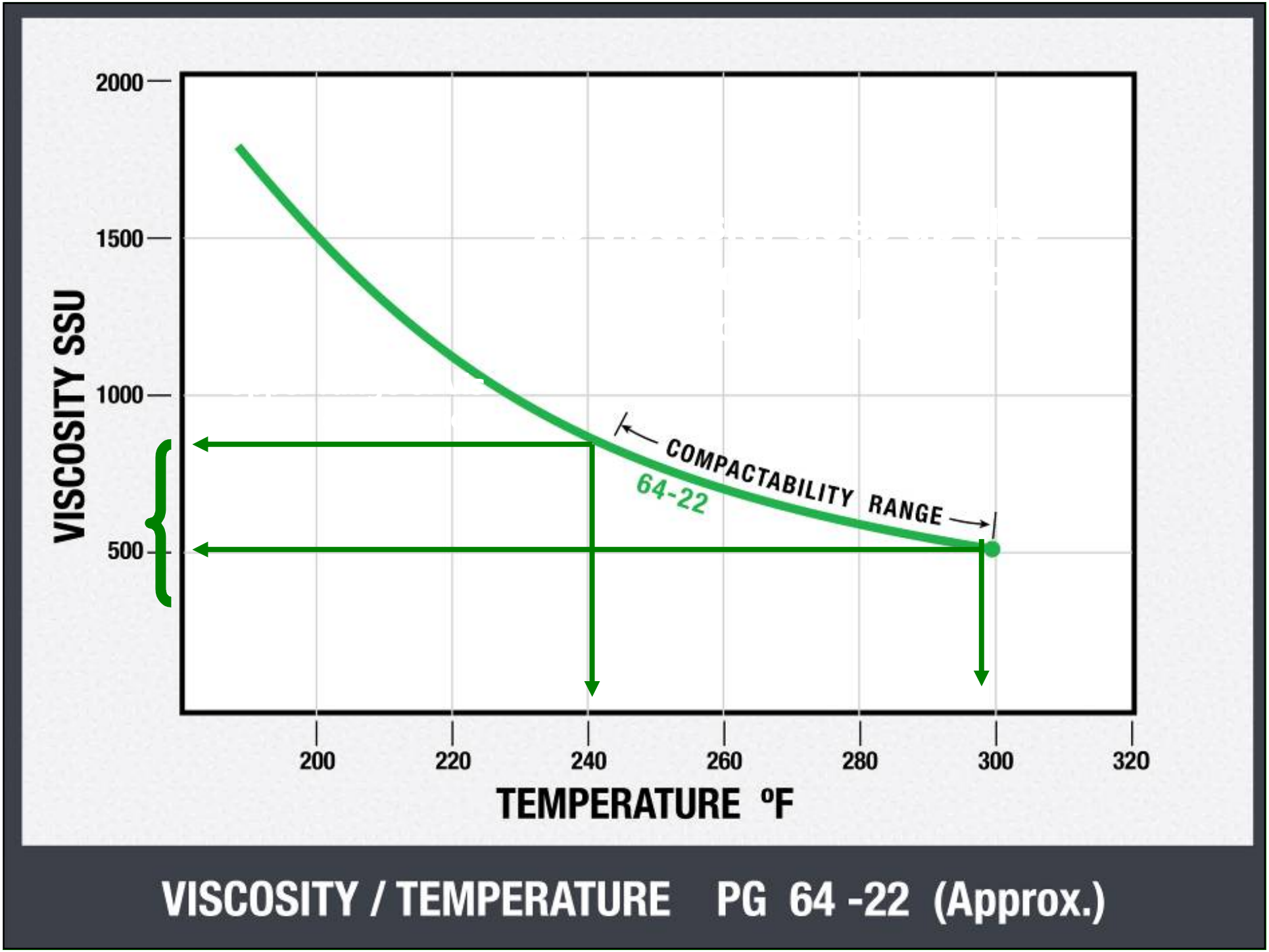
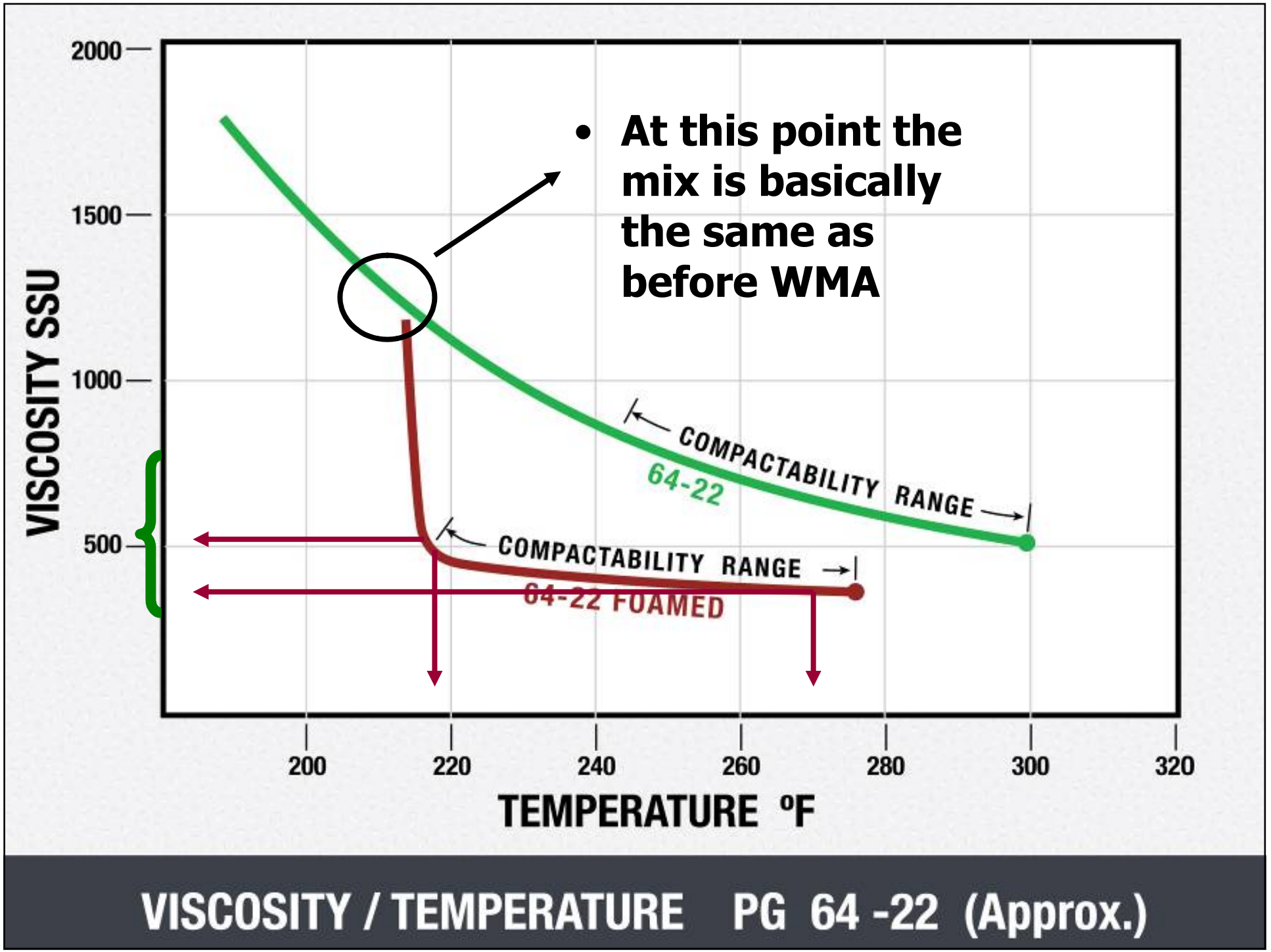


VISCOSITY / TEMPERATURE PG 64 -22 (Approx.)


2000
1500
1000
500
VISCOSITY SSU
• At this point the mix is basically the same as before WMA
COMPACTABILITY RANGE
64-22
COMPACTABILITY RANGE
64-22 FOAMED
200
220
240
260
280
300
320
TEMPERATURE °F
VISCOSITY / TEMPERATURE PG 64 -22 (Approx.)

COMPACTION

- SINCE THE VOLUME OF THE BINDER IS INCREASED ITS LUBRICATION IS IMPROVED AND THE MIX IS EASIER TO COMPACT.
- AND ITS VISCOSITY IS REDUCED!

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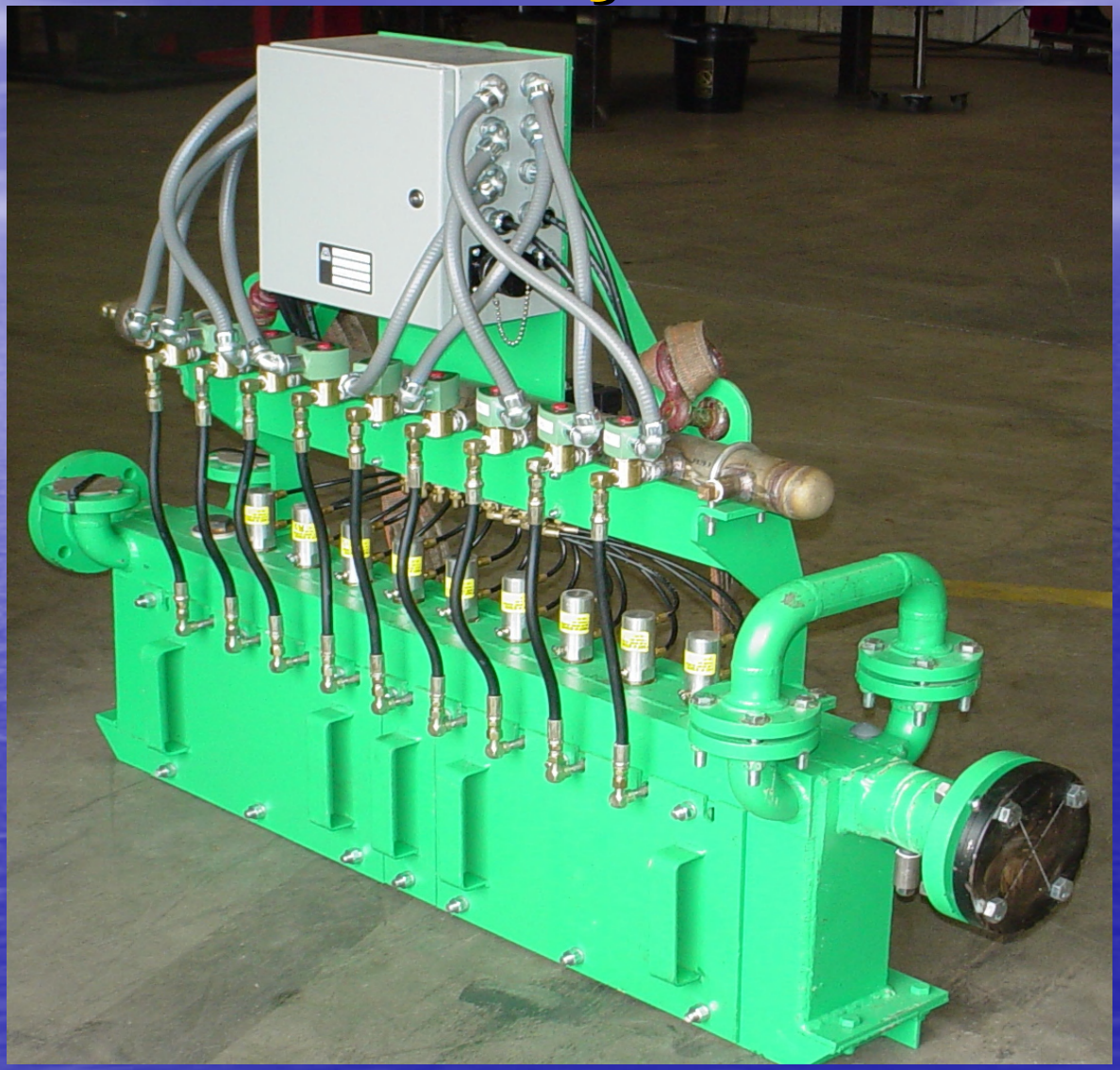
To date the Shelly Group has used these water injection foaming systems!

- Astec Double Barrel
- Terex
- Gencor

More foaming processes are being developed!

Astec System



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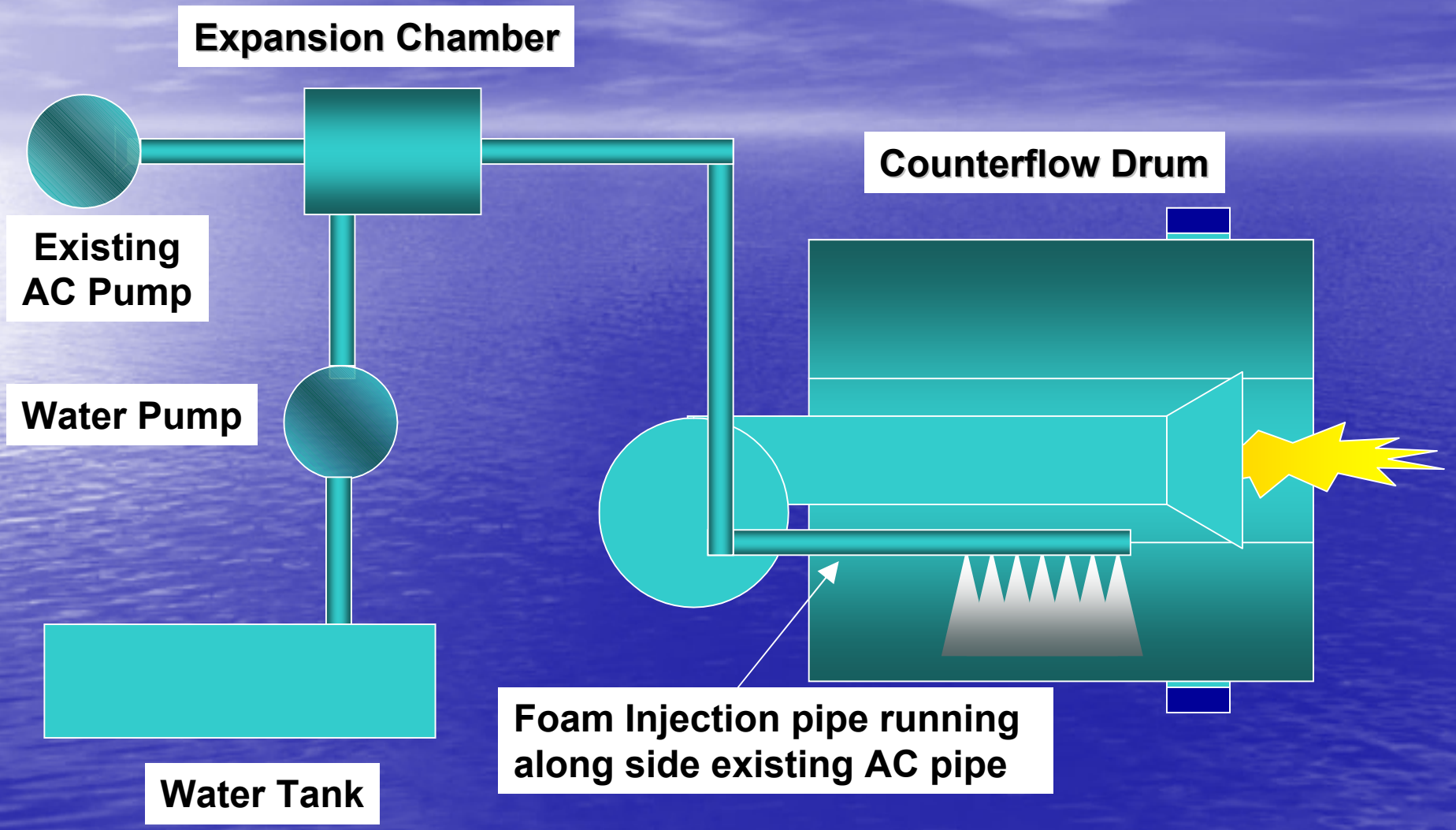
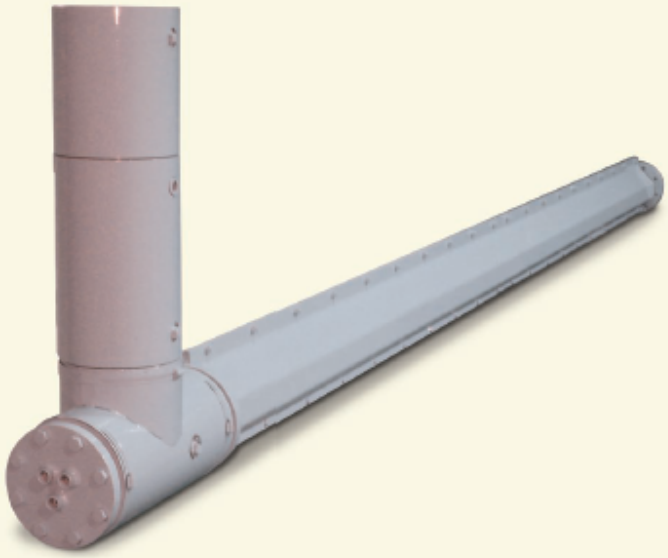
Terex Foam Warm Mix Process



TEREX®

WARM MIX ASPHALT SYSTEM

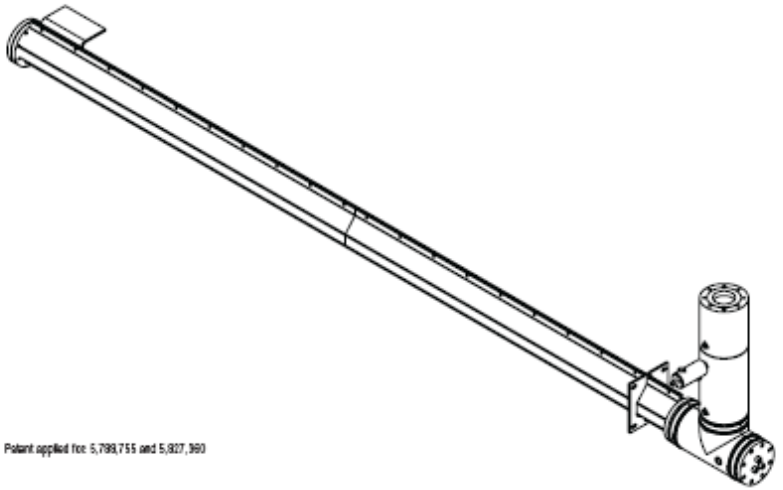


WARM MIX ASPHALT SYSTEM

Features:

- Reduces mix temperatures by up to 90° F without costly additives
- Uses Terex patented, field-proven foamed asphalt technology, originally pioneered in 1998
- Single expansion chamber ensures consistent AC/water mix at any production rate
- Produces foamed asphalt just outside of the drum and immediately injects it into the drum's mixing chamber, evenly coating the aggregate
- No moving parts (except water pump and meter)
- Fits any unitized counterflow mixing drum
- Fast easy installation into existing drum
- Complete kit requires only jacketed AC and water feed pipes to be customer-supplied
- Complete AC system is hot oil jacketed
- Patent pending

Warm Mix Asphalt System



Patent applied for: 5,799,755 and 5,927,360

Components
PLC control system to accurately control water injection and foam production • The display shows water flow rate as both GPM and TPH
Water skid includes tank, filter, 5 hp (3.73 kW) variable-frequency motor driving positive displacement water pump, high-accuracy water meter and calibration valve
Three-way, jacketed, electrically actuated AC valve
Asphalt and water check valves to prevent reverse flow of AC and water
Patented foam expansion chamber
Inject tube with multiple nozzles, adjustable for specific drum designs • Existing AC inject pipe is retained for "hot mix" production

Requires the following customer-supplied components/connections
Data to/from existing controls
Analog input providing accurate AC tons per hour • 0–10 VDC or 4–20 ma • Customer will need to supply loop power for this output also
Digital input to start/stop • 115 VAC • Input needs to be timed to "ON" when the AC needs to hit the drum mixing chamber • Input needs to be "OFF" when the AC is "re-circulating" • Input needs to be "OFF" when AC is in "suck back" mode • Two contacts provided on the PLC digital input card (No need to isolate with a relay)
Digital outputs • Water running • Water fault • Digital outputs are isolated hard contacts so customers can supply any input source they choose for feedback

Terex Roadbuilding
P.O. Box 1985, Oklahoma City, OK 73101
(405) 787.6020 1-888-TEREXRB
www.terexrb.com

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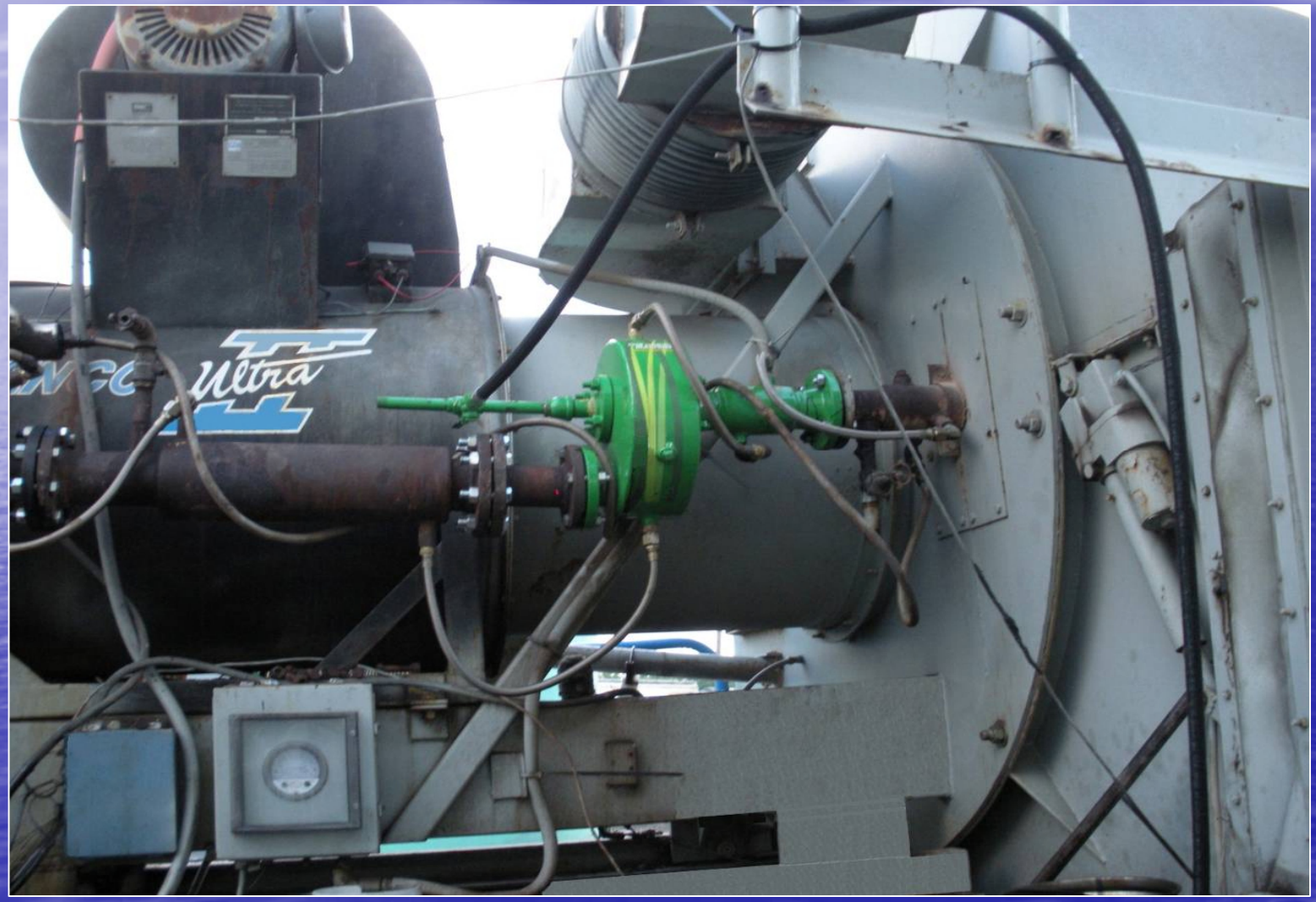
Gencor System



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Gencor Installation

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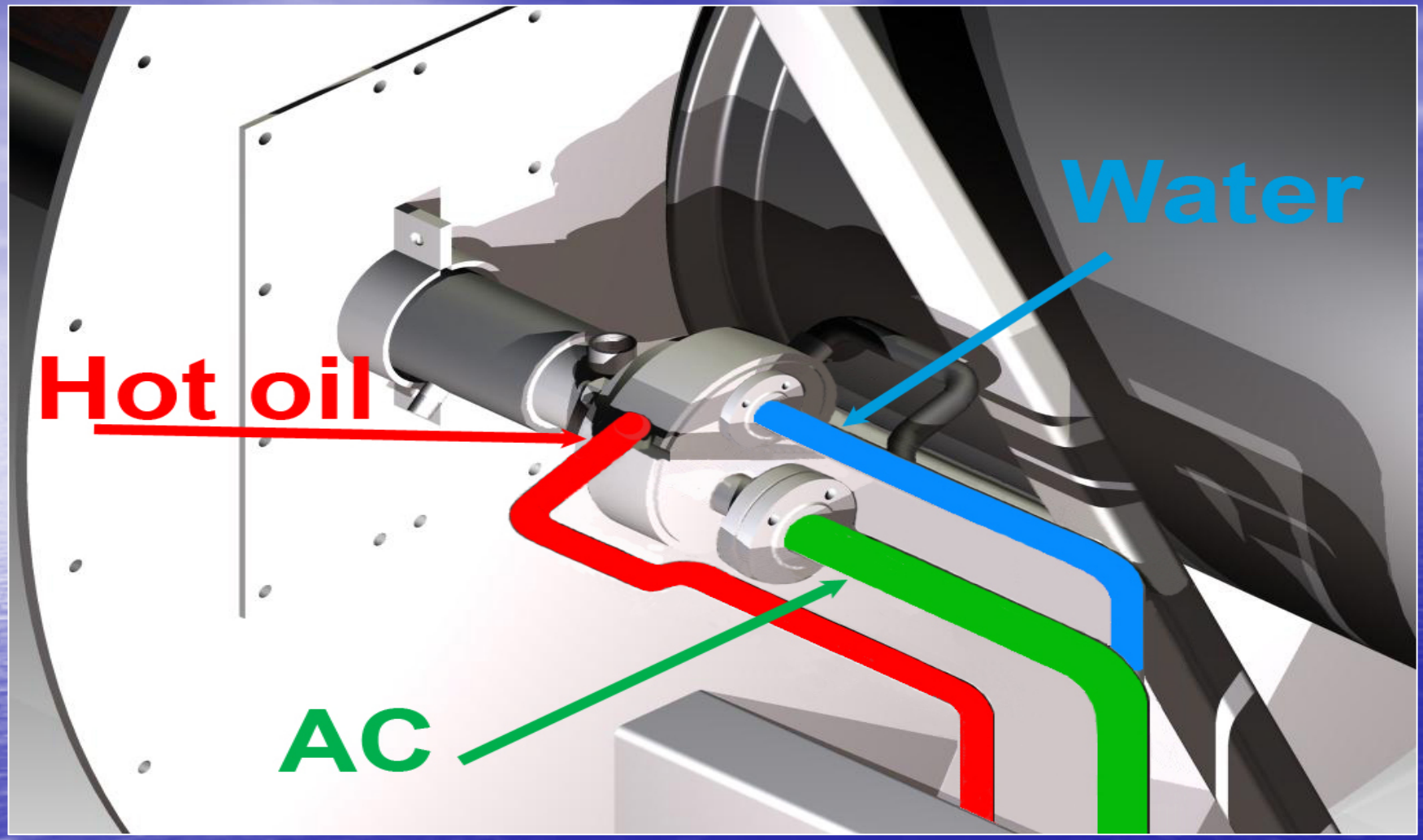

GENCOR GREEN

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REGARDLESS OF METHOD FOAMED ASPHALT:

- ALLOWS COATING AT LOWER TEMPERATURES
- LOWERS OXIDATION OF BINDER
- CAN IMPROVE COMPACTABILITY
- REDUCES FUMES.

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FOAMED ASPHALT MAY HELP REDUCE ABSORPTION

FOAMED ASPHALT
Little Smoke – Little Smell…Why?

- Light oils are either put in asphalt or left in asphalt during refining
- These light oils boil above 285°F
- By mixing at below 285°F, the boiling point is never reached…eliminating smoke (vapor) and corresponding smell!!

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CONVENTIONAL
HOT MIX
WARM MIX

HMA

WMA

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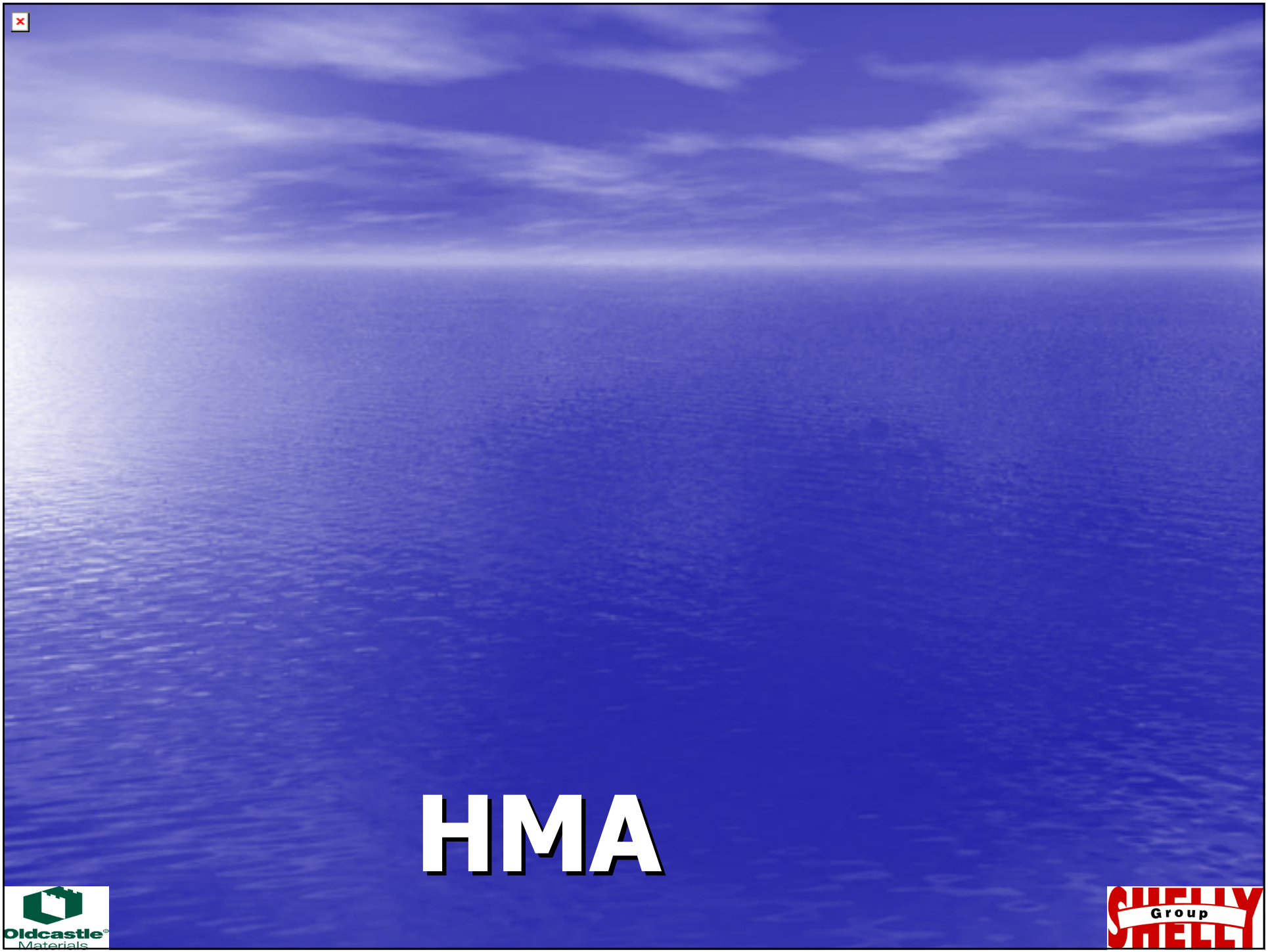
HMA
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WMA


HMA - 315° F
WMA - 265° F

High Percentage Recycle Mix with Standard Grade of Asphalt

RAP AND WMA GO HAND IN HAND!

- PLANT RUNS BETTER WITH RAP
- LESS OXIDATION AT LOWER TEMPERATURES
- USE OF STANDARD BINDER

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High Percentage Recycle Mix with Standard Grade of Asphalt

By using a standard liquid 64-22, you produce a much softer product than with virgin mix due to:

- Lower temperature results in less oxidation
- Light oil remains in liquid.

FOAMED ASPHALT-GREEN?

- Use less fuel due to 50°F lower temperature
- No volatiles
- Use more recycle
- Some lower emissions

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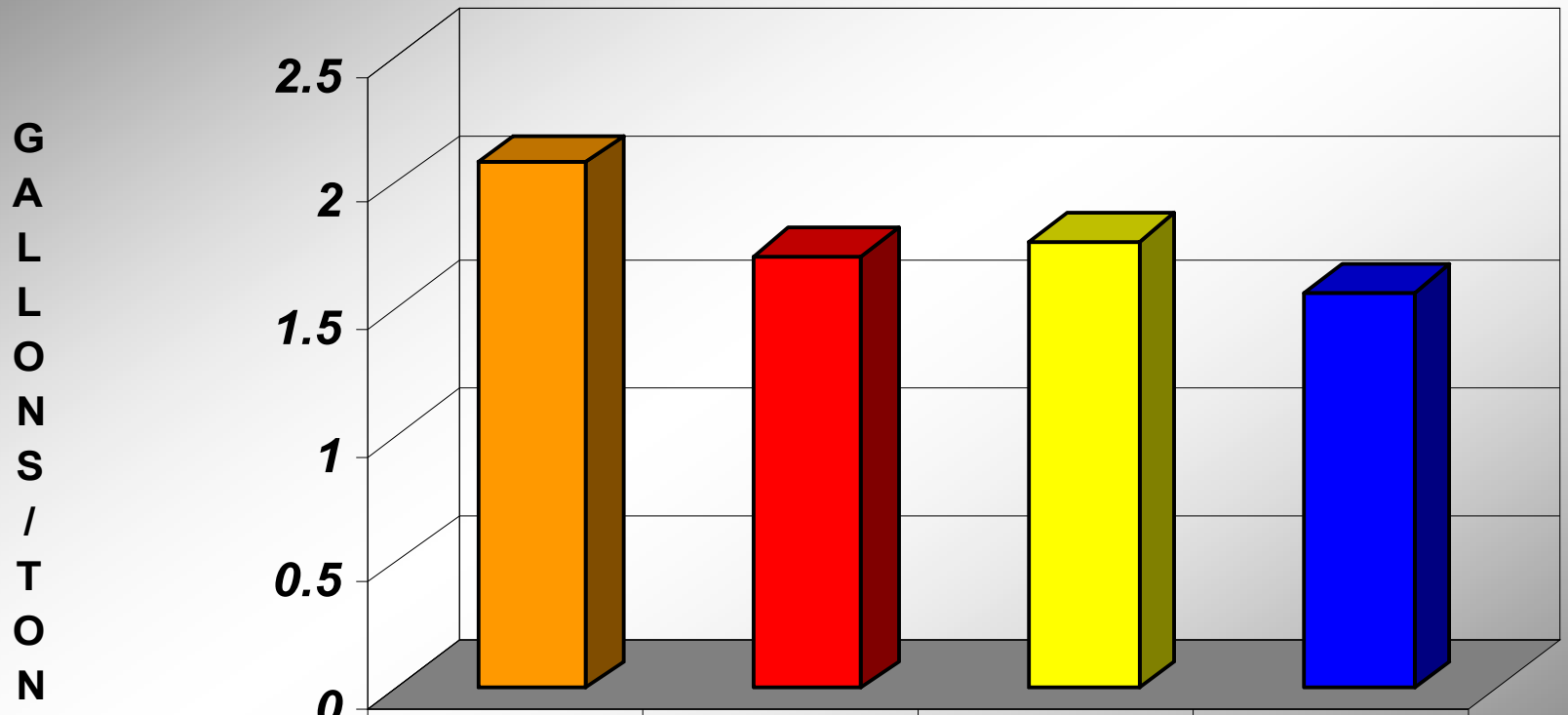
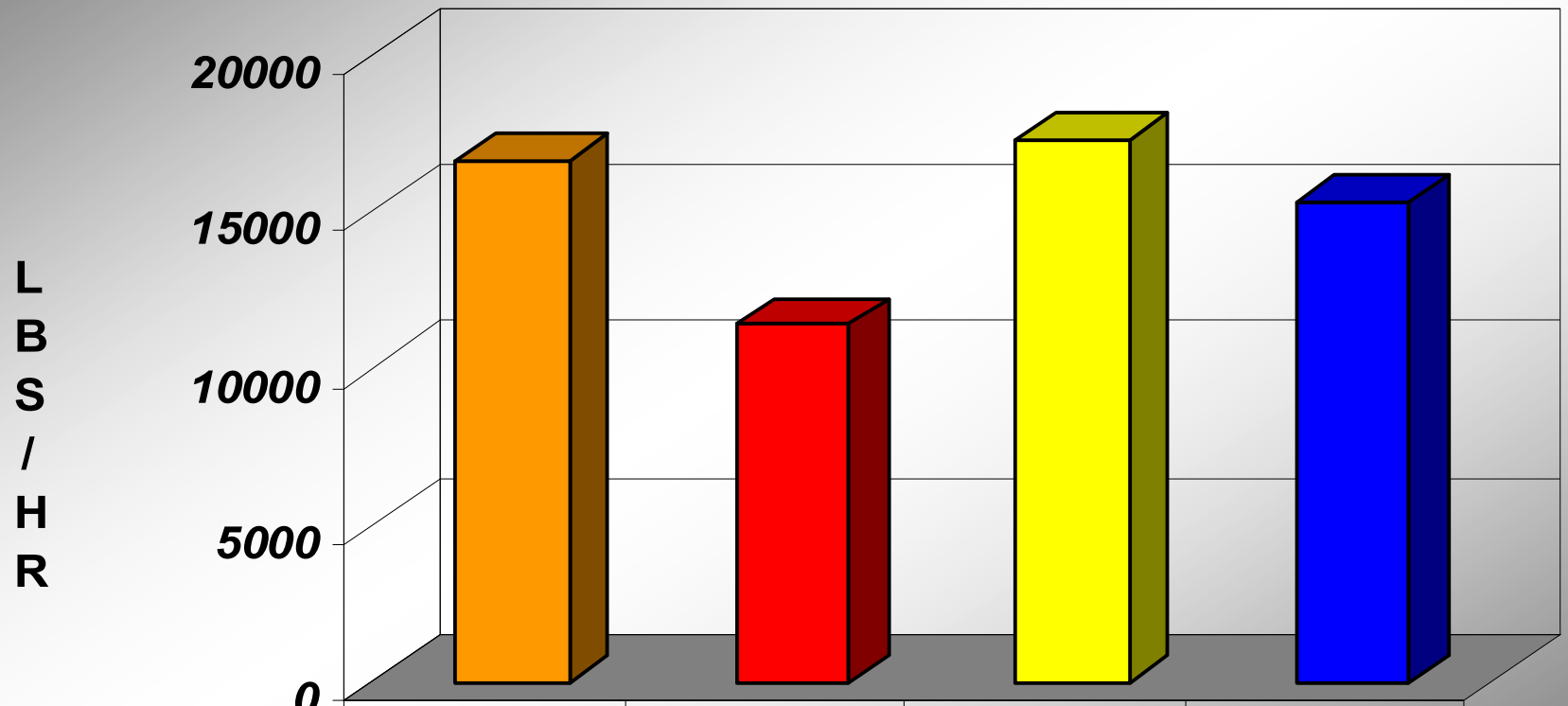
GALLONS PER TON USED OIL



	T-1 HMA Fuel	T-1 WMA Fuel	T-2 HMA Fuel	T-2 WMA Fuel
GALLONS PER TON	2.08	1.71	1.77	1.57

CO2 AVE LBS/HR



	T-1 HMA CO2	T-1 WMA CO2	T-2 HMA CO2	T-2 WMA CO2
CO2 AVE LBS/HR	16599	11378	17258	15253

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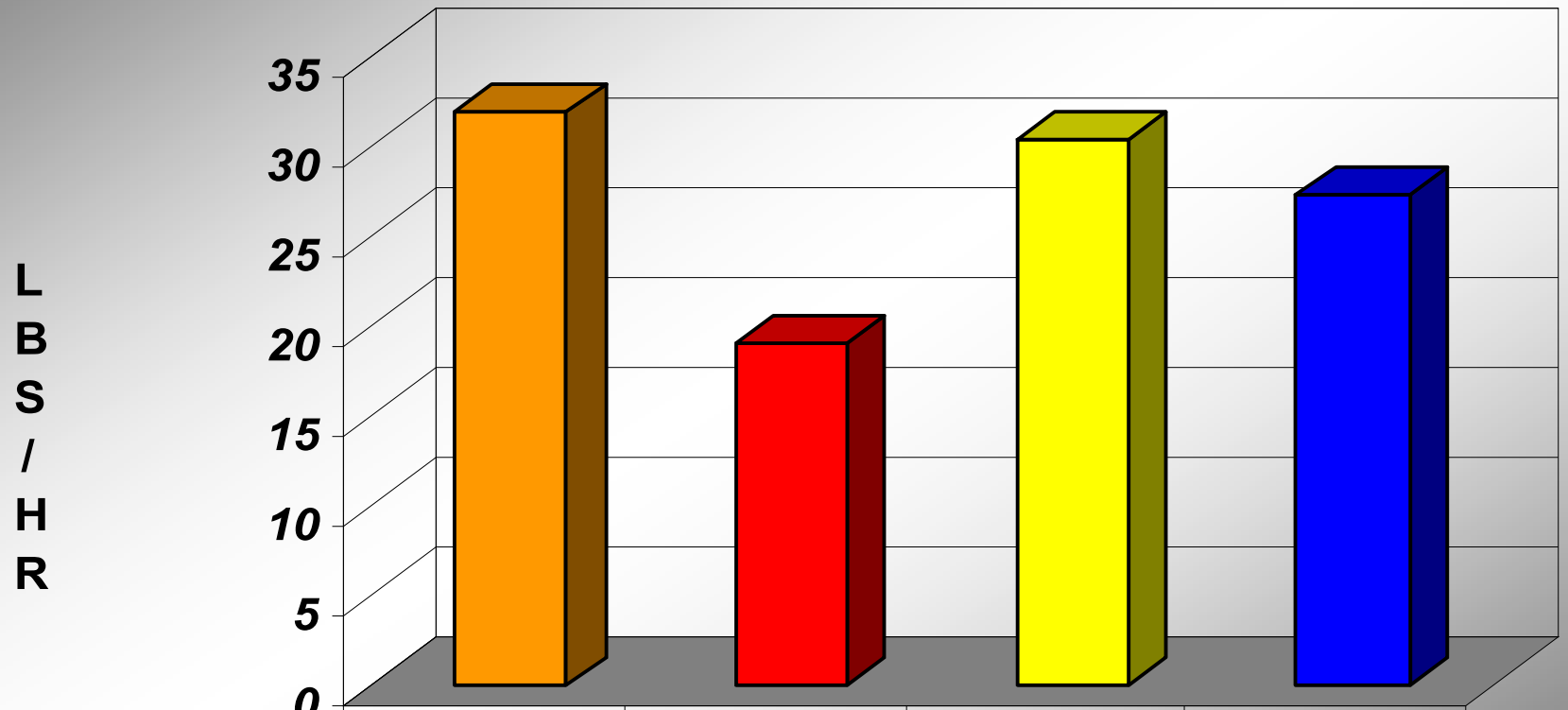
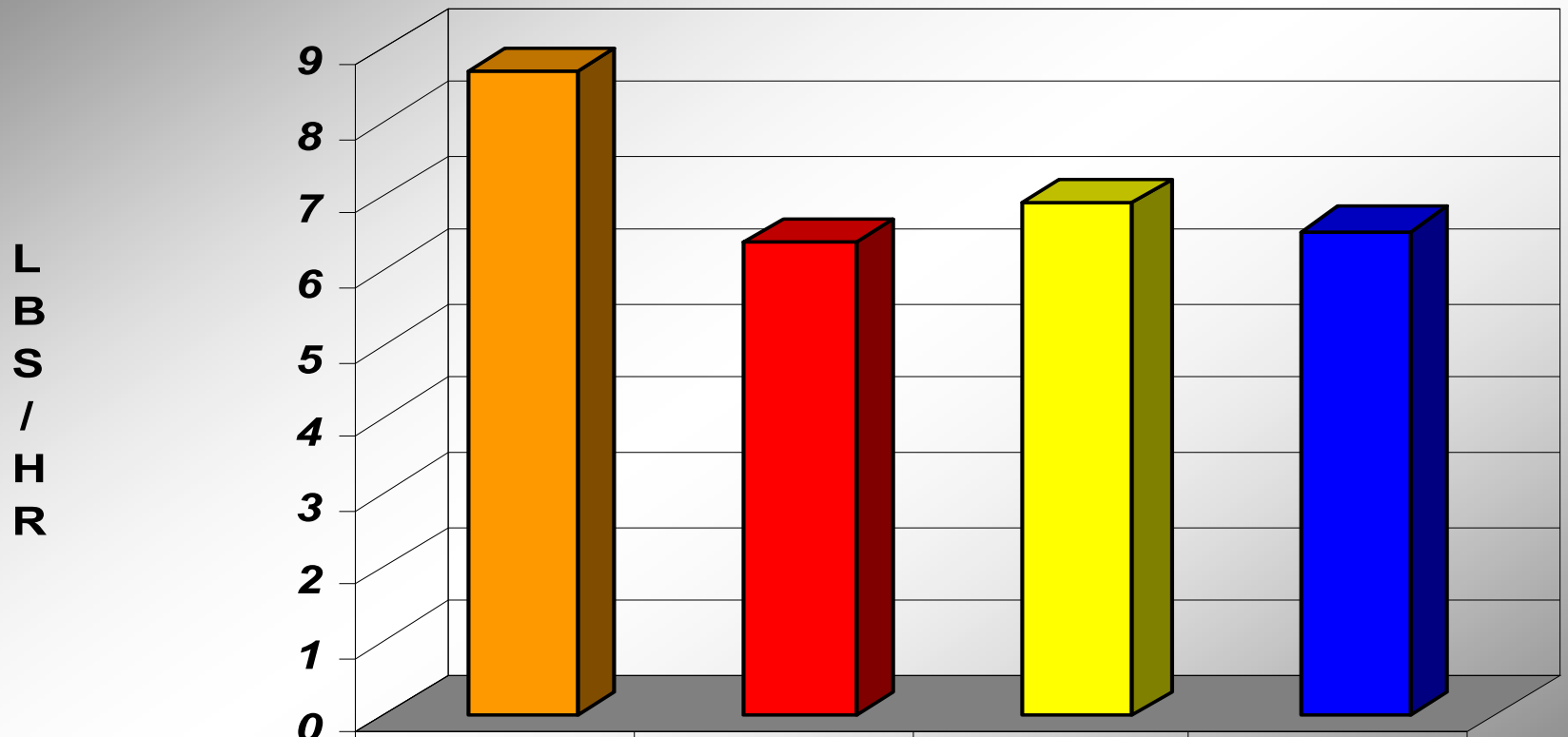
NOx AVE LBS/HR



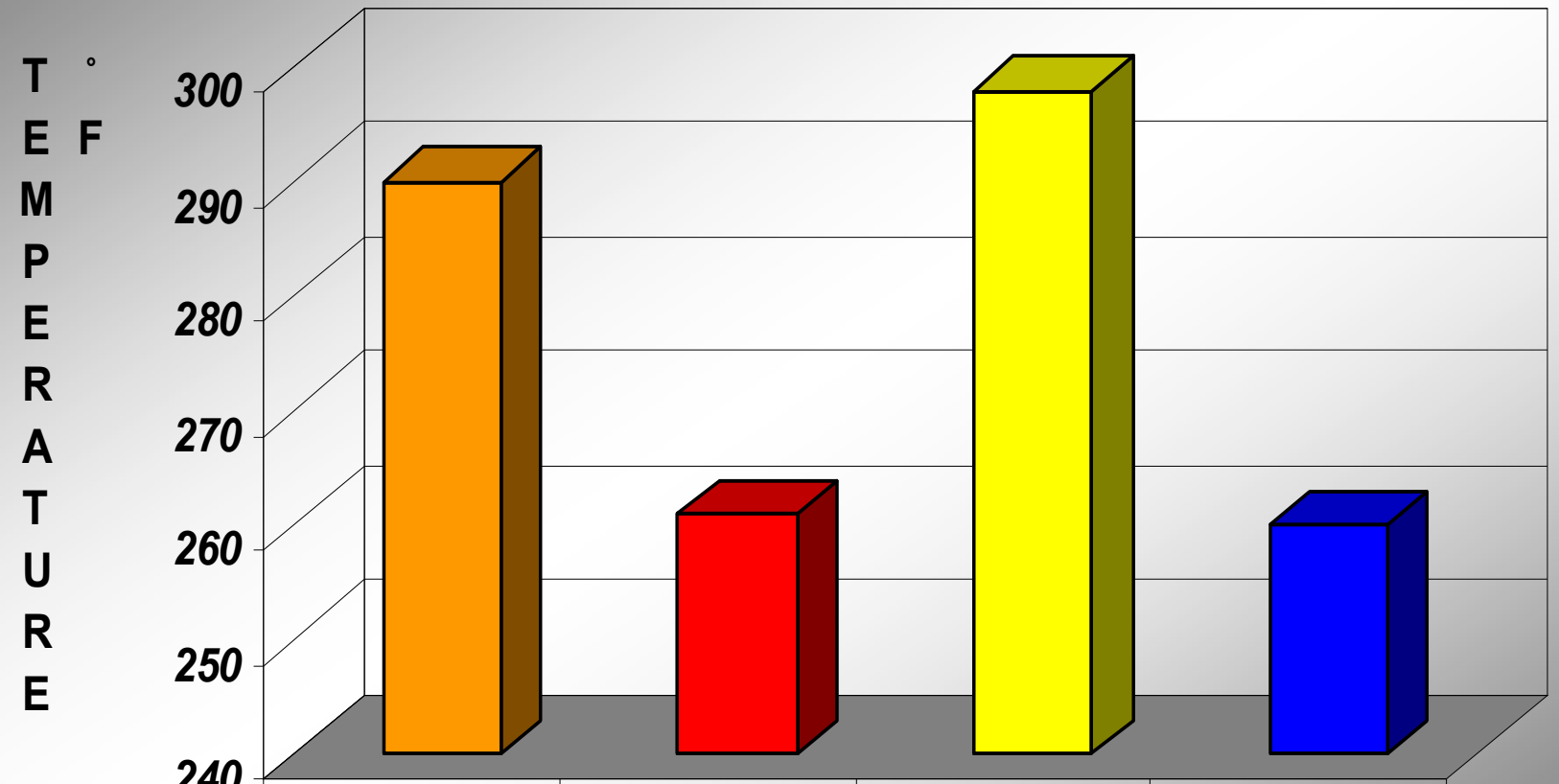
	T-1 HMA NOx	T-1 WMA NOx	T-2 HMA NOx	T-2 WMA NOx
NOx AVE LBS/HR	31.97	19.1	30.46	27.33

VOC AVE LBS/HR



	T-1 HMA VOC	T-1 WMA VOC	T-2 HMA VOC	T-2 WMA VOC
VOC AVE LBS/HR	8.7	6.39	6.92	6.54

AVERAGE MIX TEMPERATURE



	T-1 HMA Temperature	T-1 WMA Temperature	T-2 HMA Temperature	T-2 WMA Temperature
AVE MIX TEMP	290	261	298	260

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CARBON FOOTPRINT

A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.

The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of ton (or kg) of carbon dioxide equivalent.

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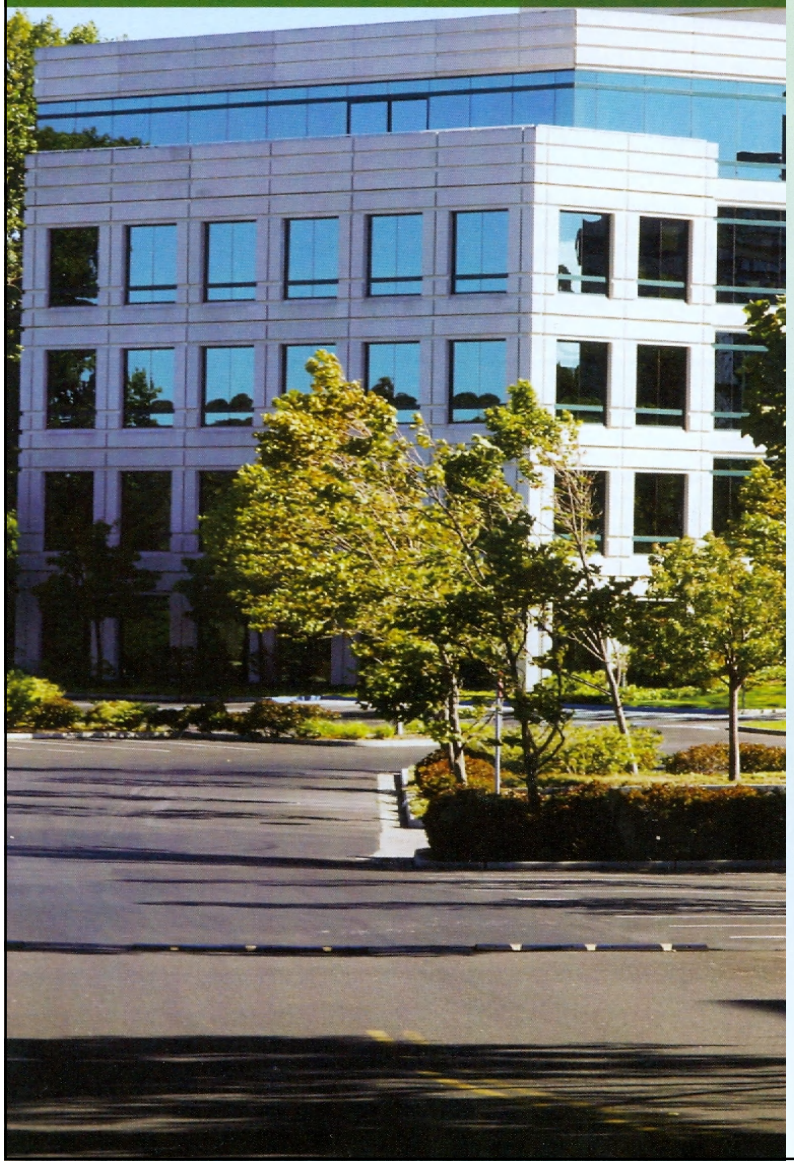
Asphalt Pavements and the LEED Green Building System



LEED® Credits: Green Asphalt

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs[1]." Sustainable development, which includes green construction practices, tries to balance the needs of people, nature, and the economy.

Opportunities to recycle, manage stormwater, mitigate urban heat island (UHI) effects, and save energy provide great potential for sustainability. There are several rating programs used to evaluate a building or construction project's environmental performance. The most prevalent system is the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED).

How asphalt works for green construction:

- ✓ Asphalt can help with stormwater management.
- ✓ Asphalt is America's most recycled material.
- ✓ Asphalt can help to reduce the urban heat island effect.
- ✓ Asphalt pavement is manufactured locally.
- ✓ Asphalt is the long-lasting pavement.
- ✓ Asphalt innovations reduce fuel consumption and carbon emissions.

More About LEED®

The LEED Green Building Rating System™ serves as a benchmark or scorecard for the design, construction, and operation of green buildings. It was designed to encourage the adoption of sustainable building and development practices.

POROUS ASPHALT STREET IN FRONT OF A LEED PLATINUM MODEL HOME

High-RAP Pavements

The incorporation of high percentages of RAP (reclaimed asphalt pavement), above the 10 to 15 percent typically used, is highly beneficial for green construction. An ID point should be awarded for incorporating higher than 20 percent RAP in a pavement

Score Card

The concepts discussed in this brochure are valid for all of the LEED rating systems which relate to pavement. The actual credits and numbers of points vary from one system to another.

The Materials and Resources (MR) credits can be strongly influenced by the selection of asphalt pavement, but are also dependent on other factors in the project. Some credits are dependent upon the existing portion of the site paved with asphalt and the portion of the pavement to be removed. The use of warm-mix asphalt offers attractive opportunities for Innovation and Design credits.

How Asphalt Earns LEED Credits

Rating Category	Credit Description	Pavement Type	Credits
SS Credit 6.1	Stormwater Design: Quantity Control	Porous Asphalt	1
SS Credit 6.2	Stormwater Design: Quality Control	Porous Asphalt	1
SS Credit 7.X	Heat Island Effect: Non-Roof	Reflective surfaces Open-graded asphalt Porous pavements	1 to 3
MR Credit 2.X	Construction Waste Management: Divert from Disposal (based on weight/volume)	RAP	1 to 2
ID Credit 1.X	Exceptional Performance Exceeding Expectations or Areas Not Addressed	Warm-mix asphalt High-RAP mixes	1 to 4

INTEGRATING ENVIRONMENTAL and TRANSPORTATION INFRASTRUCTURE OBJECTIVES through PARTNERSHIPS

ANNOUNCEMENT & INVITATION

Green Highways | Partnership Leadership Forum & Recognition Program

TRAILBLAZERS in SUSTAINABILITY

January 13, 2009
5:00 PM until 9:00 PM

Army Navy Club
on
Farragut Square
901 Seventeenth Street N.W.
Washington, D.C. 20006

COAT & TIE REQUIRED

RSVP
by
JANUARY 7, 2009

2009 GHP FORUM

The 2009 GHP Leadership Forum program will focus on legislative and policy issues surrounding green transportation infrastructure and continue with the presentation of opportunities and case studies associated with the development and implementation of sustainable transportation programs and practices at the DOT and community levels. The program will conclude with a keynote address on the role of innovation and technology by Dr. James Trefil of George Mason University.

PROGRAM

The Honorable David Wu
Chairman
Subcommittee on Technology and Innovation
Committee on Science & Technology
U.S. House of Representatives

"Green Transportation Infrastructure –
Role of Technology, Innovation, and Collaboration"

Dr. Stephen Van Beek, PhD
President & CEO
Eno Foundation for Transportation Policy

"Climate Change, Sustainable Transportation & Economic Competitiveness"

Mr. Dan Tangherlini
City Administrator and Deputy Mayor
Office of the City Administrator, Washington, DC

"Green Transportation Infrastructure – The Key to Sustainable Communities"

Mr. David Loomes
Vice President, Commercial Services
Holcim, US, Inc.

Holcim Foundation for Sustainable Construction
Awarding Innovative, Future Oriented, Sustainable Design and Construction

Mr. Granville Martin
Vice President, Environmental Affairs
JPMorgan Chase

Green Infrastructure and the Financial Markets

Dr. James Trefil, PhD
Clarence J. Robinson Professor of Physics
George Mason University

Innovation and Technology as a Framework in Ecosystem Sustainability
A CASE FOR OPTIMISM

2009 GHP RECOGNITION PROGRAM

This year's GHP recognition program will honor individuals, agencies and organizations who have made, and continue to make, outstanding contributions to the purpose, intent and principles of the green highways partnership. The program will also recognize outstanding contributions to operational and organizational programs and practices, as well as, innovation in sustainable transportation technologies.

RSVP

Mooney.Donna@epamail.epa.gov
For Additional Information or Questions:

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WILL OUR PAVEMENTS PERFORM?

- Less oxidation of mix-for every 25 degree rise in temperature oxidation doubles!
- Better coating
- More uniformity of compaction

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CHALLENGES!

- Culture of paving crews
- Customer demands it-hotter is better
- Agency specifications
- Baghouse and drum flight concerns
- Low TSR results

ODOT draft specifications

ITEM 402 ASPHALT CONCRETE MIXING PLANTS

402.01 Description

402.02 General

402.03 Scales

402.04 Thermometers

402.05 Storage

402.06 Calibration

402.07 Computerized Plant System

402.08 Polymer Binders

402.09 Water Injection System for Warm Mix Asphalt

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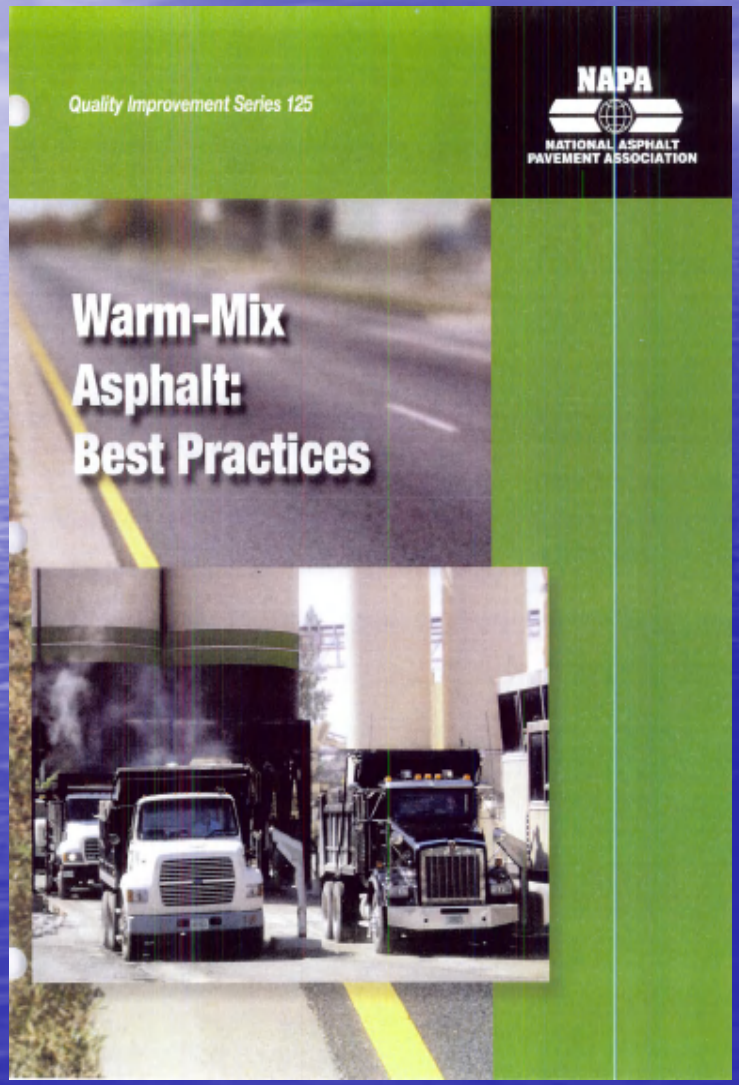
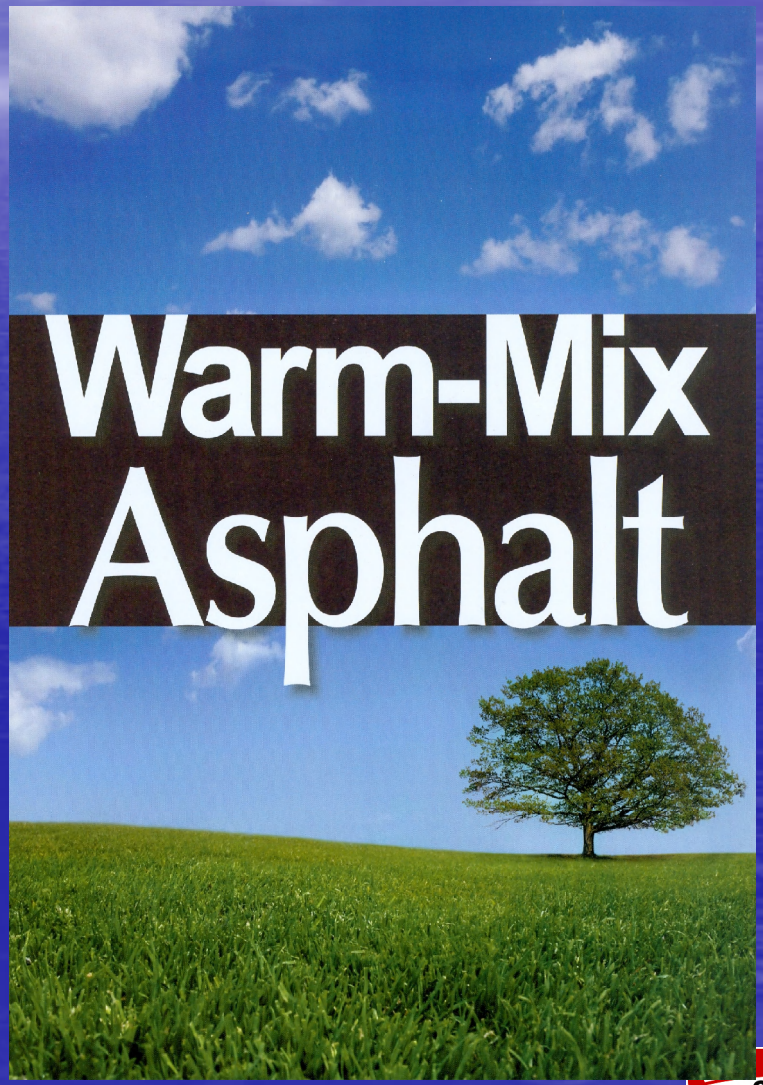
- **402.09 Water Injection System for Warm Mix Asphalt.**
- When allowed by specification use an approved water injection system for the purpose of foaming the asphalt binder and lowering the mixture temperature. Only use equipment that has been proven stable and effective thru project use on non-ODOT projects. Ensure the water injection never exceeds 1.8% by weight of asphalt binder.
- Ensure equipment for water injection meets the following requirements:
- Injection equipment computer controls are in the plant control room and are tied to the plant computer metering.
- Injection equipment has variable water injection control controlled by the plant operation rate.
- Water injection rate cannot be manually overridden by the plant operator once in the computer.
- Injection equipment stops water flow when a control or equipment failure in the injection system occurs.
- The water injects into the asphalt binder flow before the asphalt binder spray hits aggregate. Do not allow water to touch aggregate before the binder spray.
- Injection equipment includes water storage and pump control tied to the injection computer controls.
- Water storage low water alarm in the control room.
- Provide a PG binder sampling valve between the last piping tee on the tank side of the line and the injection equipment.to sample PG binder before water is injected.
- Provide a PG Binder sampling valve at the injection equipment to sample binder prior to spray.

SOURCES OF INFORMATION





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A CONTRACTOR'S PERSPECTIVE ON FOAMED WMA

SUMMARY

- Simple
- Lowers mix temperature
- Increases binder volume
- Helps with coating
- Helps with compaction
- Lower emissions-plant & road
- Reduces oxidation
- **IS GREEN!!**

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THANK YOU TO THE FOLLOWING COMPANIES FOR USE OF PHOTOS AND DRAWINGS

ASTEC INDUSTRIES

TEREX

GENCOR

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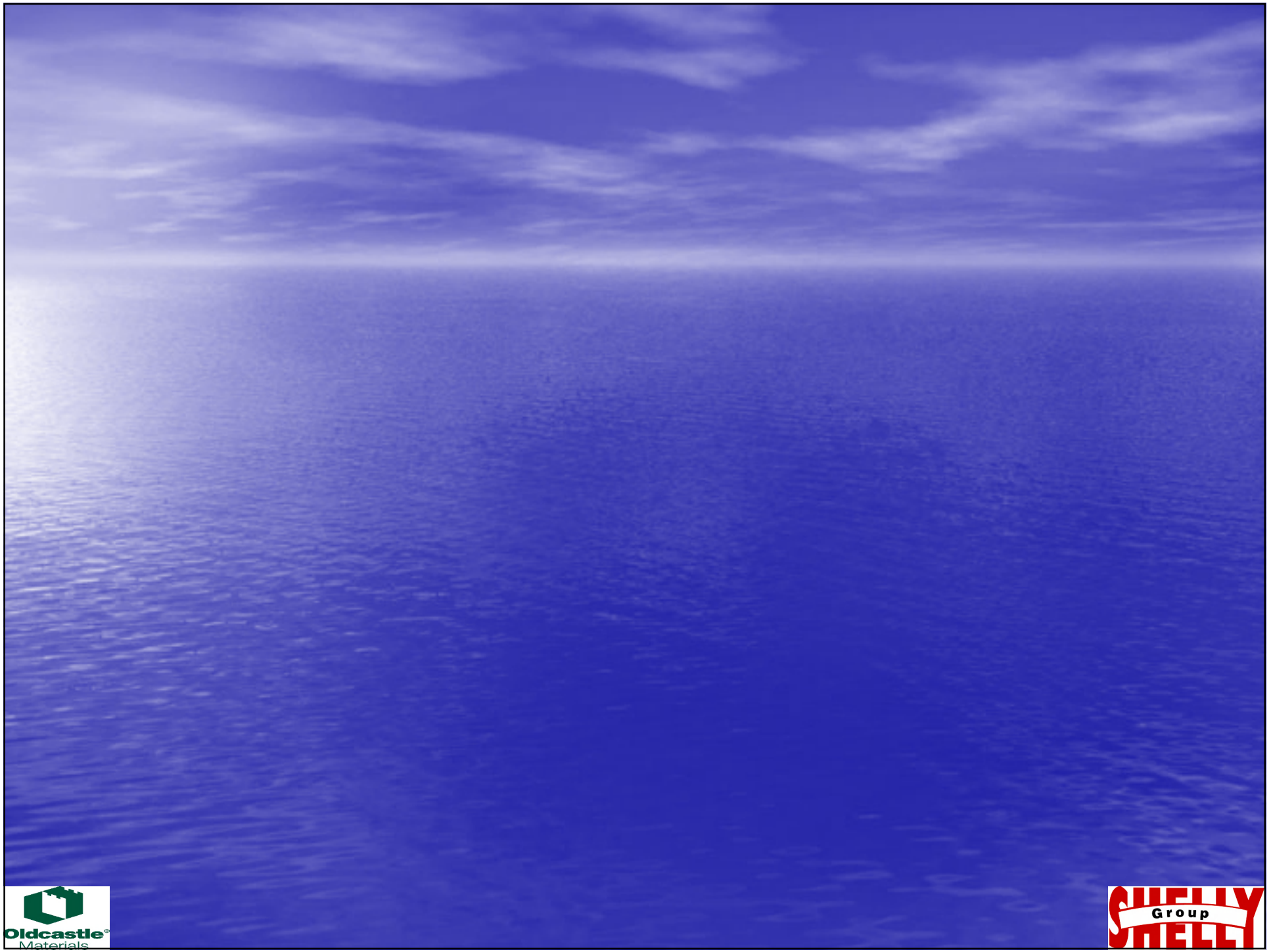
QUESTIONS?
2007 9 26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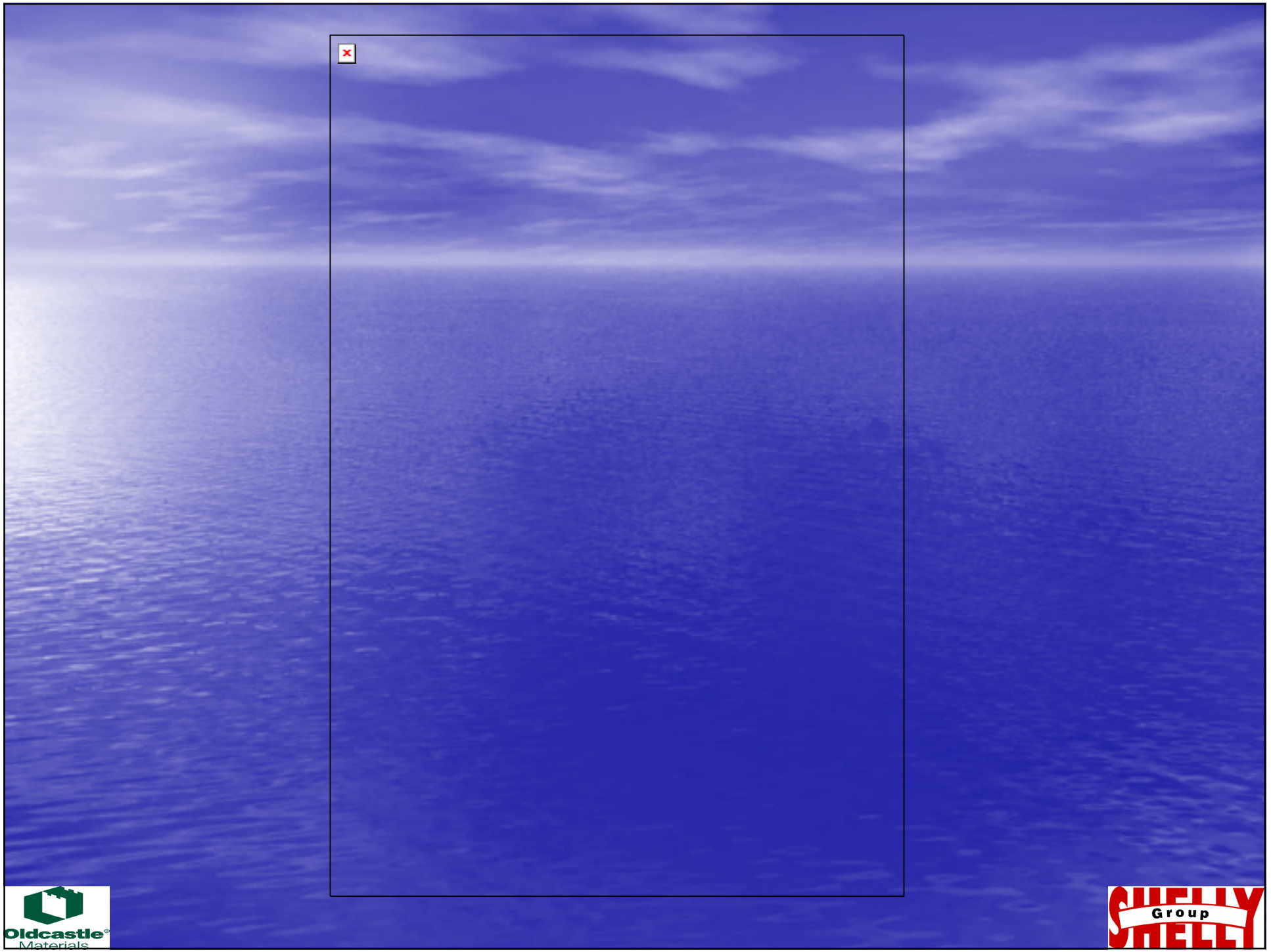

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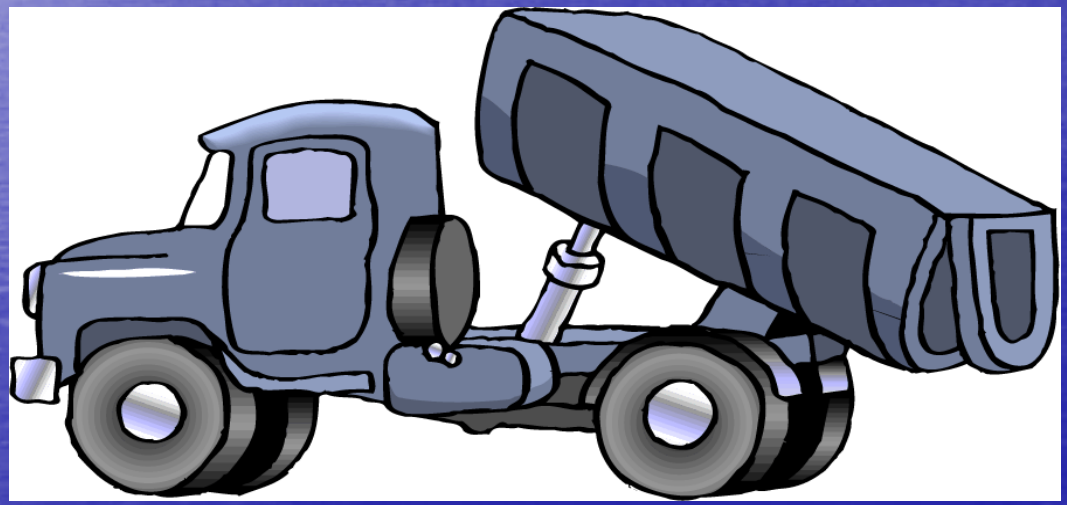
TRANSPORTING THE MIX IS NOT A PROBLEM IF IT IS COATED AND HEATED



FOAMED ASPHALT MAY BE THE STANDARD OF THE INDUSTRY OVER TIME

- PROGRESS IN OTHER STATES SUGGESTS THE EVOLUTION OF WMA HAS OCCURRED
- BENEFITS OF ENERGY SAVINGS, BETTER COMPACTION, ABILTYTO HAUL LONGER DISTANCES, AND ABILITY TO EXTEND PAVING SEASON WILL DRIVE WMA IMPLEMENTATION
- ENVIRONMENTAL BENEFITS OF WMA SHOULD BE CONSIDERED AS EQUALLY

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