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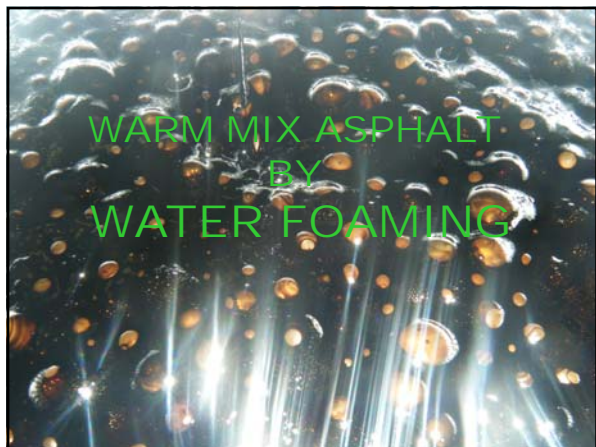
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**WMA BY WATER FOAM HAS  
A LARGE AND GROWING TRACK RECORD.  
(ASTEC DOUBLE BARREL GREEN SYSTEM ONLY)**

**– Numerous Projects and Demos**

<ul style="list-style-type: none"><li>• North Carolina</li><li>• New York</li><li>• Maine</li><li>• South Carolina</li><li>• Tennessee</li><li>• Alabama</li><li>• Texas</li><li>• Arkansas</li><li>• California</li><li>• Kentucky</li><li>• British Columbia</li><li>• France</li><li>• Russia</li><li>• Columbia</li><li>• New Mexico</li><li>• Delaware</li><li>• Cuba</li><li>• Australia</li></ul>	<ul style="list-style-type: none"><li>• Ontario</li><li>• Alberta</li><li>• Ohio</li><li>• Illinois</li><li>• Maryland</li><li>• Louisiana</li><li>• Florida</li><li>• Massachusetts</li><li>• Sweden</li><li>• Mississippi</li><li>• New Zealand</li><li>• Korea</li><li>• South Africa</li><li>• Kazakhstan</li></ul>
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**Approaching 400 units ... Millions of Tons... Worldwide**

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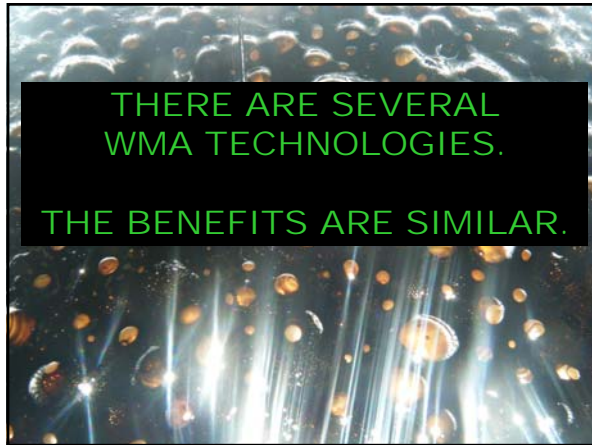
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**THERE ARE SEVERAL  
WMA TECHNOLOGIES.**

**THE BENEFITS ARE SIMILAR.**

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**IT'S GREEN!**

- 14% LESS CO<sub>2</sub> EMISSIONS
- REDUCED VOC EMISSION

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### Reduced Emissions

Volatile Organic Compounds (VOC)\*

Mix Temperature (°F)	Load-out Emissions (lb/yr)	Silo-filling Emissions (lb/yr)	% Reduction
325	2346	7312	
<b>275</b>	<b>669</b>	<b>2084</b>	<b>71.5</b>
<b>260</b>	<b>459</b>	<b>1430</b>	<b>80.4</b>

\* Based upon a plant producing mix at 400TPH with a total yearly production of 600,000 tons

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**PRODUCES BETTER PAVEMENT.**

- LESS OXIDATION OF MIX
- BETTER COMPACTION

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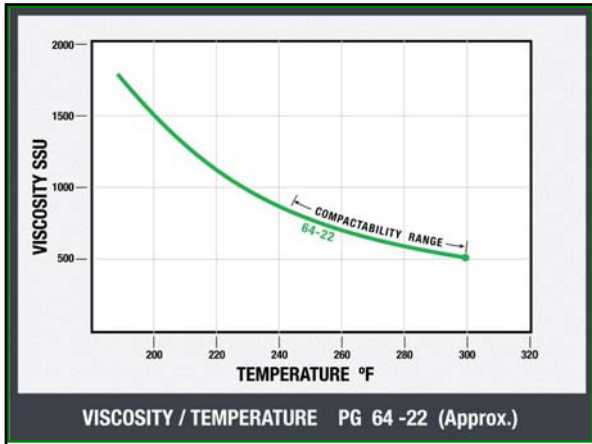
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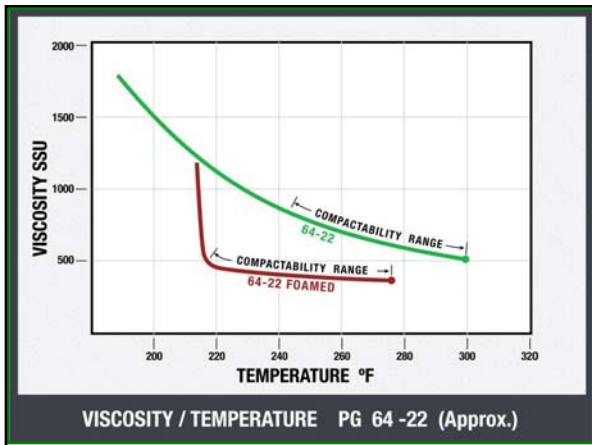
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**\$ IT'S GREEN! \$**

- USES 14% LESS FUEL
- AIDS COMPACTION



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**WATER FOAM WMA  
ADDITIVE COST ADVANTAGE**

**¼ ¢/TON ADDITIVE COST**

**5 ¢ PER TRUCK LOAD**

**\$1 FOR EVERY 400 TONS**

BASED ON 0.0785 \$/FT<sup>3</sup> WATER INCLUDING SEWAGE FEE

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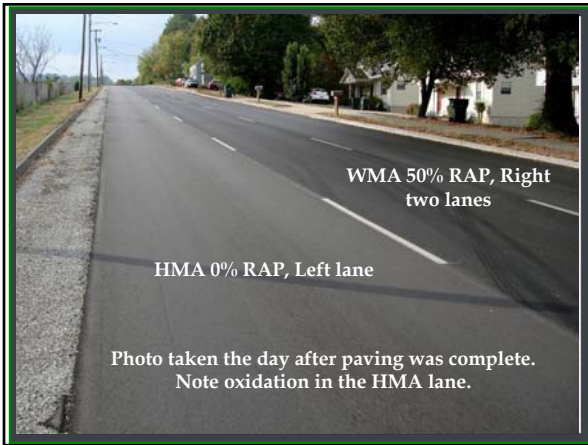
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**Main Questions That are Asked**

**How much water?**

**Where does it go?**

**What about mix performance?**

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### ASTECC FOAMED ASPHALT

How much water is injected ?  
2% by weight of virgin binder

Assuming 5%AC per ton, water injected per ton would be:

2 lb  
30.7 fluid oz.  
0.91 liters

How much water remains in the mix?



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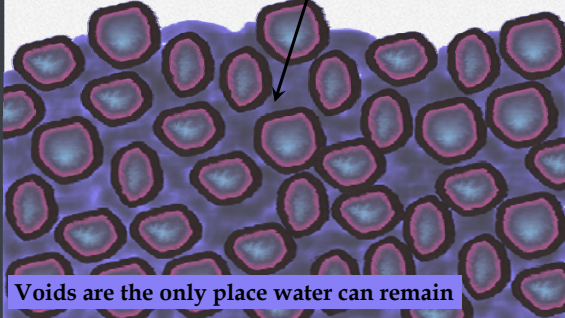
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### Uncompacted Mix:

Voids at about 25%

Voids are filled with steam at mix temperature



Voids are the only place water can remain

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### Compacted Mix:

Voids at about 5%

Voids are still filled with steam at mix temperature, but the void volume has been reduced.



Voids are the only place water can remain

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**BEFORE COMPACTION**  
25% of void space, each ton can hold....



0.149 lb  
2.3 fluid oz.  
0.068 liters

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**AFTER COMPACTION**  
5% of void space, each ton can hold....



0.0234 lb  
0.359 fluid oz.  
0.011 liters

**0.00117% of mix**

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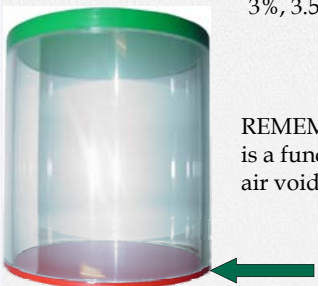
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**MORE WATER DOESN'T AFFECT RETENTION.**

**What if we inject more water?**  
3%, 3.5%, 4% of the liquid AC?



REMEMBER: Water retained is a function of the volume of air voids in the mix.

**Still 0.00117%**

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**How much retained water (internal moisture) is typically allowed per mix ton?**



0.5% or 10 lb is typical  
(total of all five containers)



0.00117% added during  
Green System Foaming

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**Technology Demonstration Test Results:**  
Nashville Area, September 2007, Limestone

▪ Advera WMA	▪ Sasobit	▪ Evotherm	▪ Astec Green System
▪ 1150 Tons Placed	▪ 705 Tons Placed	▪ 750 Tons Placed	▪ 775 Tons Placed
▪ % AC 5.16 & 5.28	▪ % AC 5.14	▪ % AC 5.22 & 5.36	▪ % AC 5.19 & 5.29
▪ % Air Voids 4.7	▪ % Air Voids 3.5	▪ % Air Voids 5.1	▪ % Air Voids 4.0
▪ Stability 1475	▪ Stability 1825	▪ Stability 1455	▪ Stability 2200
▪ TSR 51.9%	▪ TSR 65.5%	▪ TSR 72.7%	▪ TSR 84.3%
▪ Density 92.7%	▪ Density 91.0%	▪ Density 91.0%	▪ Density 91.6%

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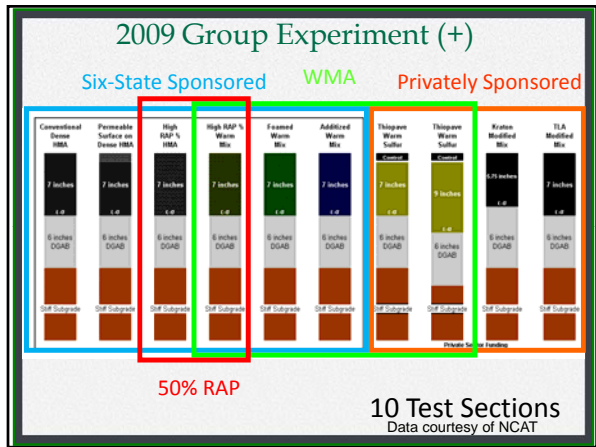
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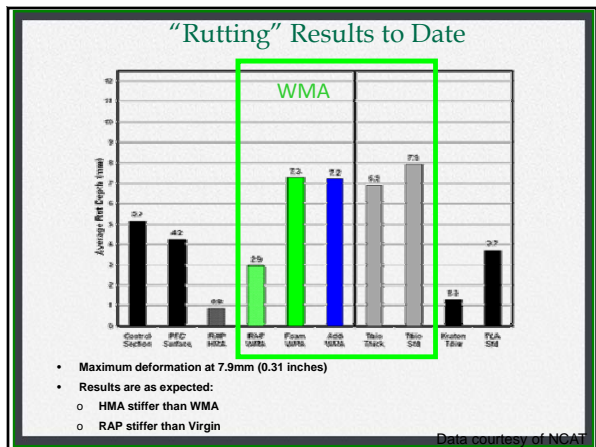
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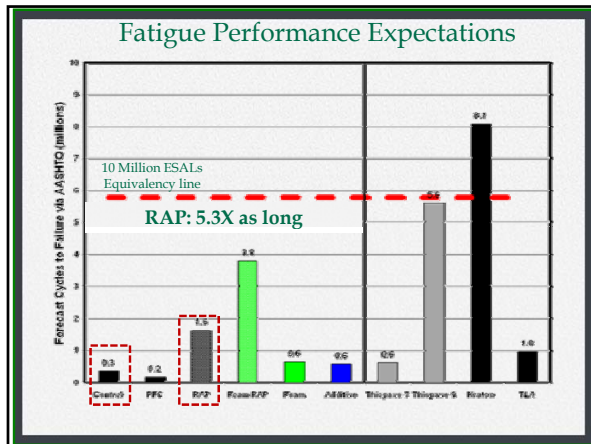
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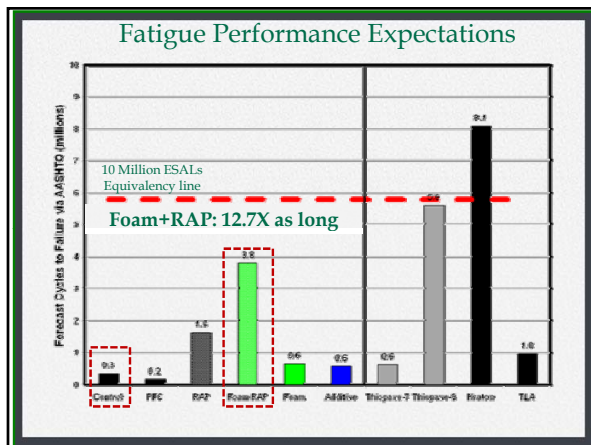
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**If some of the water remains in the mix, won't I show a high AC content?**

NO

- A small amount of water remains in the mix after compaction
- Theoretically, this could show up as AC content.
- Maximum of 0.00117% of the water remains (virgin mix)
- Beyond the measurement accuracy of AC content (typically reported to the nearest 0.1%).

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**Won't the baghouse temperature be too low when with the lower mix temperature?**

- Depends on a number of factors.
- Decreases BH temps about 35°F to 40°F (CF dryer) all other factors constant.
- Things go better with RAP

New ASTEC Stack Temperature Control System enables running all mixes without stack temperature problems.

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**Can coating be affected?**

Sometimes there is a positive effect. We have never see a negative effect.

- Good coating has been observed below 200°F
- Foam has significantly improved poor coating.

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**Do I have to do anything special to my binder?**

**NO.**

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**Won't I experience a drop in mix temperature since I am adding water?**

**NO.**

- Significant temperature drops during ordinary hauls in moderate weather is caused by **internal** moisture
- Internal moisture signs: steam and water at the silo tops, water running out of the truck beds, and a drop in mix temperature (27° F per 1/2%).
- Water remaining in the mix post compaction is 0.00117% (0.07° F drop)

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**Can I run water foamed mix at higher temperatures?**

**YES.**

- There is no danger in running the mix at higher temperatures.
- Mix simply remains workable for a longer period.

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### Can water foam WMA be stored?

YES.

- As long as the corresponding HMA may be stored
- First test was 24 hours then 48 hours
- Have stored as long as 4 days

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### Will rolling patterns change?

YES

- Generally, crews have been able to begin rolling immediately.
- At some locations, less rolling was required
- Experiment. Each situation is unique.

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### Is handwork different than that of HMA?

- Can be different depending upon the situation
- Cold day tight quarter handwork on base mixes have become difficult on a couple of jobs
- Straight pulls never an issue

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### Does WMA produced water foam look different?

- Can look the same as ordinary HMA minus smoke and smell
- Can look rich (especially virgin mixes) due to film thickness increase

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### Won't my water freeze when it gets cold?

- "Cold weather package" available through Astec Parts.
- Not meant for "winterizing".
- What about anti-freeze, chlorine or other additives? Don't do it. Clean water only.
- Some customers have had bad experiences with additives.

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HOW ASTEC DOES  
WATER FOAMED WMA  
  
(PROCESS - PATENTED)  
(EQUIPMENT - PATENT PENDING)

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### WHY MULTIPLE NOZZLES?

INSPITE OF THE FORGIVING NATURE OF THE WATER FOAMING METHOD, IT CAN BE DONE WRONG BY NOT FOAMING ALL OF THE AC.

MULTIPLE NOZZLES HELP ENSURE THAT ALL OF THE AC IS FOAMED.

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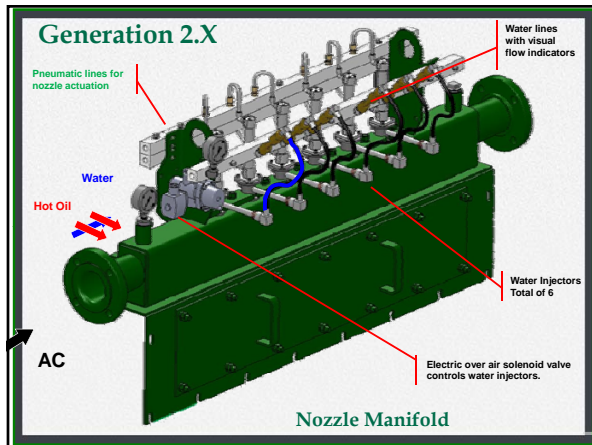
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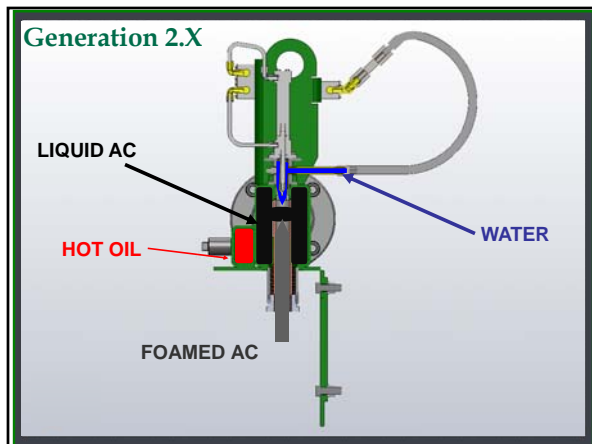
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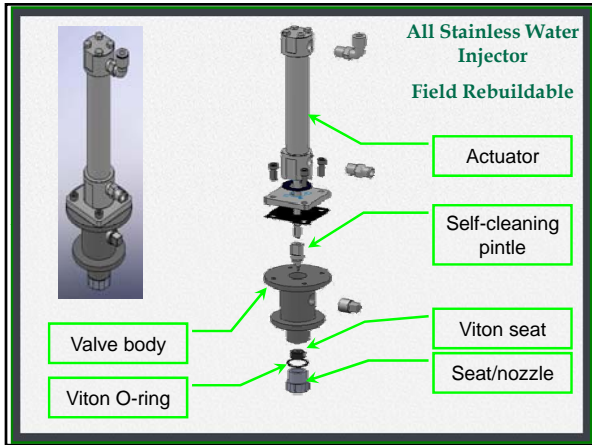
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### CONFIGURATIONS

- Generation 2.0 and 2.0s
  - Double Barrel (most common)
  - Double RAP
- Generation 2.6 and 2.6s
  - Double RAP
  - Double Drum
  - Drum mix coater
  - Parallel flow
  - Batch
  - Retrofit for other manufacturer's drums

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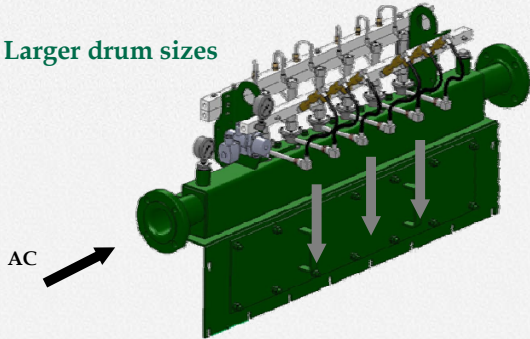
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### Generation 2.0

Larger drum sizes



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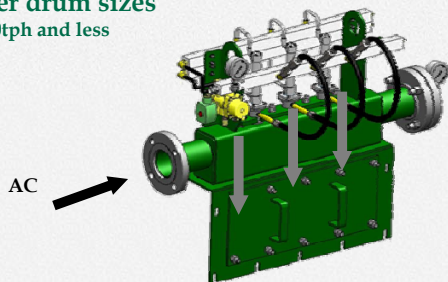
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### Generation 2.0s

Smaller drum sizes  
250tph and less



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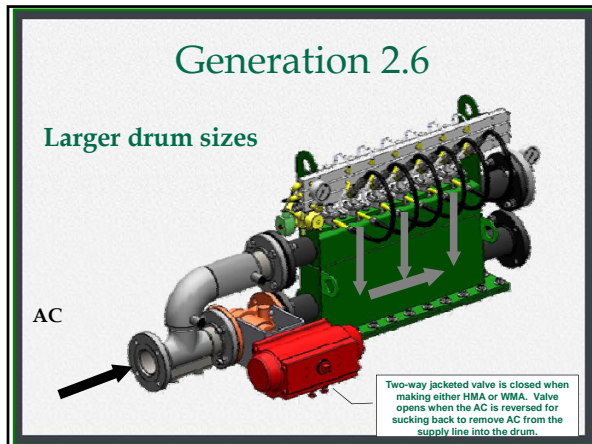
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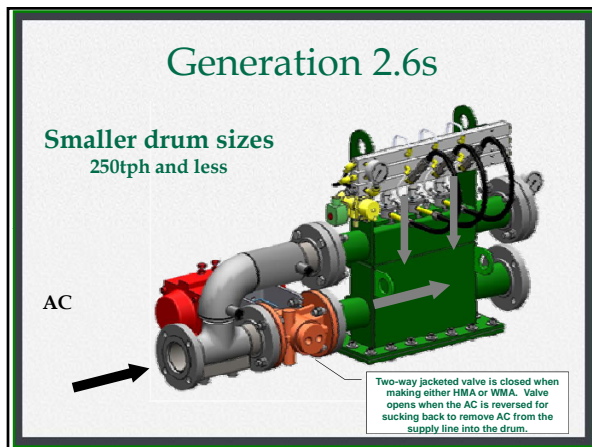
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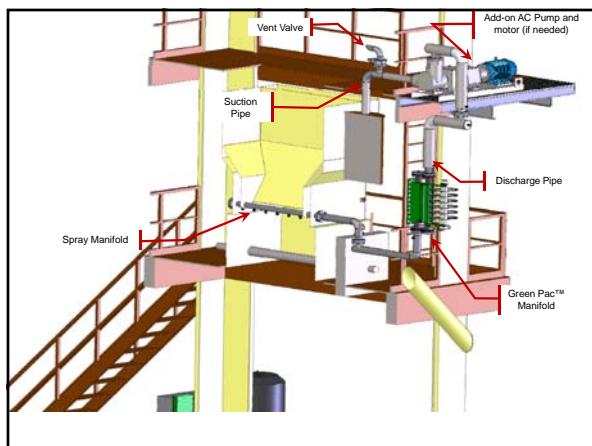
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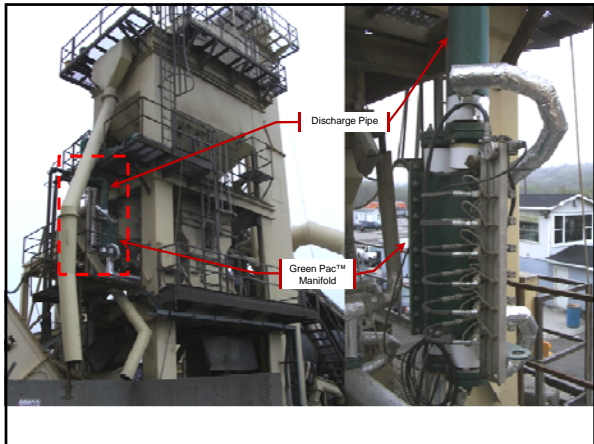
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**Green Pac™ for Batch Benefits**

- Gives existing HMA Batch Plants same proven WMA capability as continuous plants.
- Retrofits to all existing plant configurations.
- Retains original weighing system components and controls.
- Retains HMA gravity feed capability
- PLC controlled, yet utilizes existing batch control regardless of its vintage.
- Utilizes field-proven, low-maintenance Generation 2.X foaming manifold hardware.

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