Advances in Asphalt Plants to Increase RAP
Heating RAP

“Direct” Method

“Indirect” Method

“Hybrid” Method
“Direct” Method

120°C
200°C
300°C
800°C
NEL COMBUSTORE INSIDE COMBUSTOR DANS LE COMBUSTEUR

1472°F
“Direct” Method
“Indirect” Method

RAP
“Indirect” Method

Cold + Hot = Warm

RAP (Ambient Temperature) + Virgin Aggregate (High Temperature) = Mix (Mix Temperature)
“Direct” Method Limitations

120°C
200°C
300°C
800°C

NEL COMBUSTORE INSIDE COMBUSTOR DANS LE COMBUSTEUR

1472°F
“Direct” Method
“Direct” Method
3 Factors in Bitumen Oxidation

High Temperature

Oxygen

Time
Direct RAP Dryer Limitations

- Recycle fines exposed to VERY HOT oxygen-rich gas
- Bitumen + High Heat + Oxygen + Time --> Oxidation
- Bitumen + High Heat + Oxygen + Time --> Carbon Monoxide
- High Heat + Bitumen --> Volatile Organic Compounds
- Oxidation requires binder modification ($)
- Emissions may require specialized equipment and fuel ($$)

Which is worse at 50% RAP at 5% moisture?

- 1472°F (800°C): convection in oxygen-high environment?
- 855°F (457°C): conduction and steam convection with minimal oxygen?
“Indirect” Method Benefit....Steam

RAP

Dry or Wet?
“Indirect” Method Benefit: Retained Heat
“Indirect” Method Benefit... Emissions
“Indirect” Method Benefit... Time
“Indirect” Method Limitation

Limitation... Heat Transfer

Mix design can limit the %RAP possible
Limitation... Heat Transfer

Thermodynamics

How much heat is needed

Heat Transfer

How it gets where needed

Heat transfer ALWAYS wins...
And its NOT in our favor.
Can RAP mixes be characterized and compared? That is...

- Will heat transfer be a difficulty?
- Will the baghouse temperature be too high?
- What plant configuration might be required?
- What plant technology needs to be applied?
Surface Area = Heat Transfer
Where is the surface area?
Facts we know:

• Total mix surface area very important. (SMA, OGFC)

• RAP percentage very important (decades of experience)

• RAP, aggregate moisture very important (thermo, decades of experience)

• Moisture and AC content follow the surface area
Developing a predictive model:

- Surface area of the mix
- Surface area of the RAP
- Surface area of the virgin aggregate
- RAP percentage
- Difference of surface area ratio

\[
\text{DSA Ratio (％)} = \left( \frac{\text{RAP SA} - \text{Virgin SA}}{\text{Mix SA}} \right) \times 100
\]
Difference in RAP Surface Area and Virgin Agg Surface Area expressed as a % of the total mix surface area
Virgin Mix = -100%
100% RAP = 100%

DSA Ratio (%)
Economics, Thermodynamics

High RAP

Surface Area, Heat Transfer

Technology
Economics, Thermo

Surface Area, Heat Transfer

V-flights
Typical Flights

V- Flights
V-Pack™ Stack Temperature Control

Control Logic
V-Pack™ Stack Temperature Control

Stack Temperature

400°F 200°C

194°F 90°C

Hertz (Drum Speed)

40 hz 60 hz 80 hz
Economics, Thermodynamics  

Surface Area, Heat Transfer  

V-flights  

V-PAC™  

DBXHR
Shell and flights typically Corten, 1100°F (593°C)
Stainless, 1800°F (982°C) with minimal oxidation
Stainless

Corten
2.2 Million Tons...
37% to 42% RAP
300tph, 65% RAP, Tstack = 350°F (177°C)

59,120 ACFM of baghouse being used, still have some burner left...

“Inject” some quench water into the stack to get Tstack of 275°F (135°C)

Tstack reduces to 275°F (135°C)...

Baghouse flow REDUCES to 55,600 ACFM

Burner firing rate unaffected
“Direct” Method

“Hybrid” Method

“Indirect” Method
Augmenter burner and augmenter mixer

“SOFT HEAT”
Economics, Thermodynamics

Intelli-PAC™

V-flights

V-PAC™

DBXHR

Quench PAC™

RAP Predryer

“Hybrid”

Stay tuned...
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THANK YOU