ASTEC™

Asphalt Plant Efficiency

BUILT TO **CONNECT**

Greg Renegar

From concept to culture

- Who works for a company with a safety culture?
- Is there just a goal, or are there rules?
- Goals vs. rules
- Goals → rules → habits → **culture**

- **GOAL: Culture of profitable behavior**

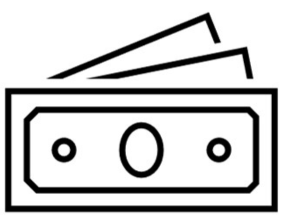
- **Make a list of operation rules that will create a culture of profitability**

EFFICIENCY - Used to describe many things

The Goal – To think about asphalt plant efficiency differently– **to make good decisions**

What is Efficiency?

$$\text{EFFICIENCY} = \frac{\text{What you get}}{\text{What you give}}$$

DEFINING "**EFFICIENCY**"

EFFICIENCY = **Mix** / **Energy + materials**

(Fuel + Electricity)

- **Radiation**
- **Emissions**
- **Stack gases**
- Friction
- HP loss
- **Electrical**

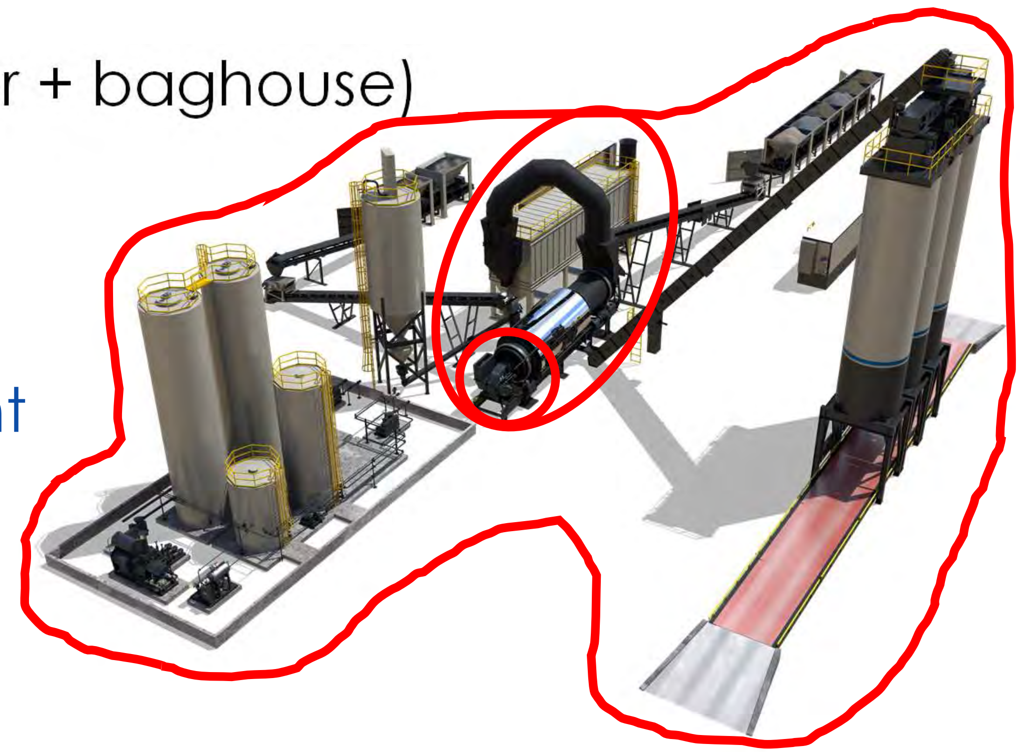
- Dust
- **Water**
- **Stockpile**

Different "Categories" of Efficiency

Component efficiency (burner)

System efficiency (burner + dryer + baghouse)

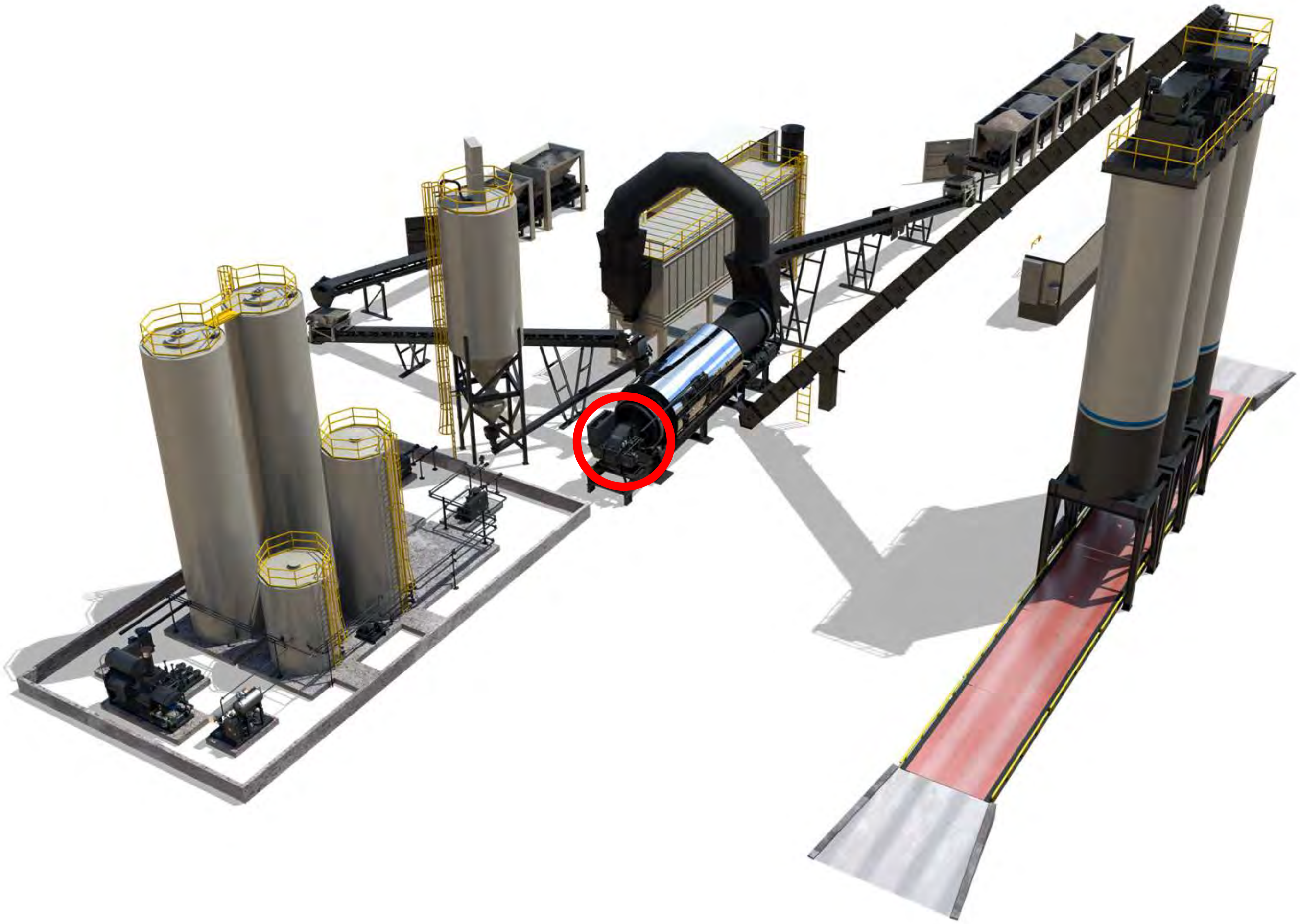
Plant & operation efficiency



You could have good component and system efficiency…

And have a less profitable plant!

Component Efficiency



DEFINING Burner **"<u>EFFICIENCY</u>"**

Burner EFFICIENCY = **Heat** / **Fuel + air + electricity**

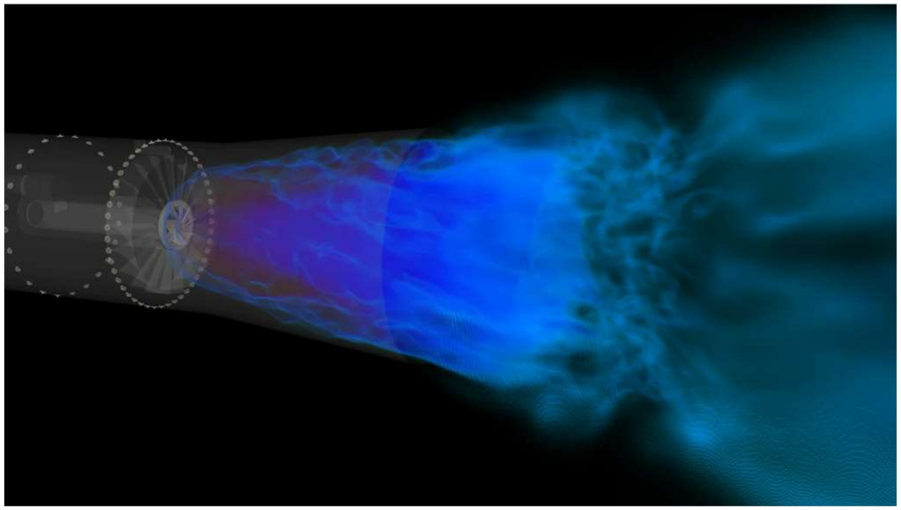
These things still have unused energy

- Carbon Monoxide (CO)
- HC (Hydrocarbons)

Component Efficiency – Burners

$C_X H_Y$ + O_2 → **HEAT** + H_2O + CO_2 or CO

Fuel (Hydrocarbon) | Oxygen (Air) | Water | Carbon Dioxide | Carbon Monoxide



Can tuning make your burner more "efficient"?

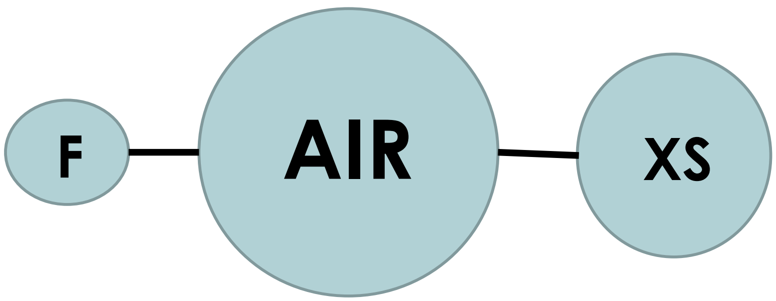
Yes but…

3 cu ft CO = 1 cu ft nat gas

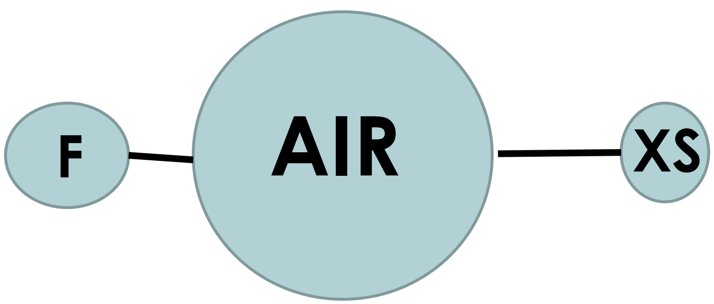
Defining burner "efficiency" is critical!

Combustion Air Basics

Stoichiometric – textbook amount



Lean – cool – good emissions? – low tph
More material carry out



Rich – hot – good emissions? - large dia.
Drum heat damage

Burner technologies

TOTAL AIR BURNER

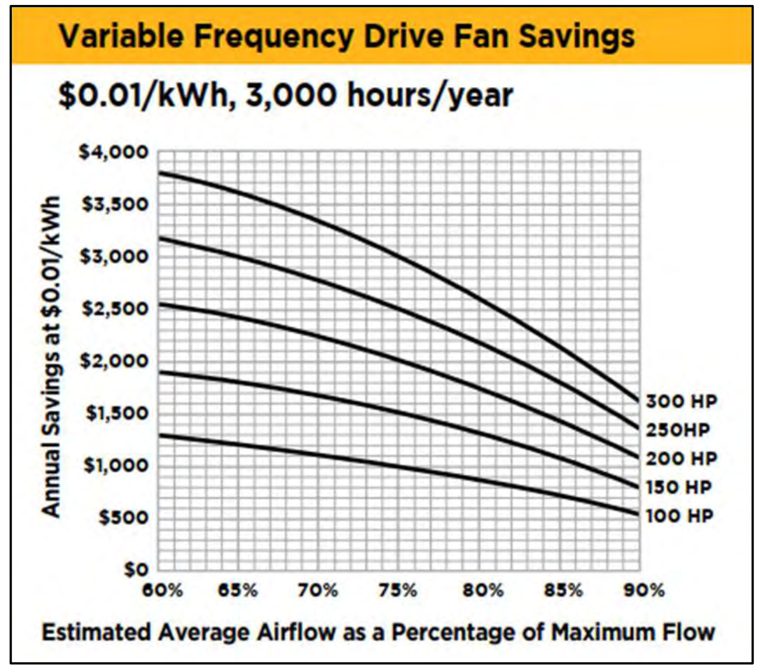
OPEN-FIRED BURNER

- Total Air – **don't oversize the burner !**
- Total Air with VFD really "wins"
- Does it "move the needle" or is it a "baby-step"?
- You won't know until the burner is adjusted

Component Efficiency – VFD

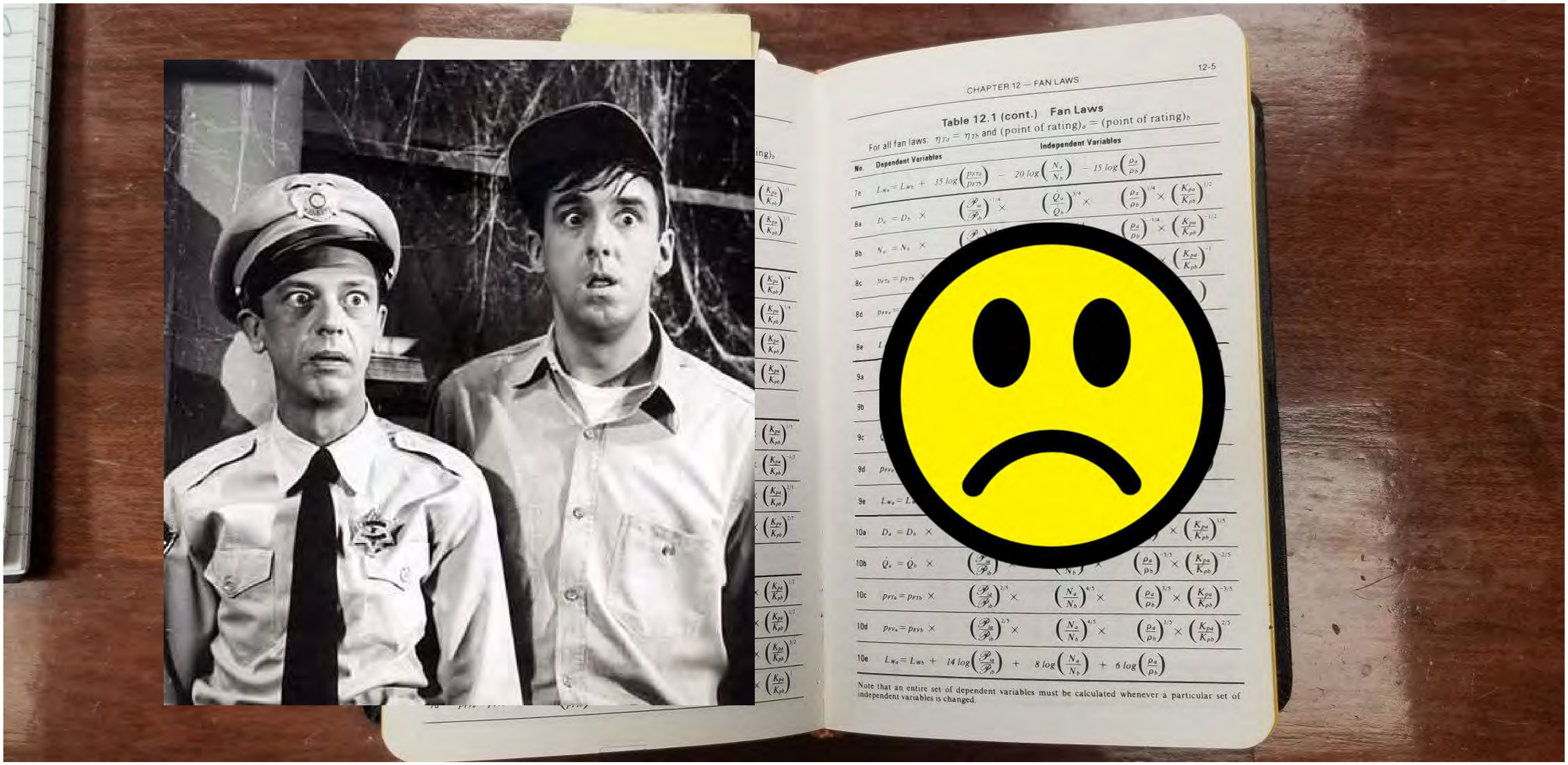
Variable Frequency Drive (VFD)

- **Fans:** Can save a lot of energy compared to a damper
- **Drum:** Helps keep energy loss down
- **Drag:** Reduces wear – still green



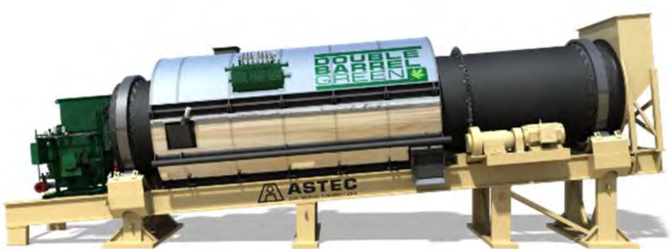
Source: NAPA Publication QIP-132 / Alliant Energy

Fan Laws

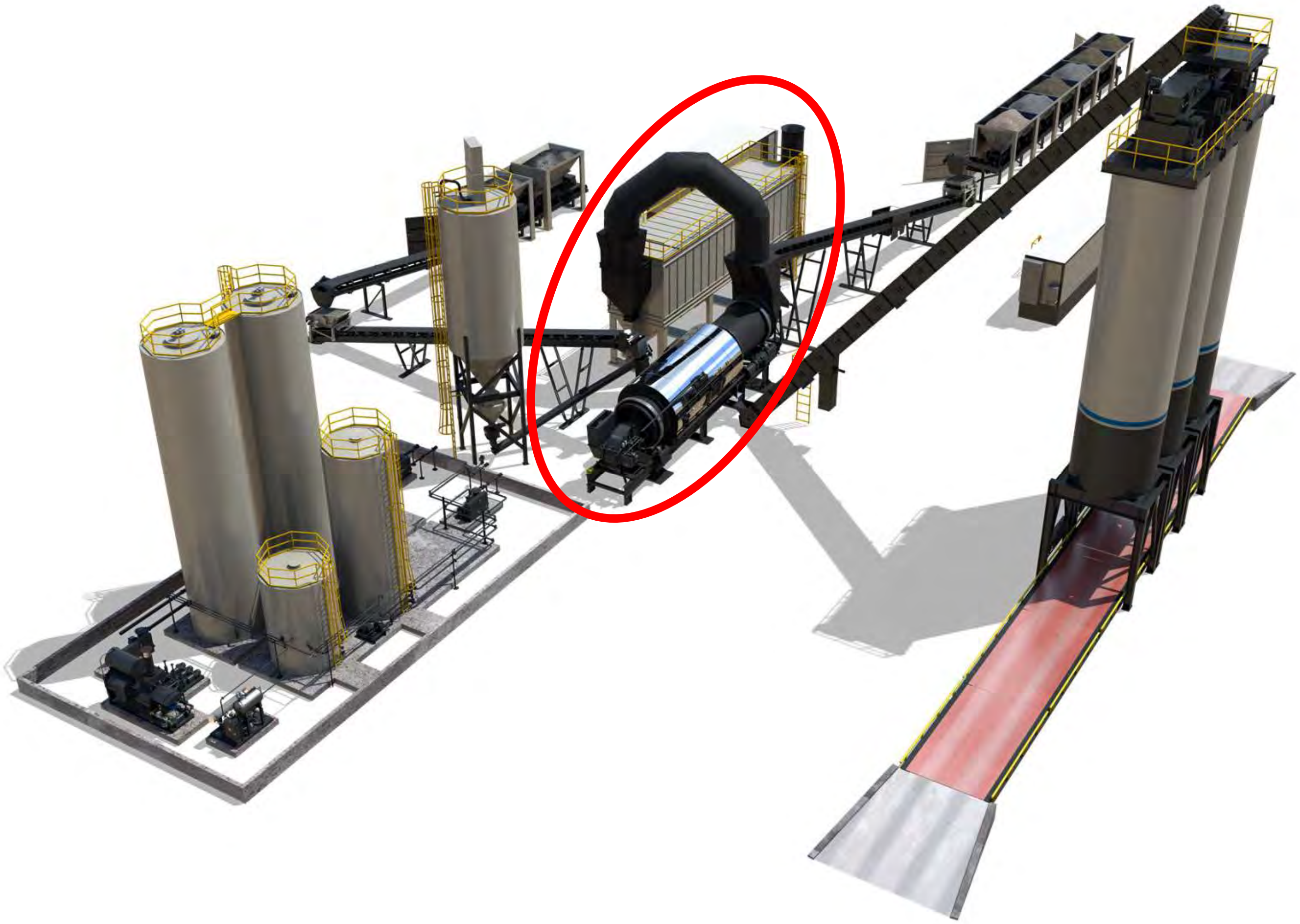

12-5
CHAPTER 12 — FAN LAWS
Table 12.1 (cont.) Fan Laws
Note that an entire set of dependent variables must be calculated whenever a particular set of independent variables is changed.

What are VFDs good for?

- **Energy savings:**
  - Baghouse exhaust fan **(80% speed = 50% energy)**
  - Burner fan **(50% speed = 12.5% energy)**



System Efficiency



System efficiency

– Good component performance doesn't necessarily equal good heat transfer – **WHAT ?!?!?**

– How can this be so?

– The burner, dryer, and baghouse comprise a **system**

– The components must be **matched** and **work together**

The Difference between thermodynamics and Heat Transfer

- **<u>Thermodynamics</u>** is how much energy (heat) is needed
- **<u>Heat transfer</u>** is how the heat is delivered to where it is needed

"Thermodynamics"
(How much energy)

"Heat transfer" (where the energy is going)

System Efficiency

Suppose we have two plants…

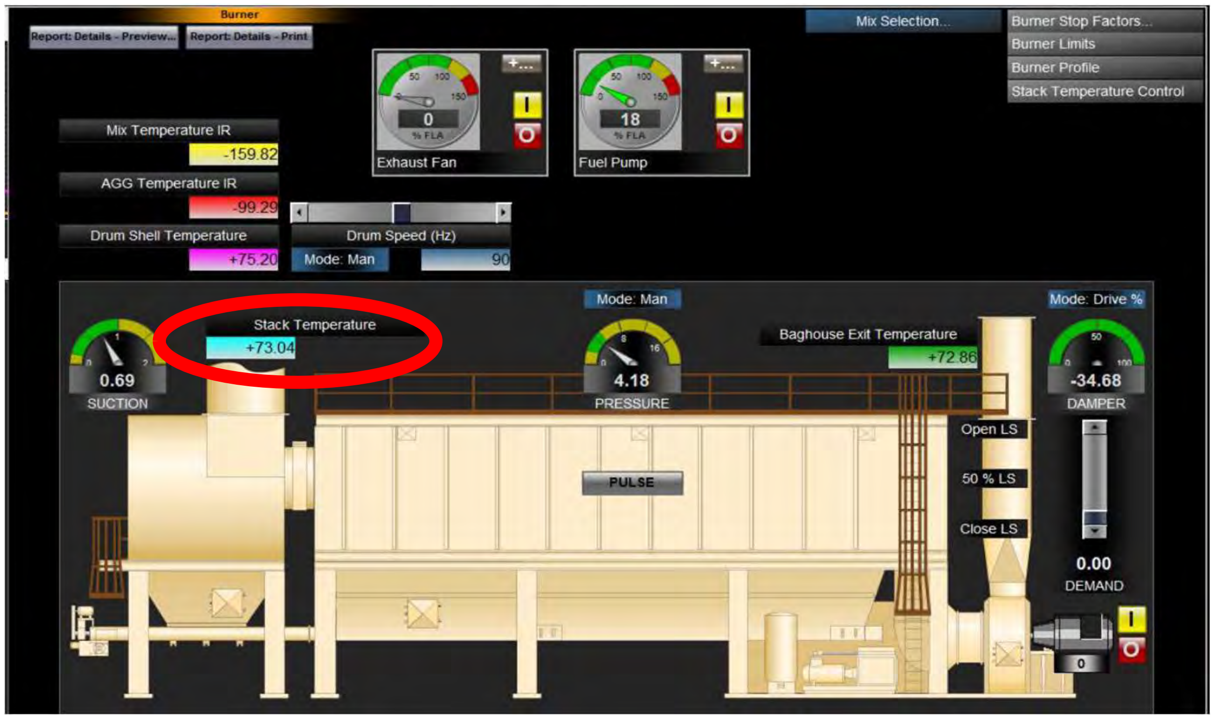
- Same mix
- Same aggregate and RAP source
- Same mix temperature
- Same production rate
- Same moisture contents
- Same fuel
- Same burner

What number on the console indicates which plant is drying more "efficiently"?

(Which plant has more heat going into the aggregate?)

System Efficiency

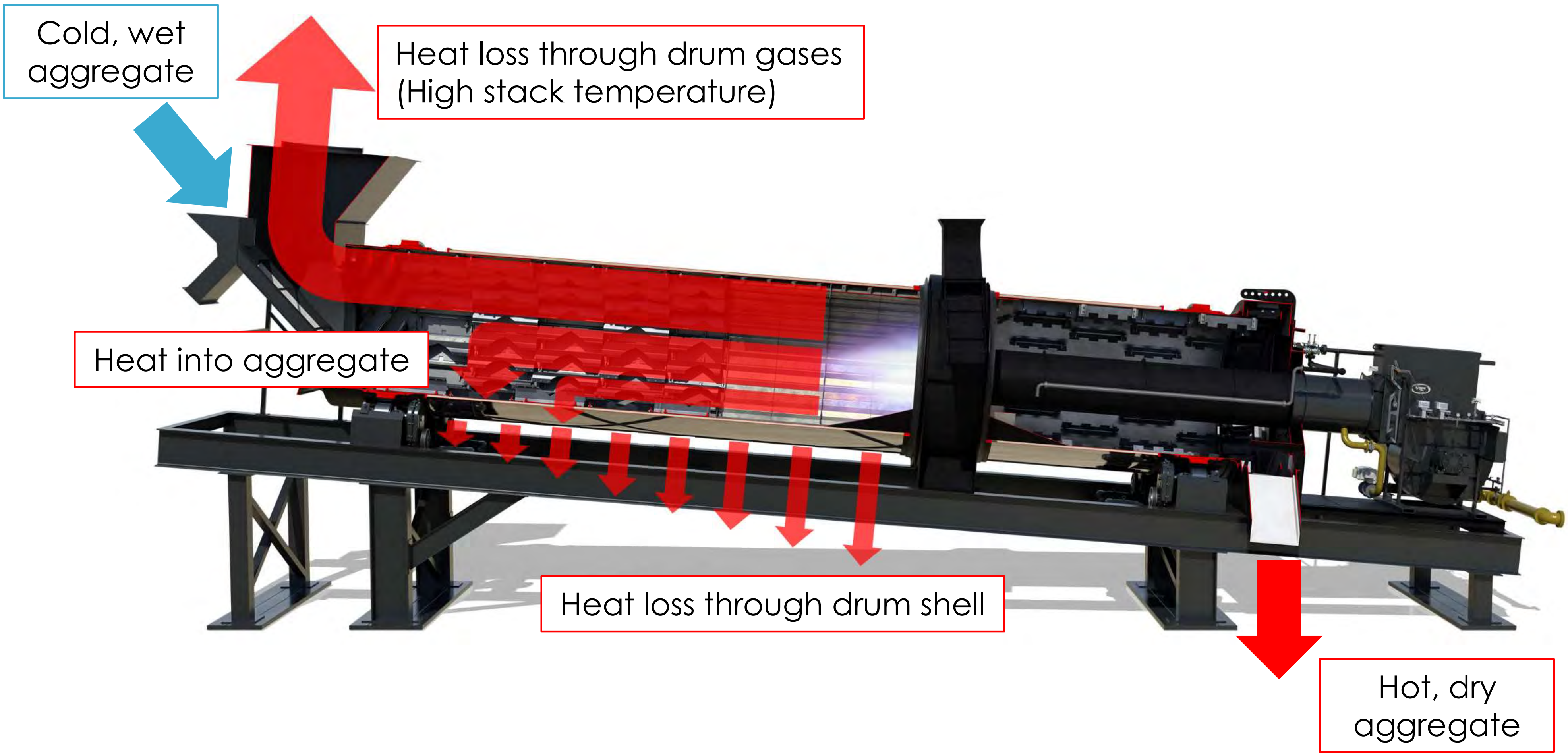
The ONE thing you see *every day*…



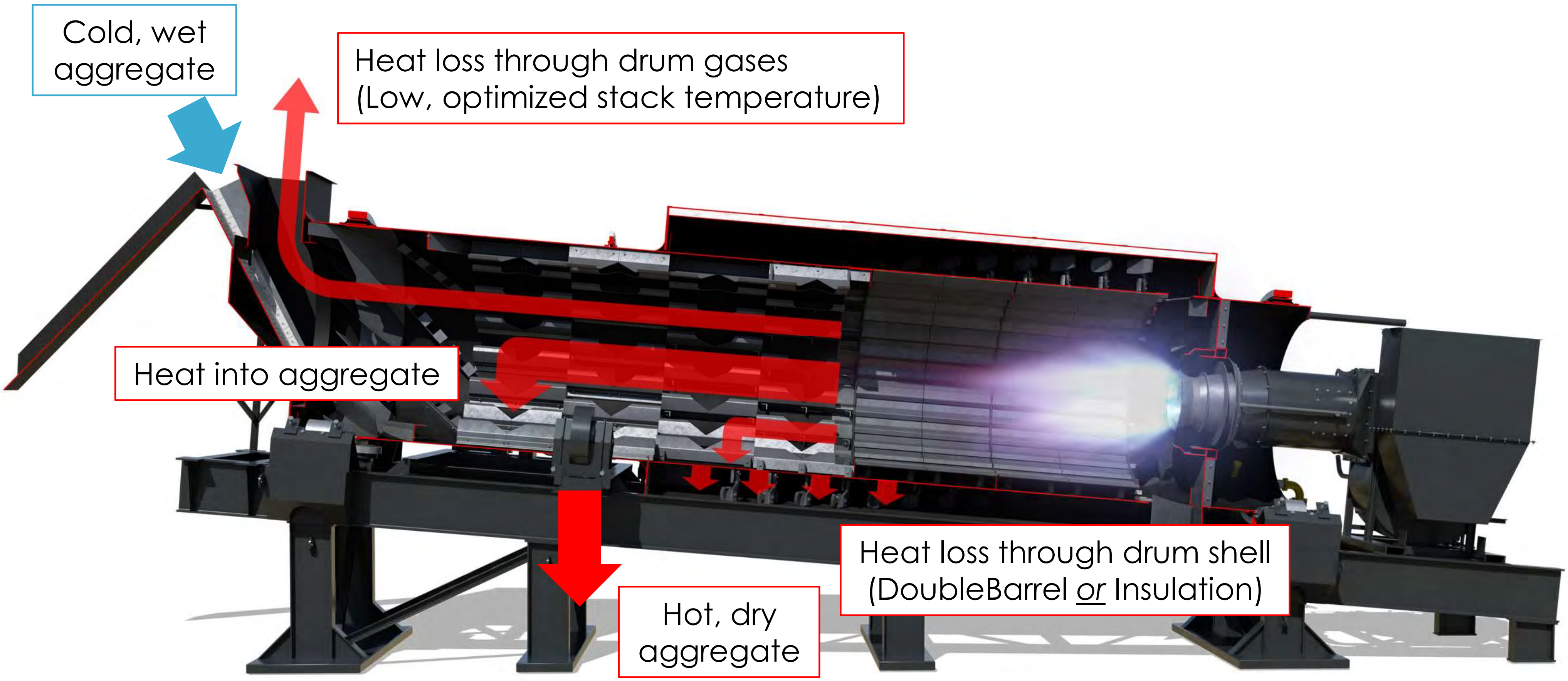
STACK TEMPERATURE!

(Drum exit gases)

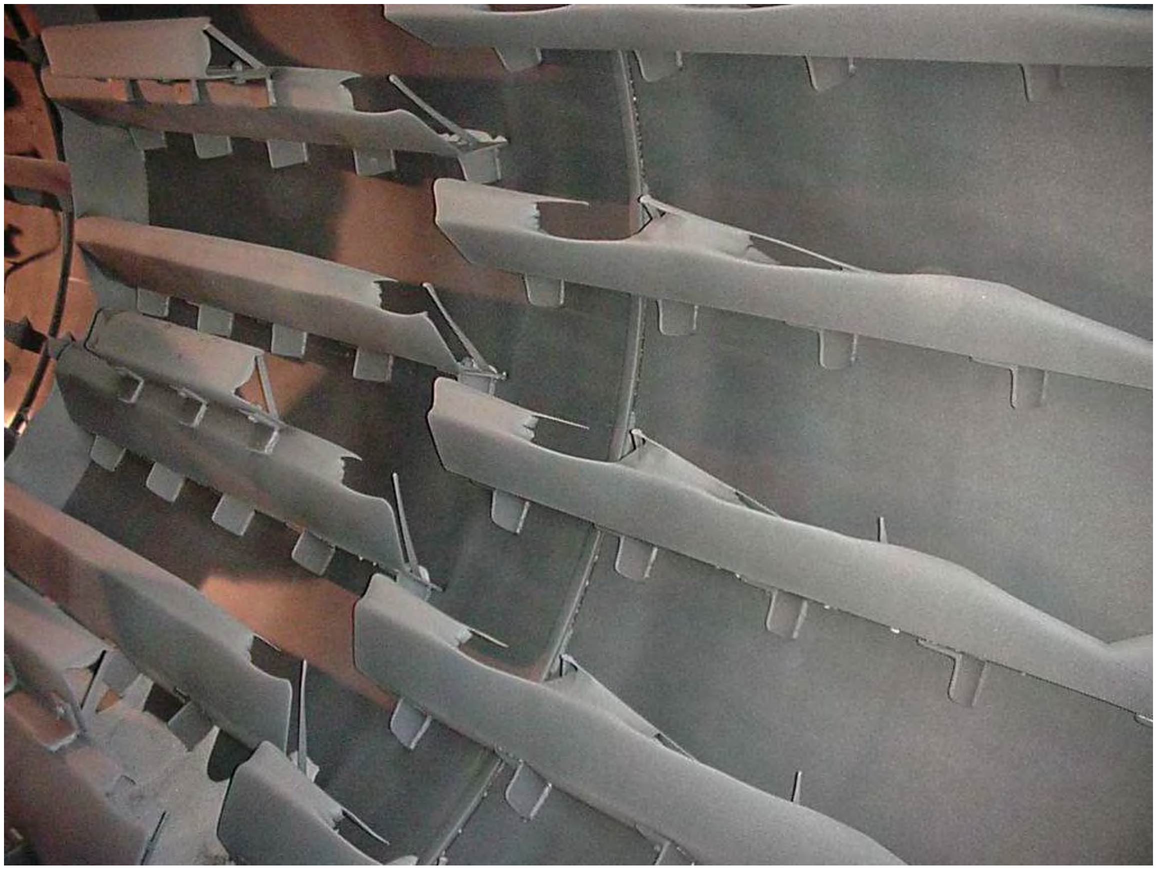
Dryer System Efficiency



System Efficiency



Drum flighting and EFFICIENCY



Do these flights veil properly?

Probably not, but it depends

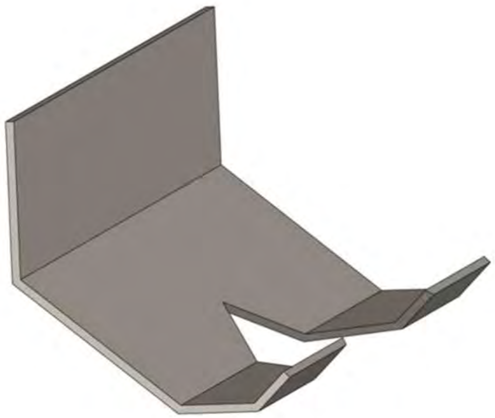
Maintenance Affects Efficiency!

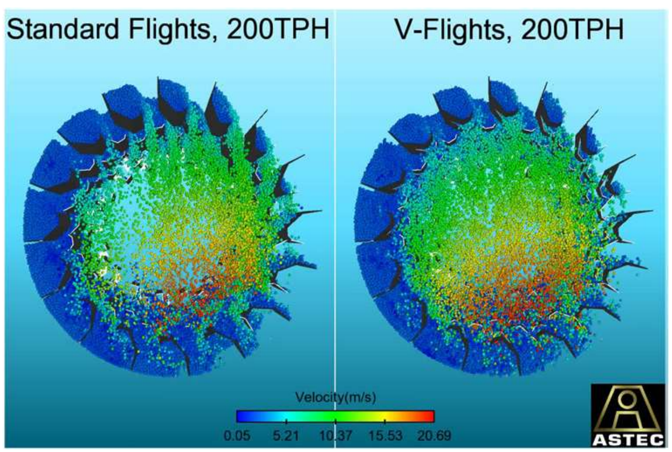
Stack Temperature Control

- How can the stack temperature be changed
  - Change flights
  - Modify flights – cut / weld
  - Modify flight system (Add dams, kickers, etc.)

  - **Press a button in the control house – V-Pac (VFD)**

V-Pack™ Stack Temperature Control

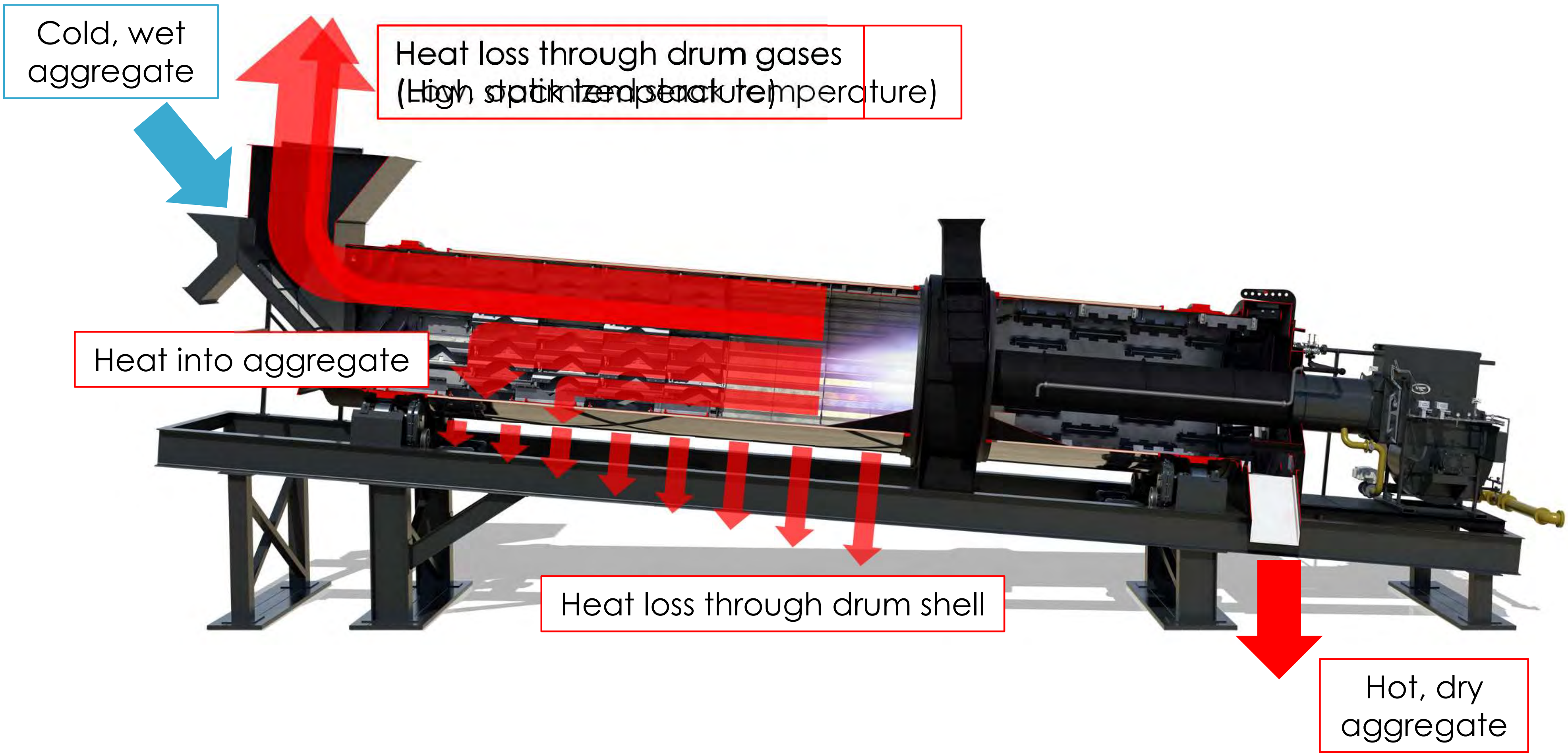




VFD and Controls

The VFD changes the drum speed. Controls determines how much.

System Efficiency



Stack Temperature Effect on Production and Fuel

60F = 10% production

4% effect on fuel required

60-10-4

Stack temperature

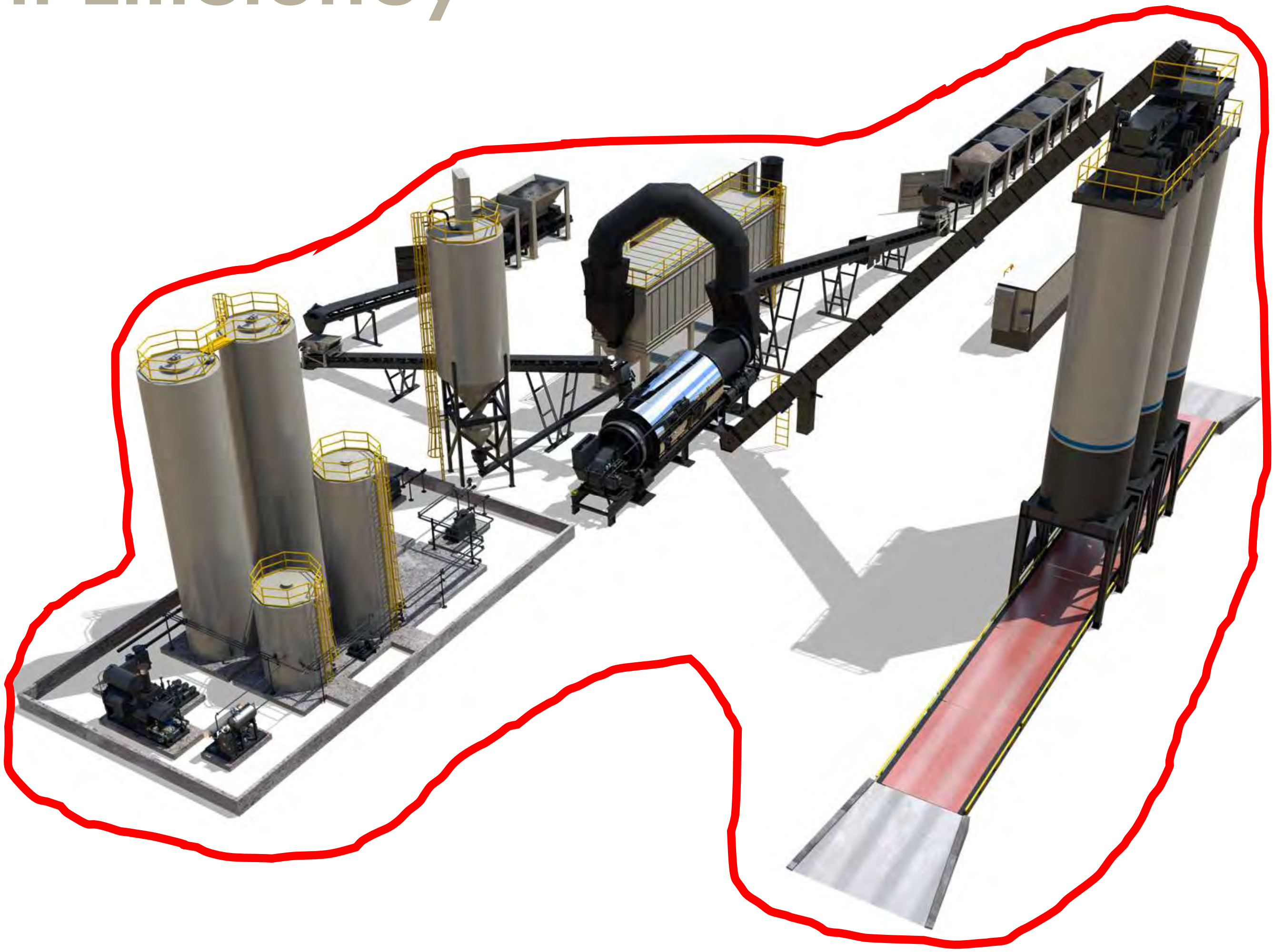
- **How low is too low?**

- **Is below 212 F too low?**
- **What is the dew point temperature?**

- **Bad things can happen if you go too low…**
- **Mudding on the bags – won't pulse off – high delta P – low tph**
- **Plug up augers – hopper full of dust – plant down**
- **Corrosion**

High Baghouse ΔP

Plant Efficiency



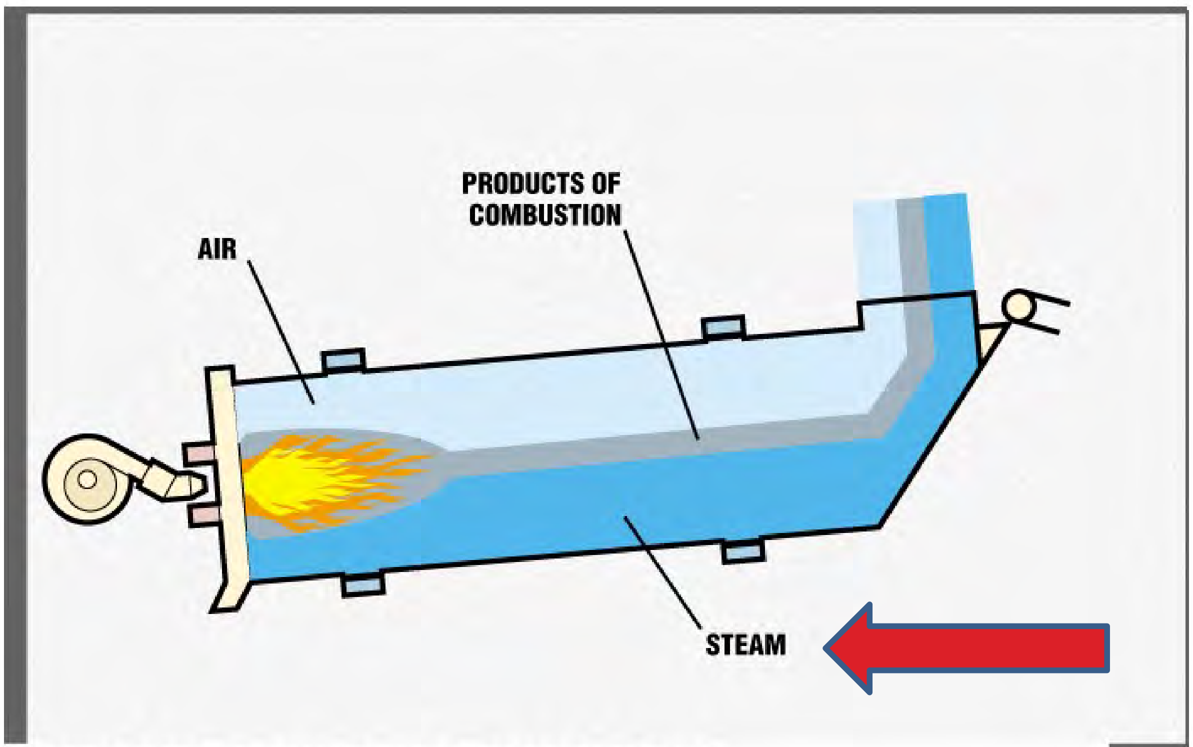
Moisture's Effect on Fuel Consumption

52% of Fuel is Required to Process the Water

1% change in moisture = 11% Reduction in Fuel Consumption

1-11-11

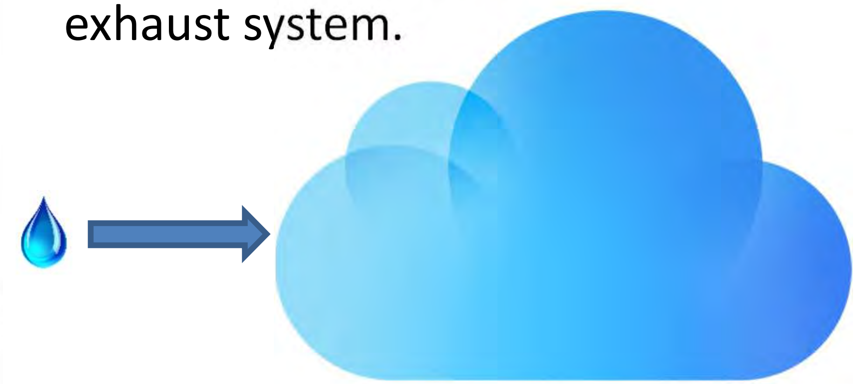
HOW DOES MOISTURE AFFECT PLANT CAPACITY?



EXHAUST COMPONENTS IN A TYPICAL DRYER

As water turns to 240 F steam it expands 1747 times.

That is why a small percentage of water makes a big difference to the exhaust system.

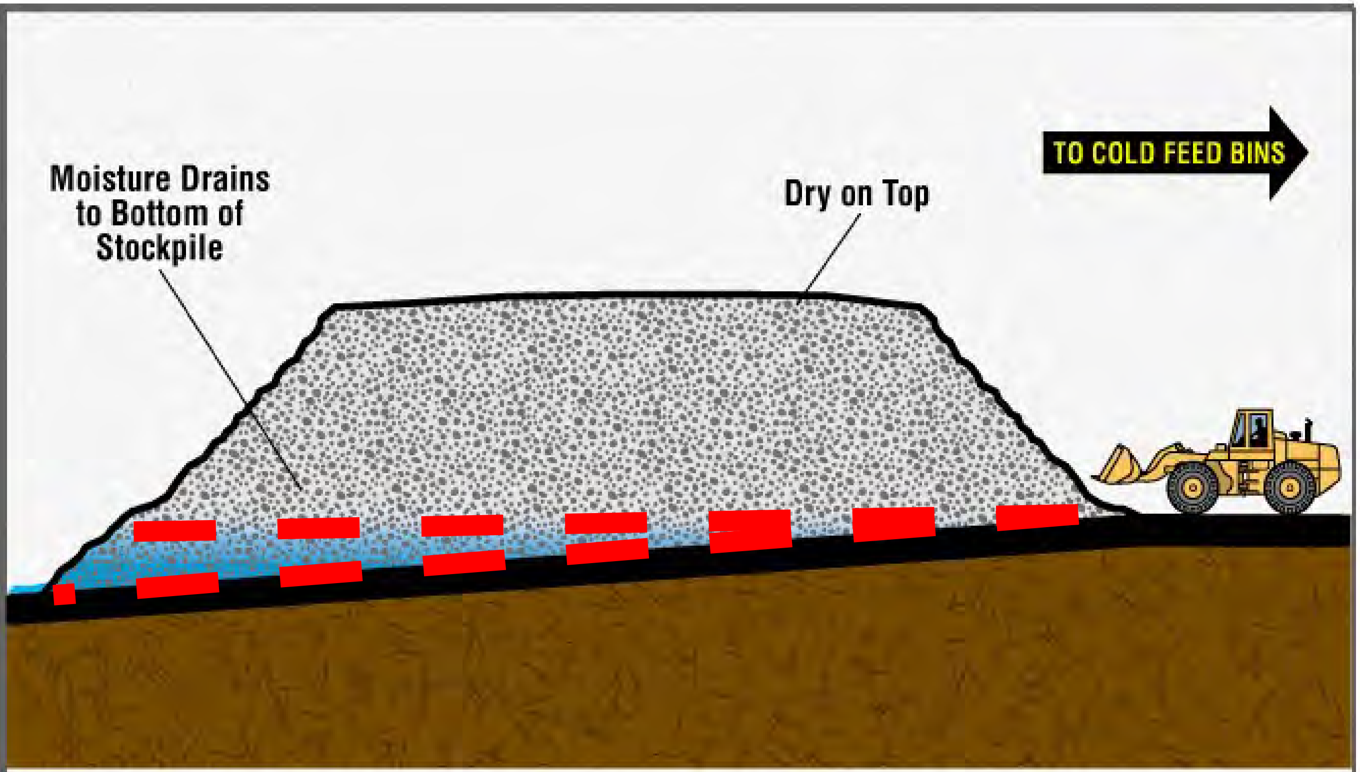


X 1747

Moisture matters!

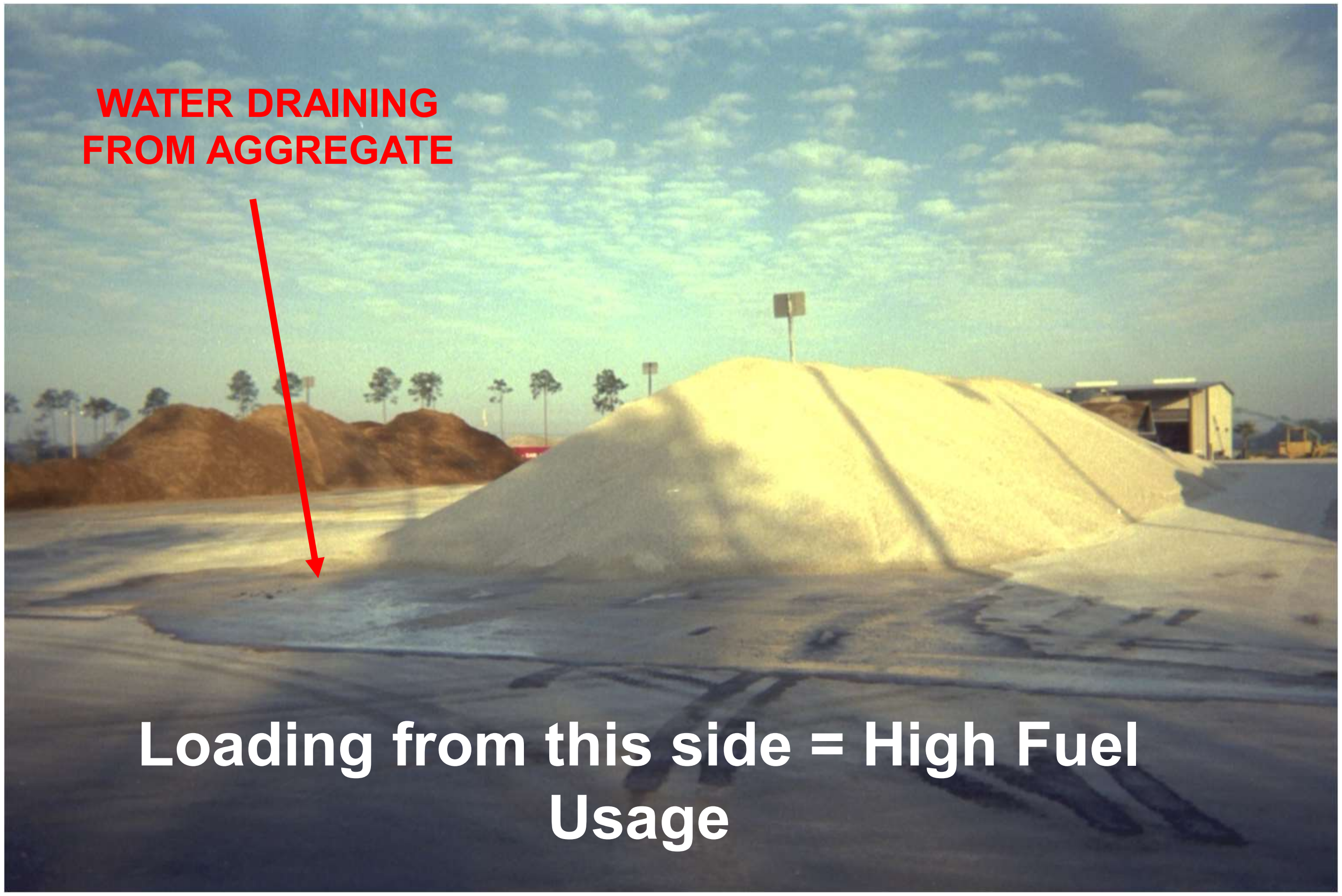
1% Moisture = 12% production

1-11-11



STOCKPILES WITH IDEAL 6% SLOPE

Small things = Big effect



Plant Efficiency – Moisture

Good stockpile management practices can have an oversized effect on plant efficiency.

- **Slope & Pave**
- **Cover (sometimes)**
- **Load from the dry material**

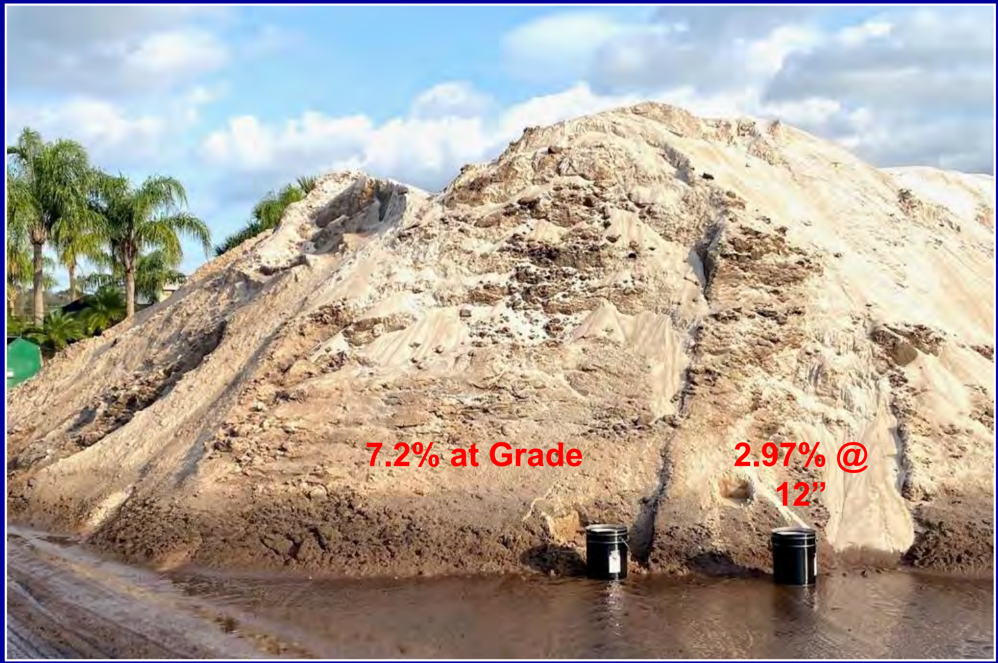
A 2% reduction in moisture can reduce the burner energy requirement by 21%*.

**Based on Astec internal calculations. Third party verification in progress.*

Managing Moisture …

Natural Sand

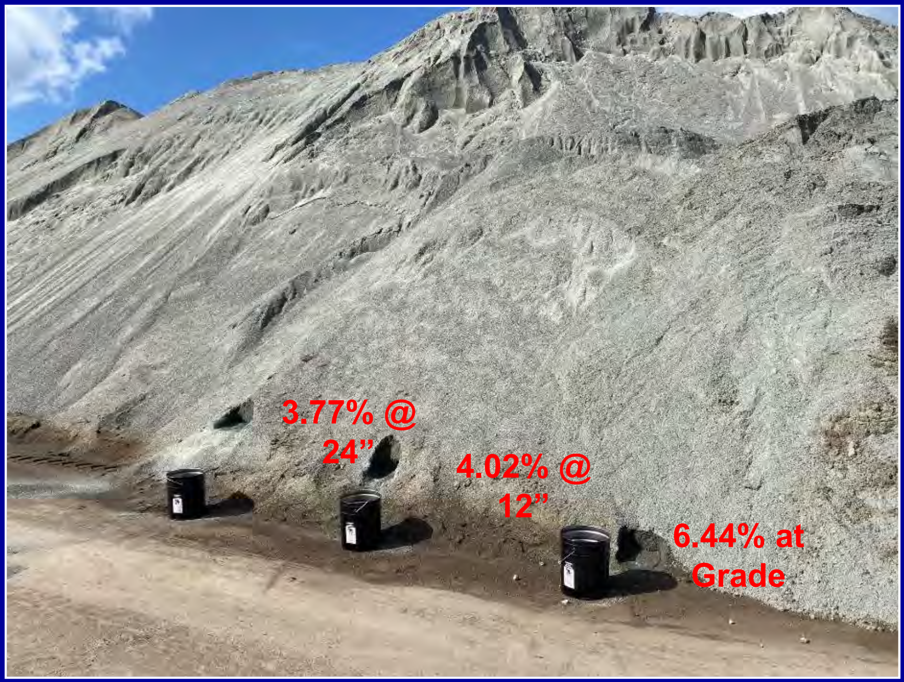
4.2% less - up 12”



Managing Moisture …

Stone Screenings

2.4% less - up 12”



Managing Moisture …

3/8” Stone

1% less - up 12”

Cold feed bins covered too

Material inside and outside

Feed bin rain covers - Australia

Cold Feed bin covers – Colombia, South America

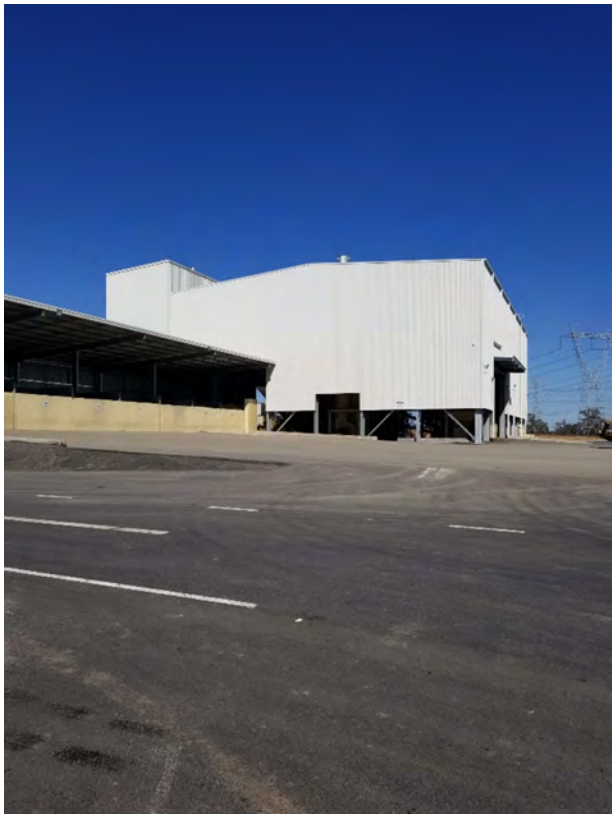
High operational Efficiency trumps component / system efficiency

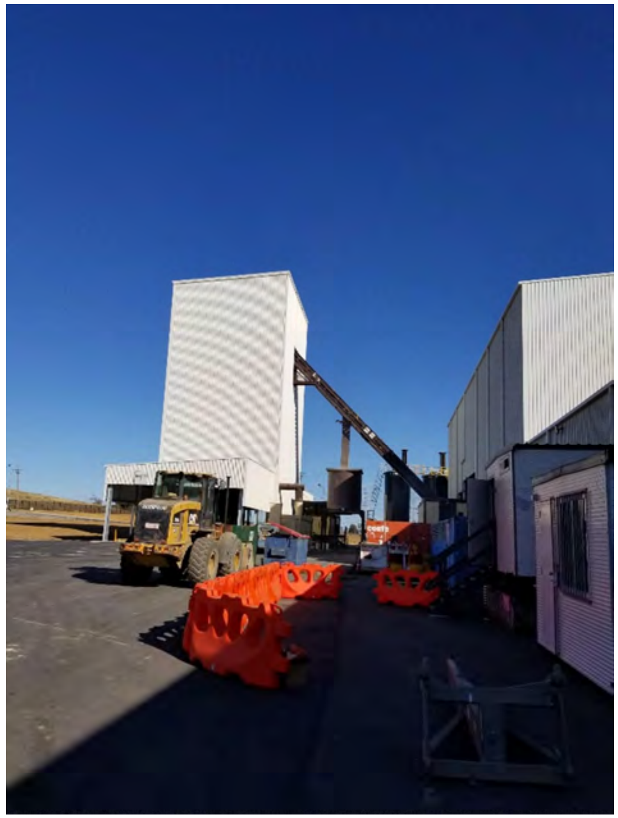
Parallel flow drum mixer (obsolete - high stack temp)

Old burner technology

Low component / system efficiency – High plant efficiency

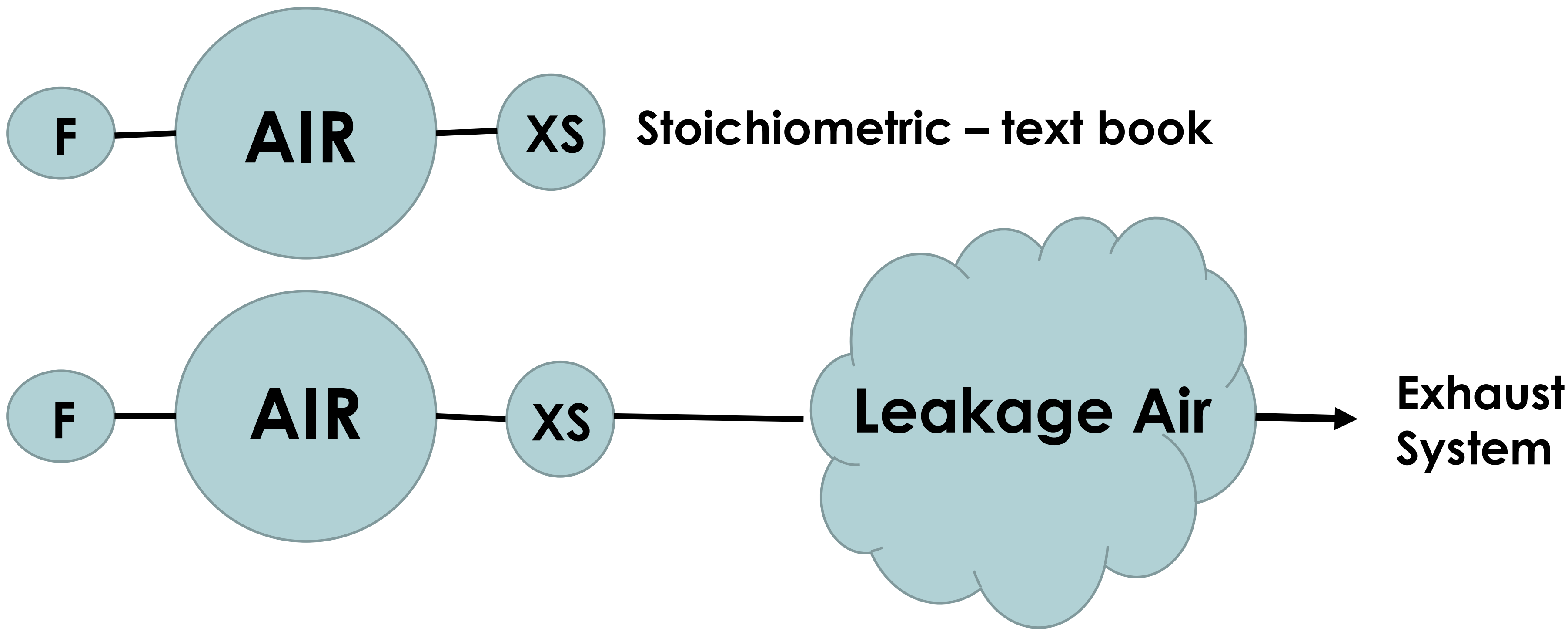
Welcome to the future – Covered everything!





Sydney, Australia

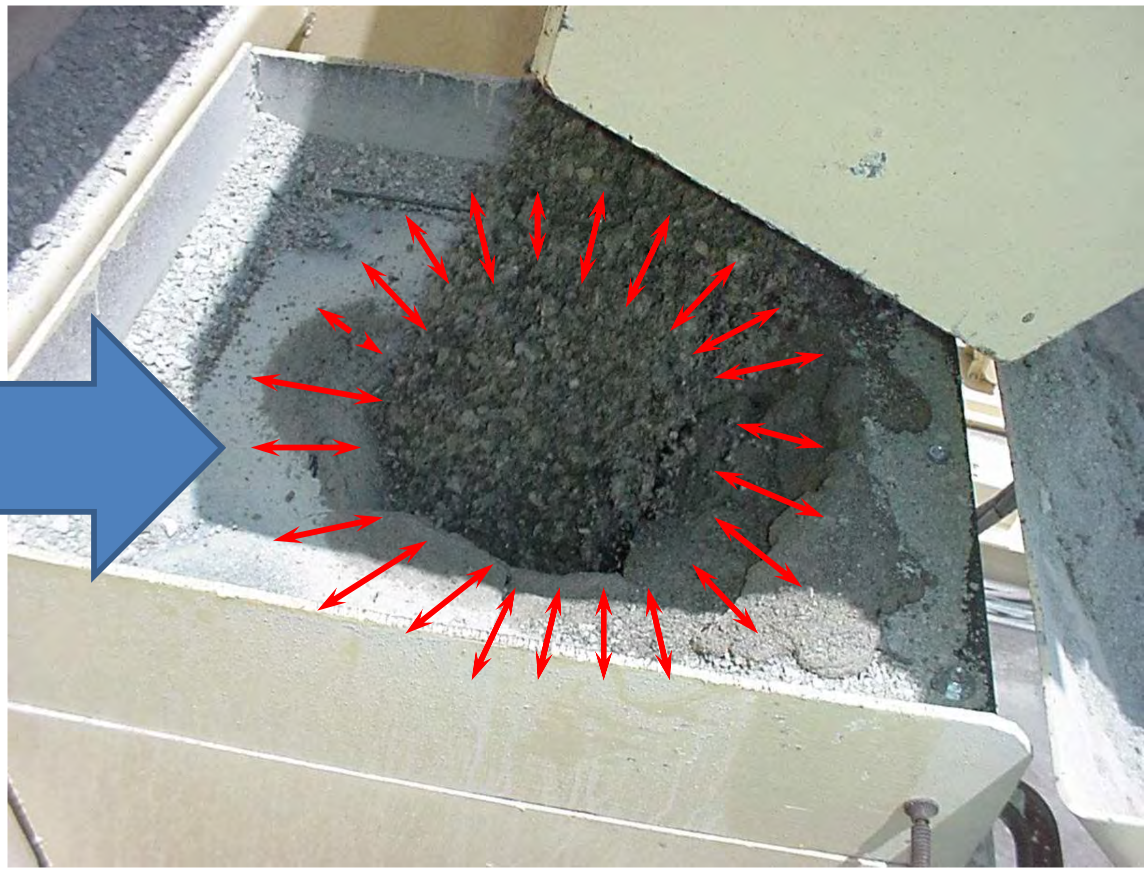
Leakage Air – Is it a big deal?



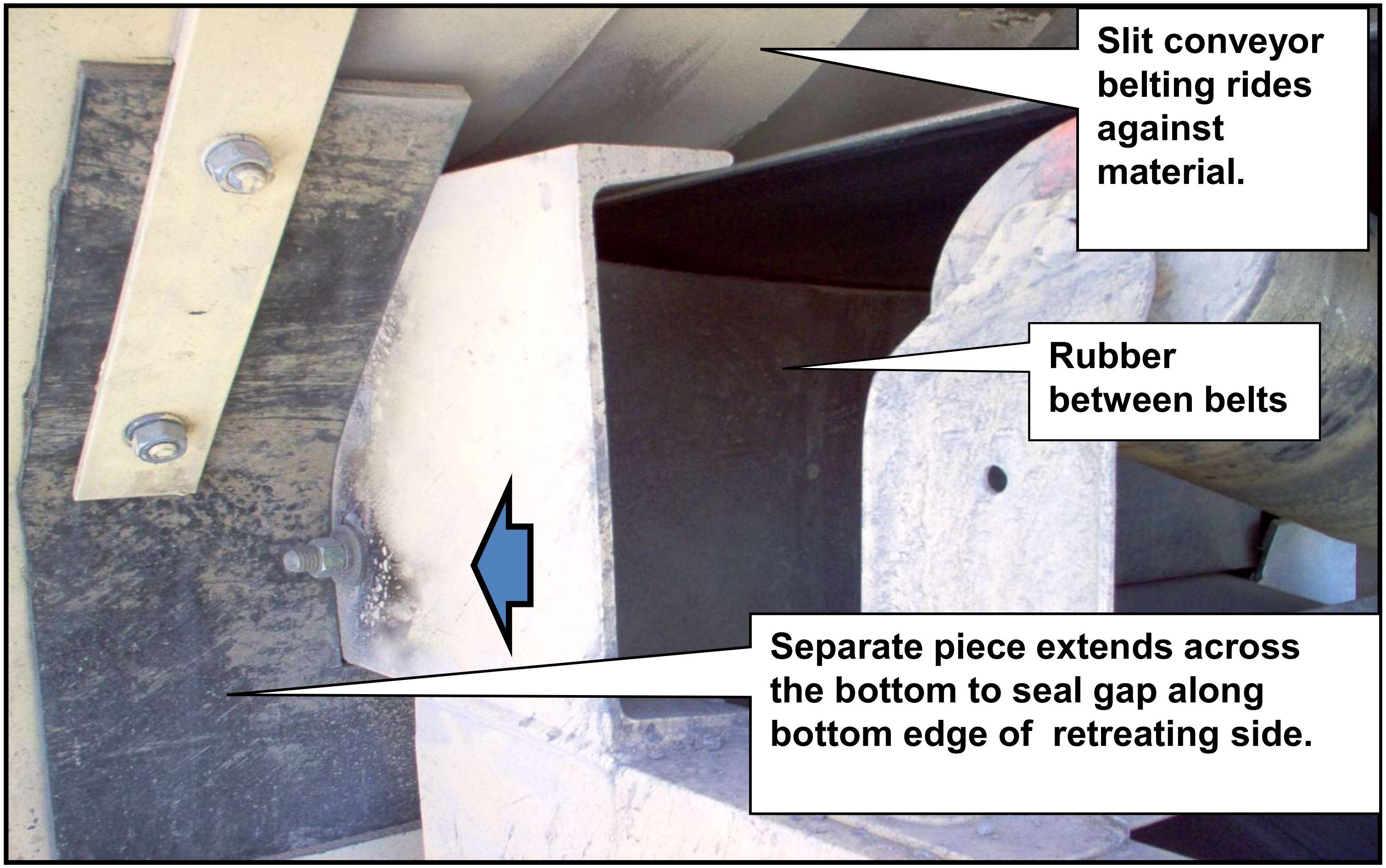
Production Rate Killer

Air Leakage – Drum inlet chute

Drum inlet chute seal made from conveyor belting



Air Leakage – Slinger conveyor to drum

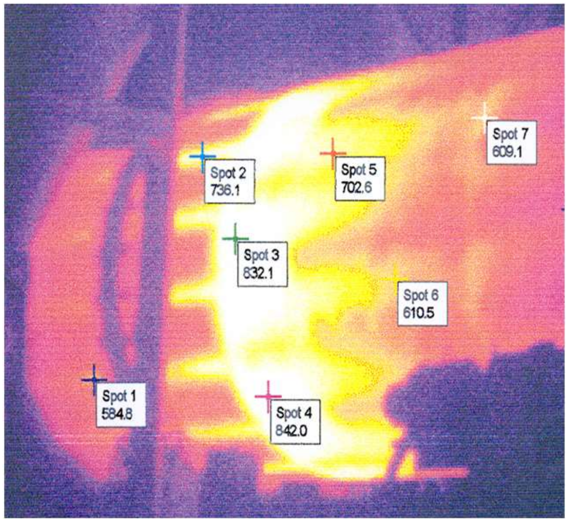


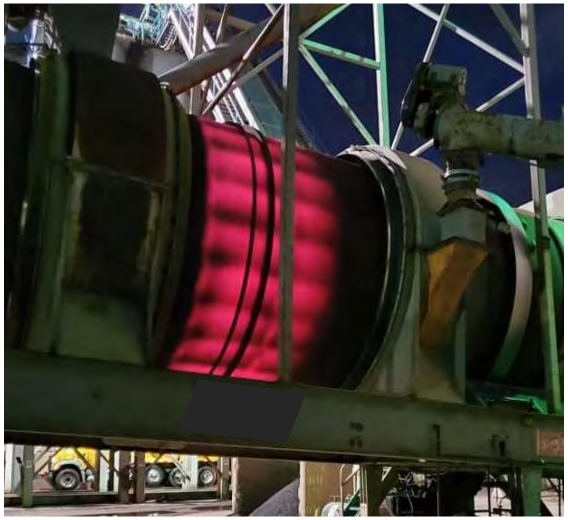
To insulate or not, that is the question!

Everything that gets hot besides the mix is a waste of energy, but what does it make sense to insulate?

Insulating Your Plant

- Dryer drum → Insulate?
- Duct work → Worth the effort?
- Baghouse → Lots of surface area





Insulating Your Plant

- AC tank farm → Yes!
- AC piping → Yes!
- Pipe flanges → Yes!

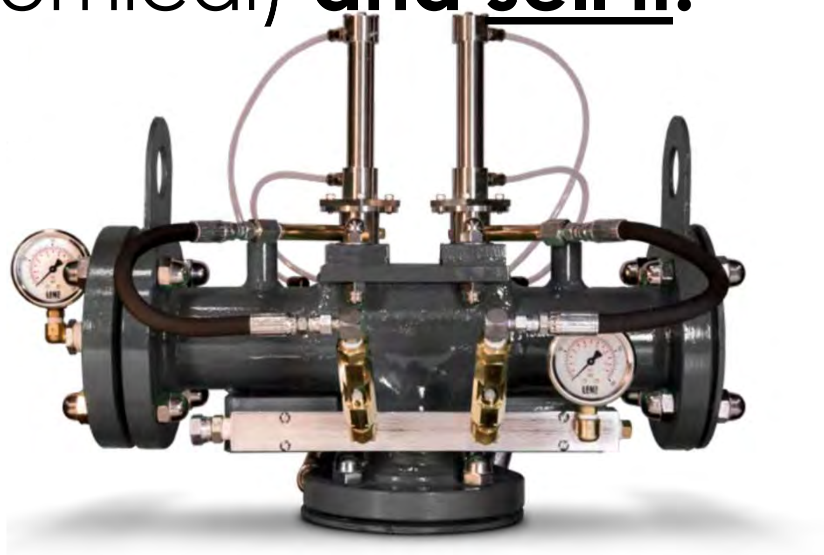
Jacketed Asphalt Piping					
Asphalt Pipe Nominal Size	Hot-Oil Jacket Nominal Size	Loss Per Linear Foot BTU Per Hour		Loss Per Flange BTU Per Hour	
		Un-insulated Jacket	Insulated Jacket	Un-insulated	Insulated
3 inches	4 inches	1598	86	1890	120
4 inches	6 inches	2349	122	2600	134
5 inches	8 inches	3057	148	3240	178

Hot Oil Piping				
Pipe Diameter	Loss Per Linear Foot BTU Per Hour		Loss Per Flange BTU Per Hour	
	Un-insulated	Insulated	Un-insulated	Insulated
1-1/2 inches	676	47	1205	97
2 inches	846	54	1660	115
2-1/2 inches	1024	55	2155	125
3 inches	1243	72	2485	130

Source: NAPA Publication QIP-132 & Astec Technical Paper T-140

Plant Efficiency – Mix Temperature

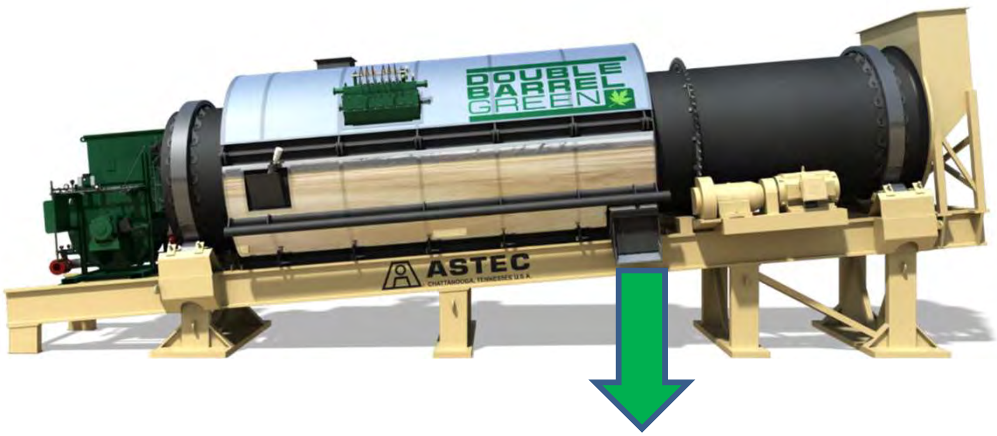
Pick a Warm Mix technology (mechanical or chemical) **and <u>sell it</u>!**

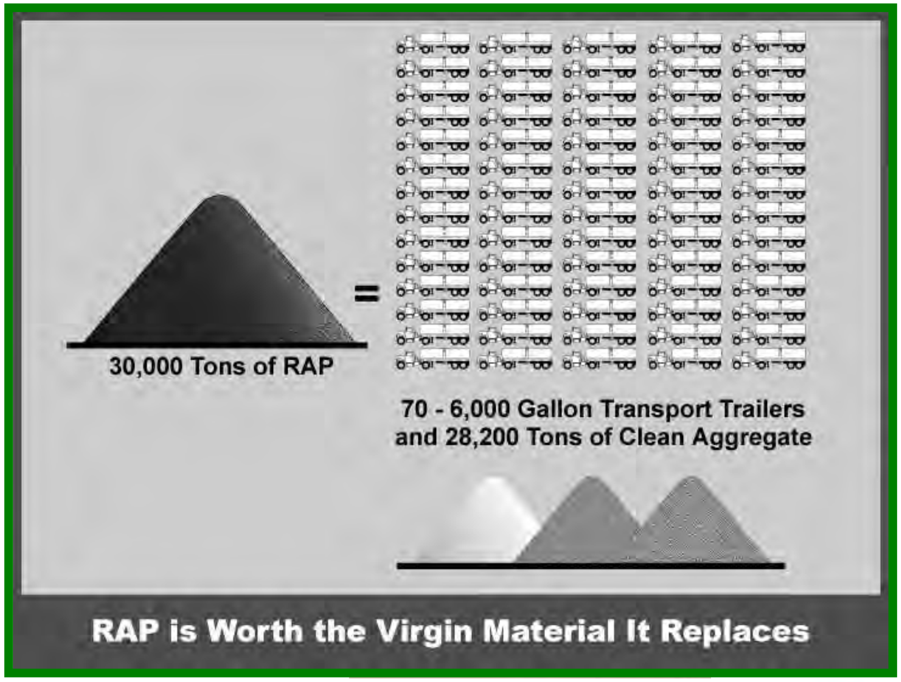


A 50° F reduction in production temperature can reduce fuel consumption by 11%*

**Based on Astec internal calculations. Third party verification in progress.*

RAP – The low carbon choice

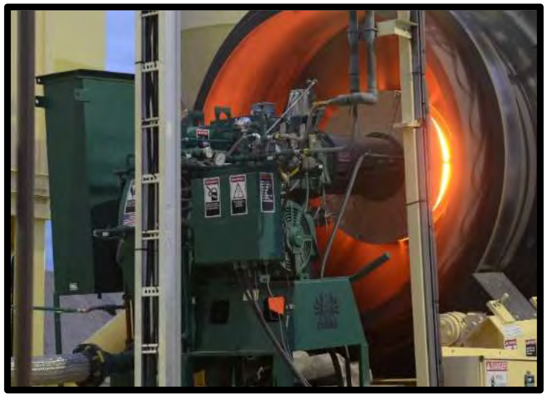




We must do RAP the right way!

- Fractionate when appropriate
- Best practices always
- Equipment – RAP Bins, Heat x-fer
- Mix Design
- Training

Which plant is more profitable?



Old Technology

- Starts at 6am loading out of pre-filled silos
- Starts up at 8:30am
- Runs 2 to 3 mixes, has enough trucks
- Runs ALL DAY (changeovers, no mid-streams)
- Fills the silos at end of day

New Technology

- Starts at 6am making mix
- Runs 2-3 mixes on various jobs, short of trucks
- Mid-streams at 8:30 for 45min
- Runs another 300 tons (finished for the day)
- Cleans out
- Gets a call at 10:15am for a 150ton parking lot job for afternoon.
- Fires back up at 11:00am
- Runs 147 tons, then midstream while paving foreman figures the last bit needed.

Surge and Storage

How does silo use affect plant efficiency?

Plant Efficiency – Operations

- Plants that start and stop more than 3 times per shift use up to 20 - 35%* more fuel

The solution: Storage silos.

Operate your continuous plant…continuously!

When compared to theoretical steady-state operation. Percentages from NAPA Publication QIP-132.

FACT

- Our most successful customers use the long term storage capabilities to become more profitable.

Store mix if you want to…

- Keep your private customers
- Get your competition's private customers
- Make and sell more tons per day
- Minimize cost per ton by running continuously
- Increase quality on mix – more bonus money

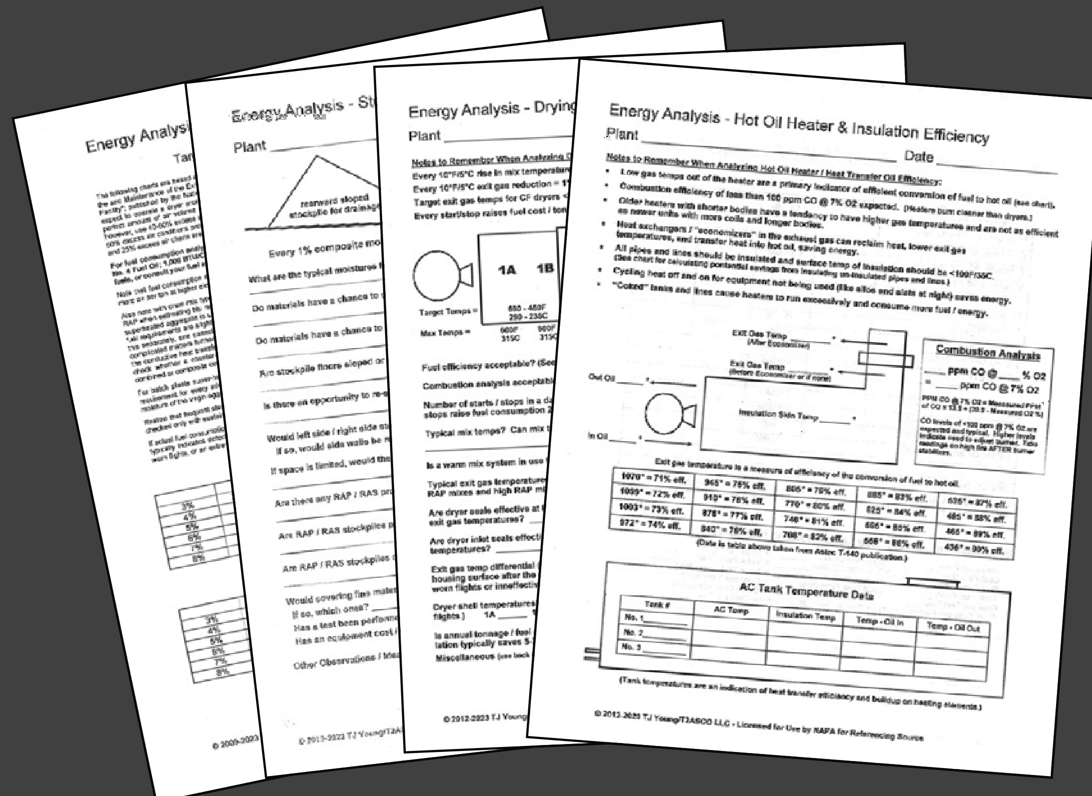
The Road Forward

A Vision for Net Zero Carbon Emissions for the Asphalt Pavement Industry

Production Strategies for Saving Money and Reducing Emissions

Self Audit Worksheets

- Stockpile Management
- Dryer Efficiency
- VFD Exhaust Fan
- Hot Oil System



ABOUT ASTEC

- Based in Chattanooga, TN USA and founded in 1972
- Unique vision to bring state-of-the-art technology to traditionally low-tech industries
- Built on the legacy of putting customer service first.
- Market-leading brands have become a global leader in the manufacture of equipment from Rock to Road.

Greg Renegar
grenegar@astecindustries.com