# Evolution of HMA Plants
# &
# Pavements for a Sustainable Future

**AAPA 14th International Conference**

**September 2011**


# FAMILY OF COMPANIES

## Asphalt Group

ASTEC
Chattanooga, TN

DILLMAN EQUIPMENT
a division of Astec, Inc.
Prairie du Chien, WI

HEATEC
Chattanooga, TN

CEI ENTERPRISES
Albuquerque, NM

## Mobile and Underground Group

ROADTEC
Chattanooga, TN

CARLSON
Tacoma, WA

ASTEC UNDERGROUND
Loudon, TN

AMERICAN AUGERS
West Salem, OH

## AggReCon Group

KPI-JCI
ASTEC COMPANIES
Yankton, SD - Eugene, OR

ASTEC MOBILE SCREENS
Sterling, IL

## Aggregate and Mining Group

TELSMITH
Mequon, WI

OSBORN
Johannesburg, South Africa

BTI
BREAKER TECHNOLOGY, INC.
Ontario, Canada
Solon, OH
Riverside, CA

## Other Group

Peterson
an Astec Industries Co.
Eugene, OR

ASTEC AUSTRALIA
Sumner Park, Australia


ASTEC
AUSTRALIA

# ASTEC: Active in Industry

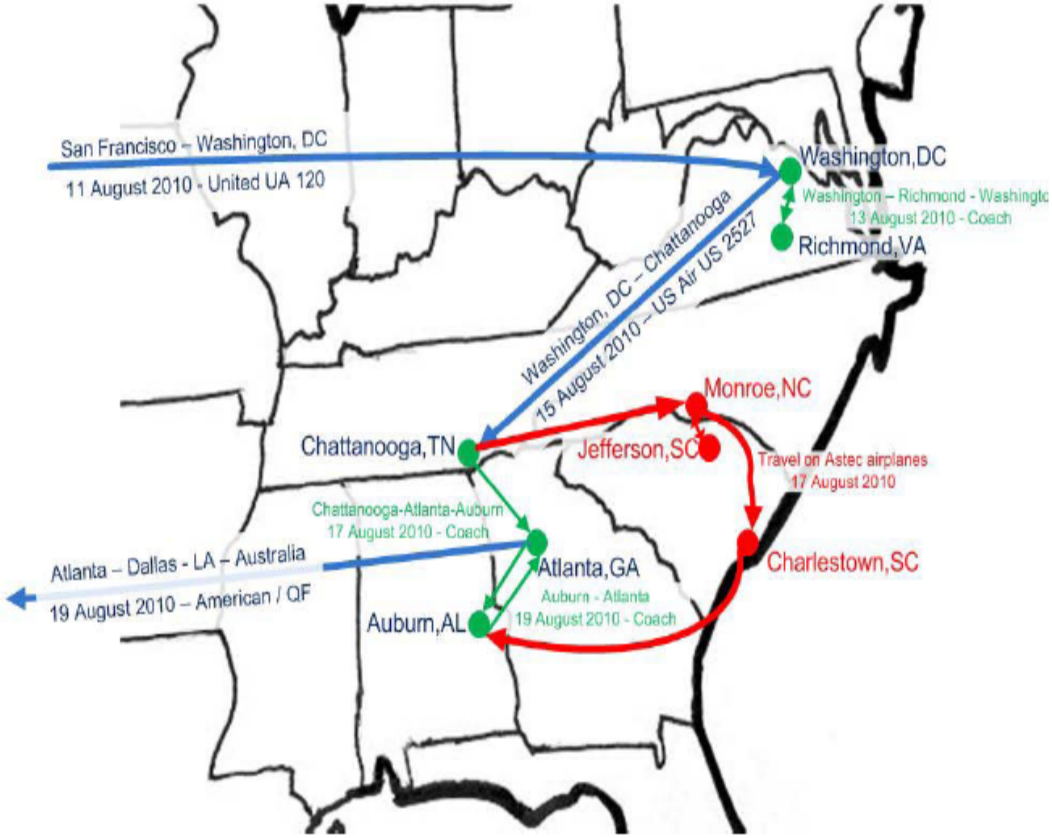
- Across the world support and active participation in associations like:
  - NAPA
  - AAPA
  - Association of Equipment Manufacturers
  - American Road and Transportation Builders association

AAPA

# STUDY TOUR 2010

## California travel


## Washington, Tennessee & Alabama travel



# AAPA 2010 Study Tour to USA

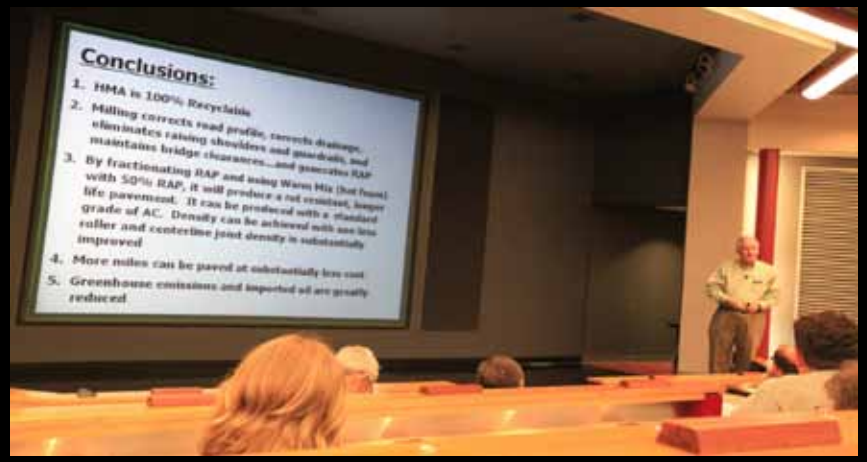
Key issues for the tour

- Perpetual Pavements
- Warm Mix Asphalt
- Recycled Asphalt Pavements

In conjunction with Astec Australia, we organized meetings in the USA with key Departments of Transport, Asphalt Contractors and Academia / Researchers.

# AAPA Study Tour at ASTEC

- Marshall Thompson
  - Fatigue Endurance Limits
  - Perpetual Pavements
  - RAP & RAS
- Don Brock
  - WMA & RAP

# Organized meetings with D.O.T.’s & transport across TN, NC, SC and AL


**AAPA 2011 Study Tour at NCAT in Auburn, Alabama**

**Listening, learning and taking the message back to Australia**


Questions?
David


Mervyn


AAPA
STUDY TOUR
2010
Feedback Seminars
Brisbane.Q
Perth, WA
Sydney.NSW
Adelaide. SA
Melbourne. Vic

# AAPA 2011 Study Tour Outcomes

- Perpetual Pavements
  - Strong support for long life flexible pavement project with USA feedback on concepts and practice
  - Links to NCAT, FHWA, State DoT for materials performance
  - Meeting visitors to this conference:
    David Timm, Marshall Thompson, Buzz Powell
- WMA & RAP
  - Increased acceptance of benefits
  - Advantages of combining WMA & RAP
  - Drive for use of all available RAP
  - Increased acceptance of WMA in Australian spec's

# 1598

Sir Walter Raleigh discovers Trinidad Asphalt Lake

# 1893

Barber Asphalt & Paving Co.

# WARREN'S PORTABLE ASPHALT PLANT

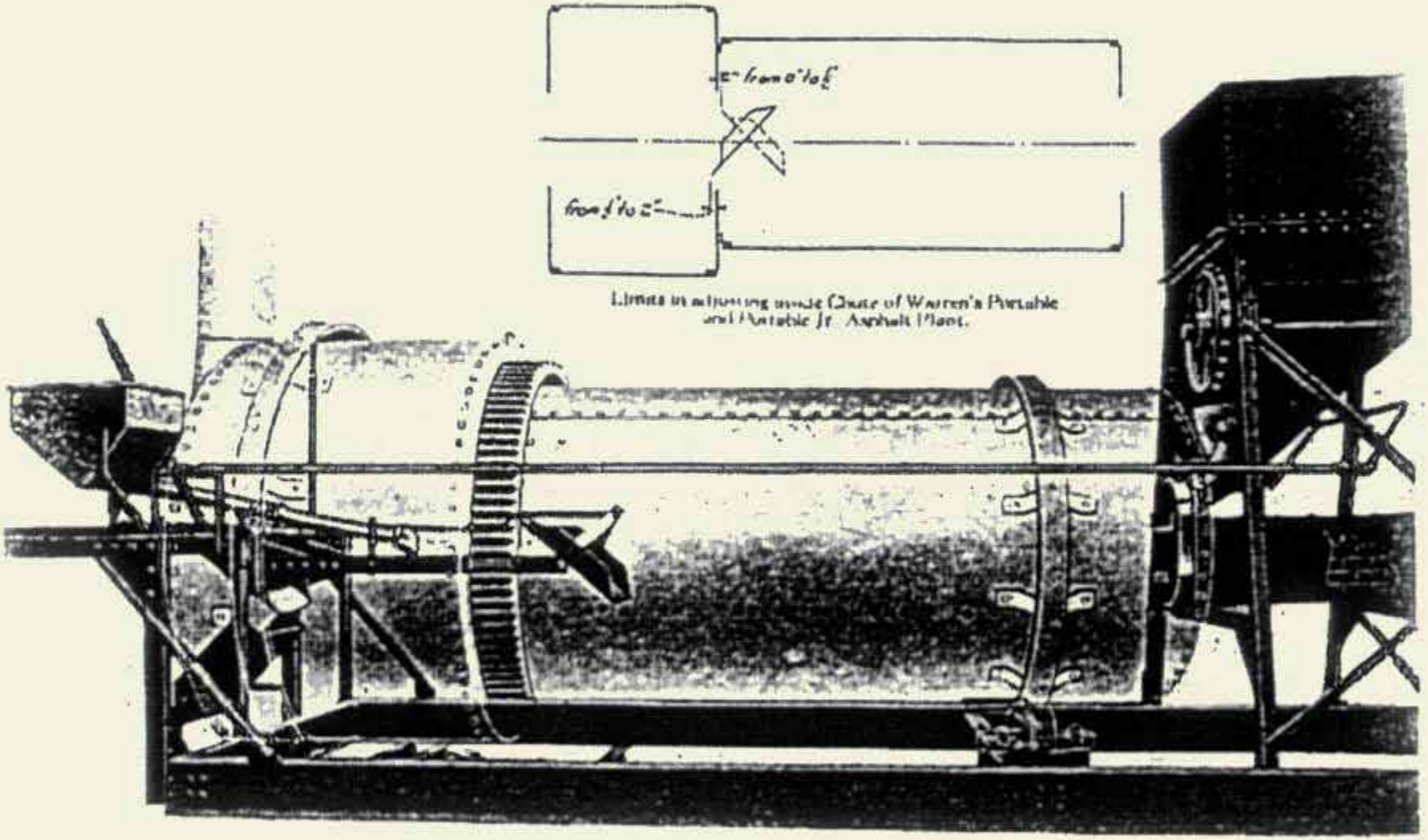
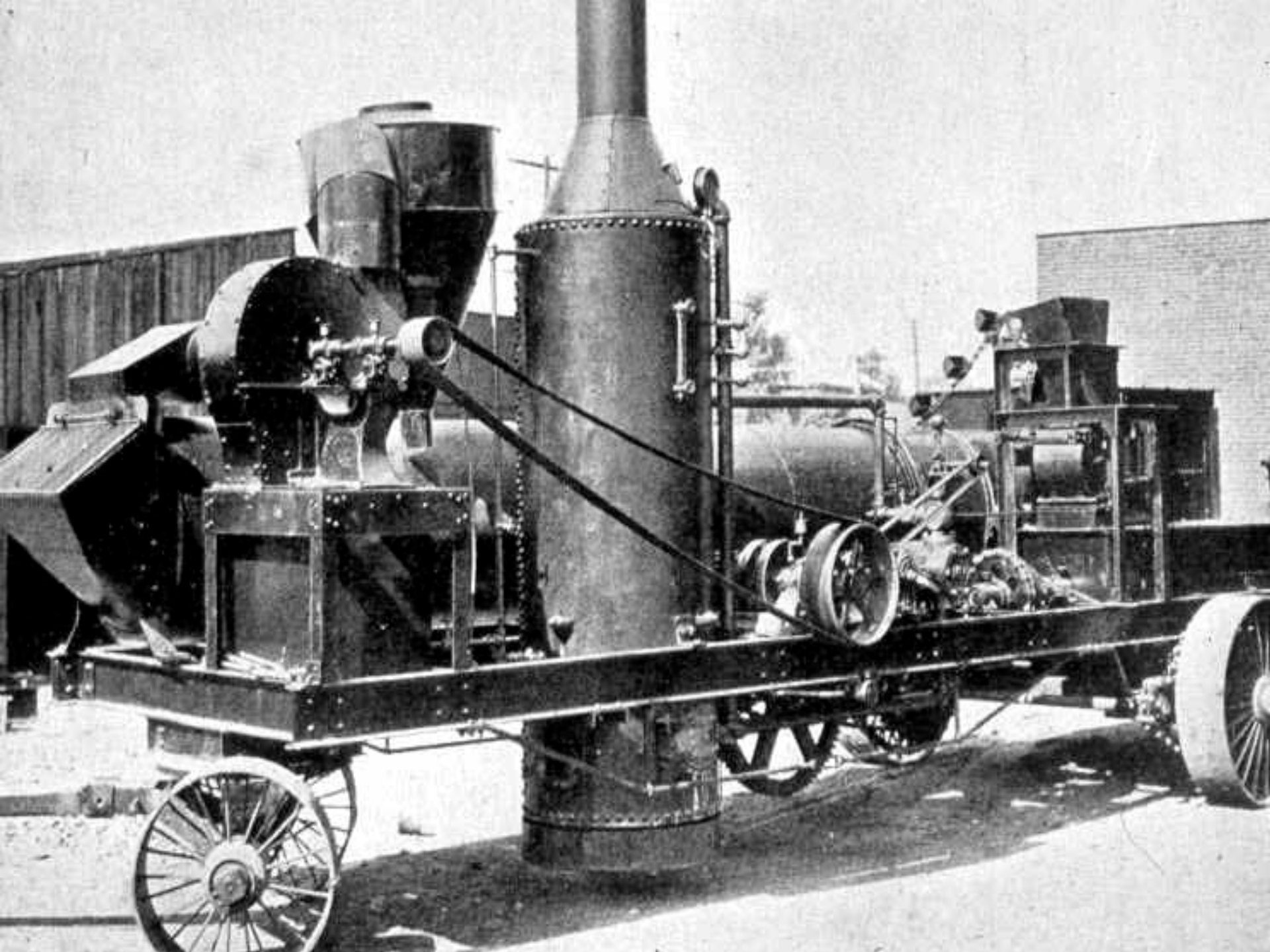
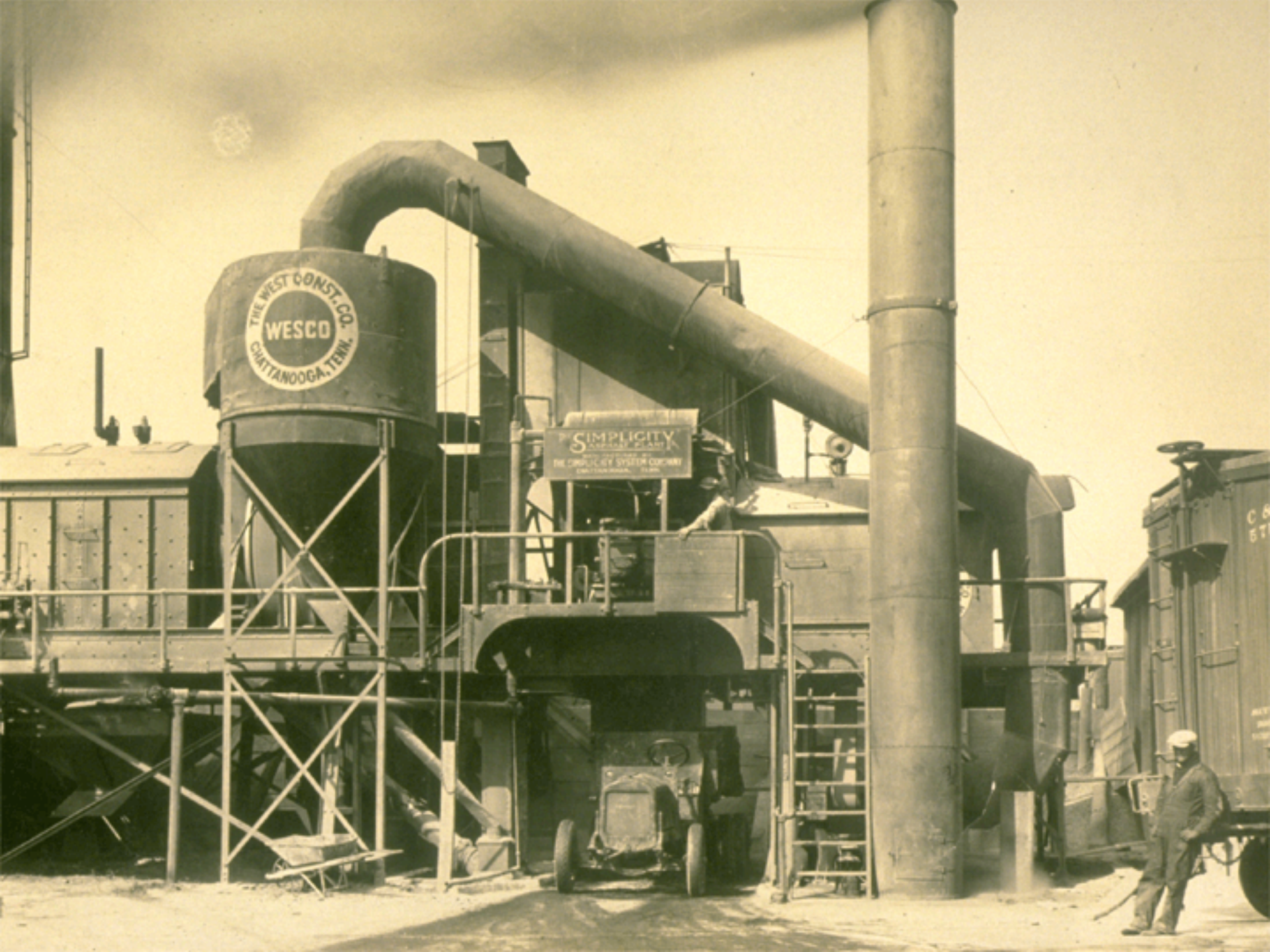
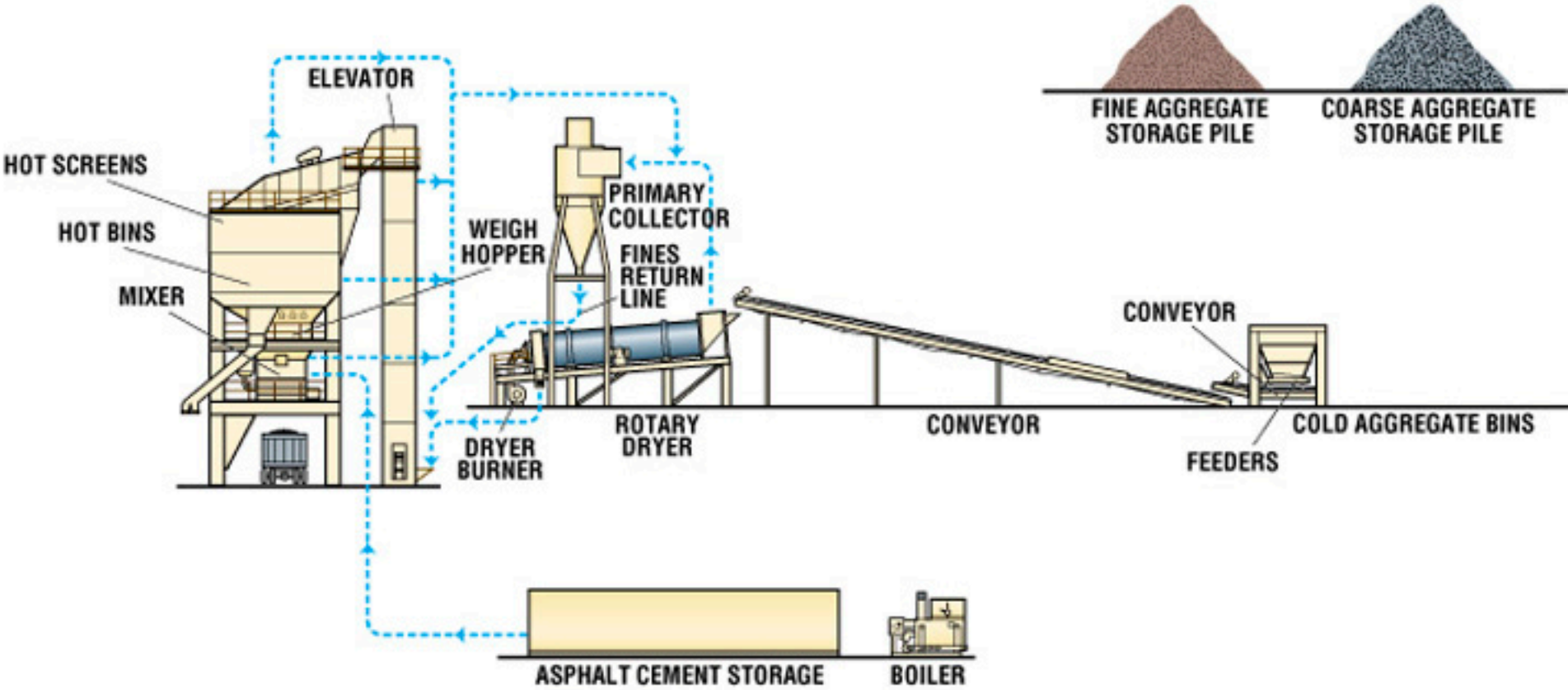


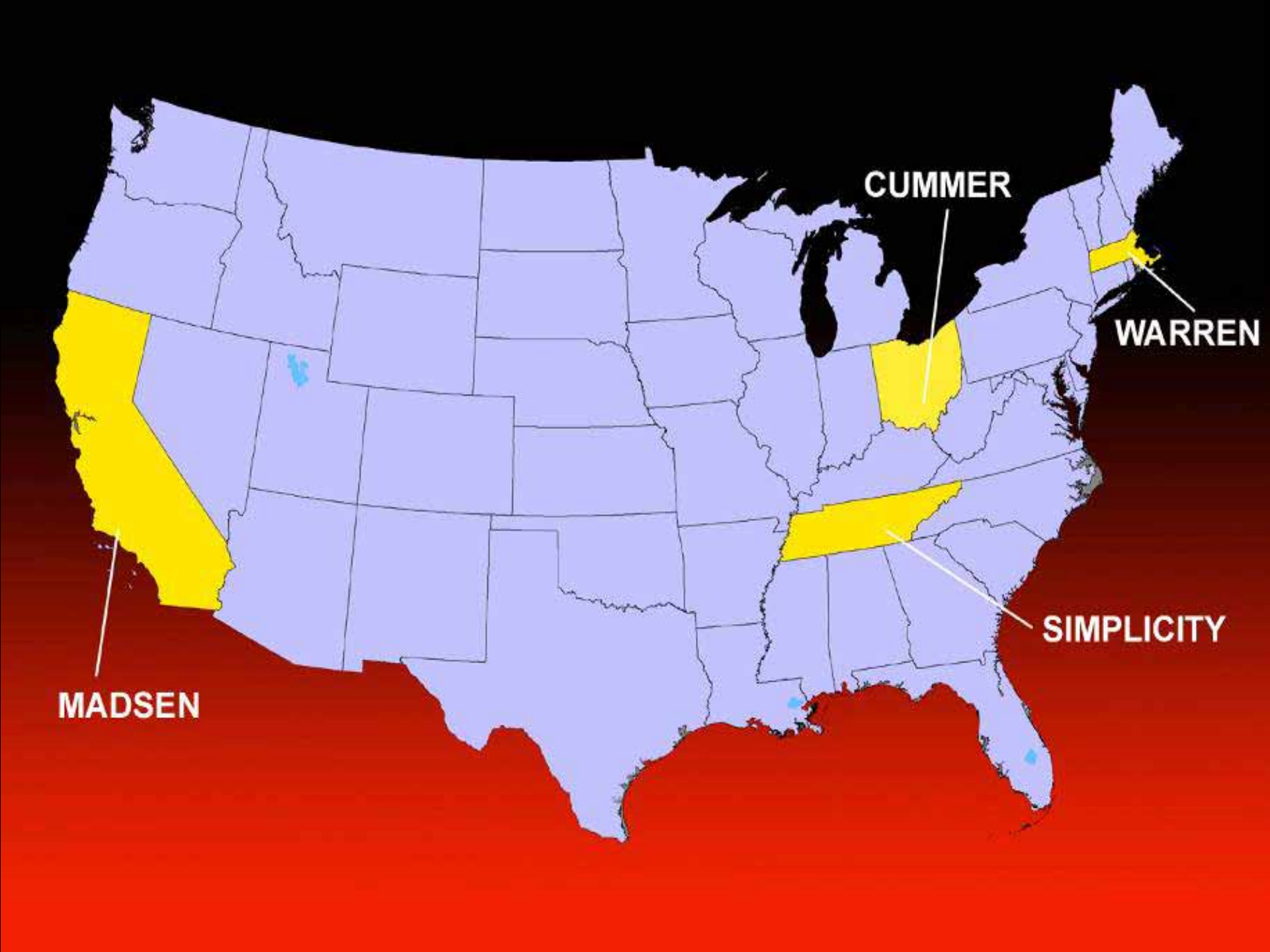

PHOTO OF BOTHELL ROAD
TAKEN MAY 8, 1912
W B & S SEATTLE, WASH.

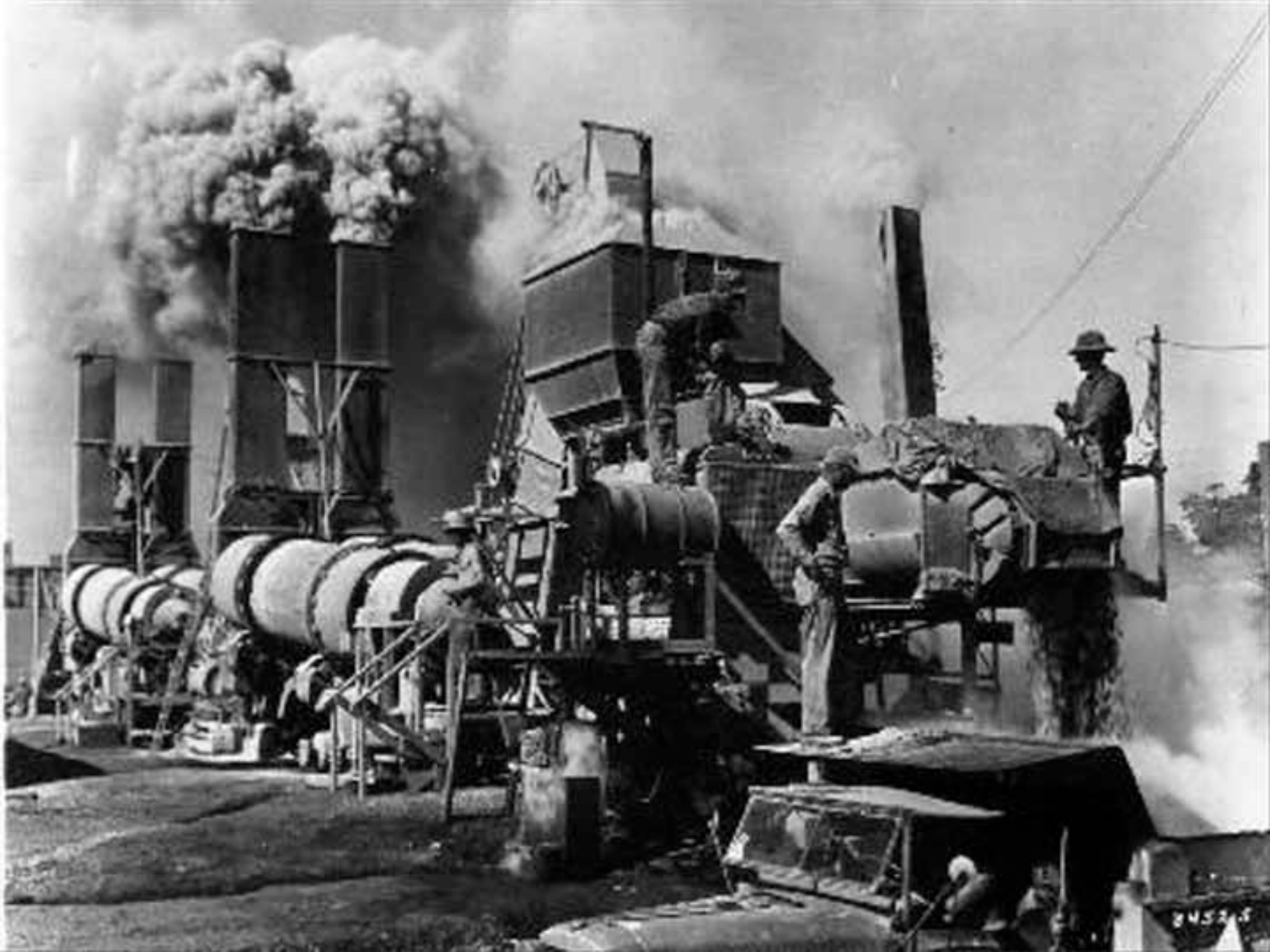


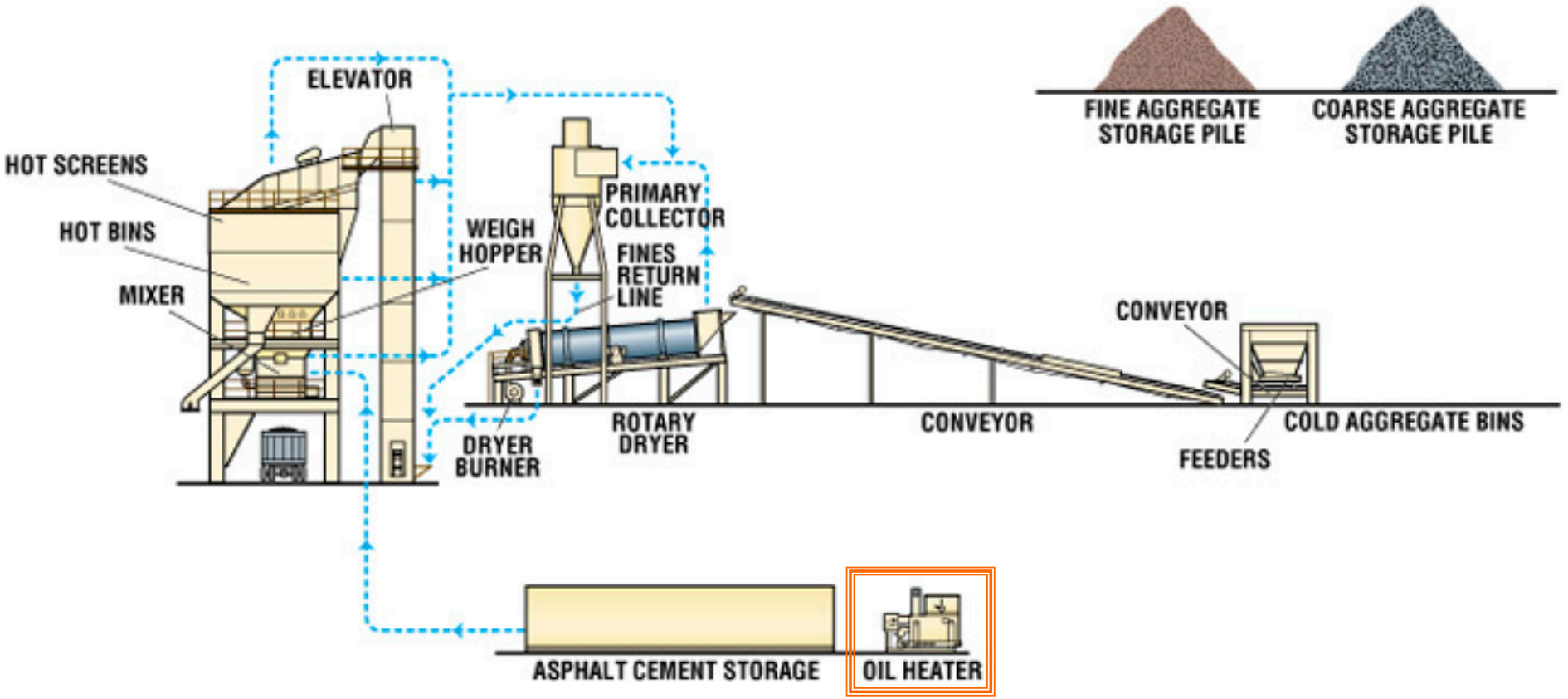

THE WEST CONST. CO.
WESCO
CHATTANOOGA, TENN.
SIMPLICITY



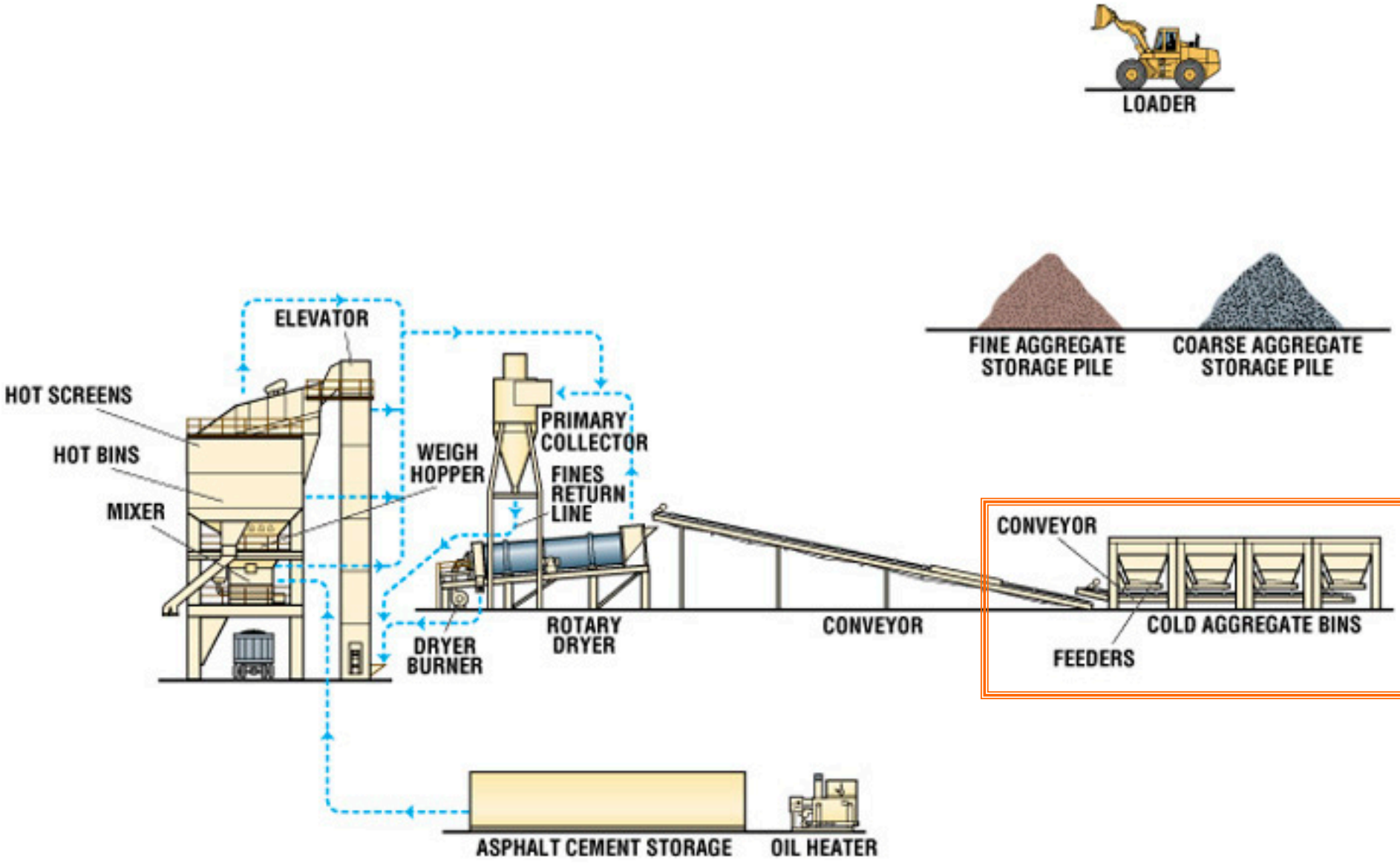

# PROCESS FLOW DIAGRAM FOR BATCH MIX ASPHALT PAVING PLANTS


CUMMER
WARREN
SIMPLICITY
MADSEN






# PROCESS FLOW DIAGRAM FOR BATCH MIX ASPHALT PAVING PLANTS




# PROCESS FLOW DIAGRAM FOR BATCH MIX ASPHALT PAVING PLANTS

# Grading Requirements for Coarse Aggregates

| Size Number | Normal Size (Sieves with Square Openings) | Amounts Finer Than Each Laboratory Sieve (Square-Openings), Weight Percent | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 4 inch (100mm) | ¾ inch (90mm) | 3 inch (75mm) | 2 ½ inch (63mm) | 2 inch (50mm) | 1 ½ inch (37.5mm) | 1 inch (25mm) | ¾ inch (19mm) | ½ inch (12.5mm) | ⅜ inch (9.5mm) | No. 4 (4.75mm) | No. 8 (2.36mm) | No. 16 (1.8mm) |
| 1 | 3½ in. to 1½ in. (90 to 37.5mm) | 100 | 90-100 | | 25-60 | | 0-15 | | 0-5 | | | | | |
| 2 | 2½ in. to 1½ in. (63 to 37.5mm) | | | 100 | 90-100 | 35-70 | 0-15 | | 0-5 | | | | | |
| 3 | 2 in. to 1 in. (50 to 25mm) | | | | 100 | 90-100 | 35-70 | 0-15 | | 0-5 | | | | |
| 357 | 2 in. to No 4 (50 to 4.75mm) | | | | 100 | 95-100 | | 35-70 | | 10-30 | | 0-5 | | |
| 4 | 1½ in. to ¾ in. (37.5 to 19mm) | | | | | 100 | 90-100 | 20-55 | 0-15 | | 0-5 | | | |
| 467 | 1½ in. to No. 4 (37.5 to 4.75mm) | | | | | 100 | 95-100 | | 35-70 | | Oct-34 | 0-5 | | |
| 5 | 1 in. to ½ in. (25 to 12.5mm) | | | | | | 100 | 90-100 | 20-55 | 0-10 | 0-5 | | | |
| 56 | 1 in. to ⅜ in. (25 to 9.5mm) | | | | | | 100 | 90-100 | 40-85 | 10-40 | 0-15 | 0-5 | | |
| 57 | 1 in. to No. 4 (25 to 12.5mm) | | | | | | 100 | 95-100 | | 25-60 | | 0-10 | 0-5 | |
| 6 | ¾ in. to ⅜ in. (25 to 4.75mm) | | | | | | | 100 | 90-100 | 20-55 | 0-15 | 0-5 | | |
| 67 | 3¼ in. to No. 4 (19 to 4.75mm) | | | | | | | 100 | 90-100 | | 20-55 | 0-10 | 0-5 | |
| 7 | ½ in. to No. 4 (12.5 to 4.75mm) | | | | | | | | 100 | 90-100 | 40-70 | 0-15 | 0-5 | |
| 8 | ⅜ in. to No. 8 (9.5 to 2.36mm) | | | | | | | | | 100 | 85-100 | 10-30 | 0-10 | 0-5 |
| | | | | | | | | | | | | | | |

Yellow indicates range of passing on 57's

# ASTM Gradation Surface Standards

| Mesh Number and Size | Surface Area Sq. Ft/Lb |
|---|---|
| 200 | 150.2 |
| 100 | 73.9 |
| 50 | 37.2 |
| 30 | 18.8 |
| 16 | 9.3 |
| 8 | 4.65 |
| 4 | 2.33 |
| 3/8″ | 1.16 |
| 1/2″ | 0.87 |
| 3/4″ | 0.58 |
| 1″ | 0.43 |
| 1-1/2″ | 0.29 |
| 3″ | 0.145 |

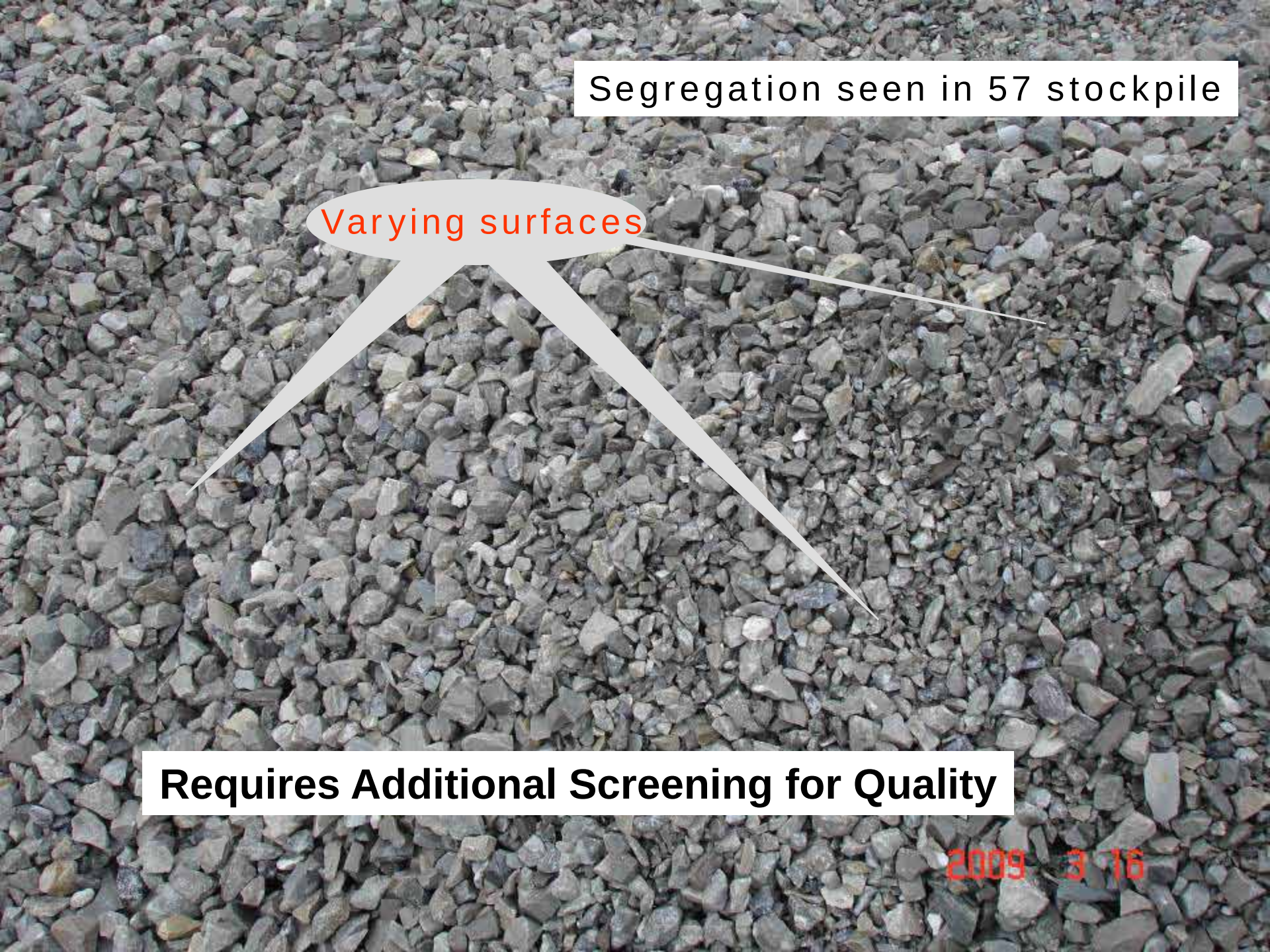
# Extreme Ranges of Gradation For 57 Stone

| 57 Stone | Coarse | Area | Fine | Area |
|---|---|---|---|---|
| 1 | 5 | 2.15 | 0 | 0 |
| 3/4 | | | | |
| 1/2 | 70 | 60.9 | 40 | 34.8 |
| 3/8 | | | | |
| 4 | 25 | 58.2 | 50 | 116.5 |
| 8 | 8 | | 5 | 23.2 |
| 16 | 16 | | 5 | 46.5 |

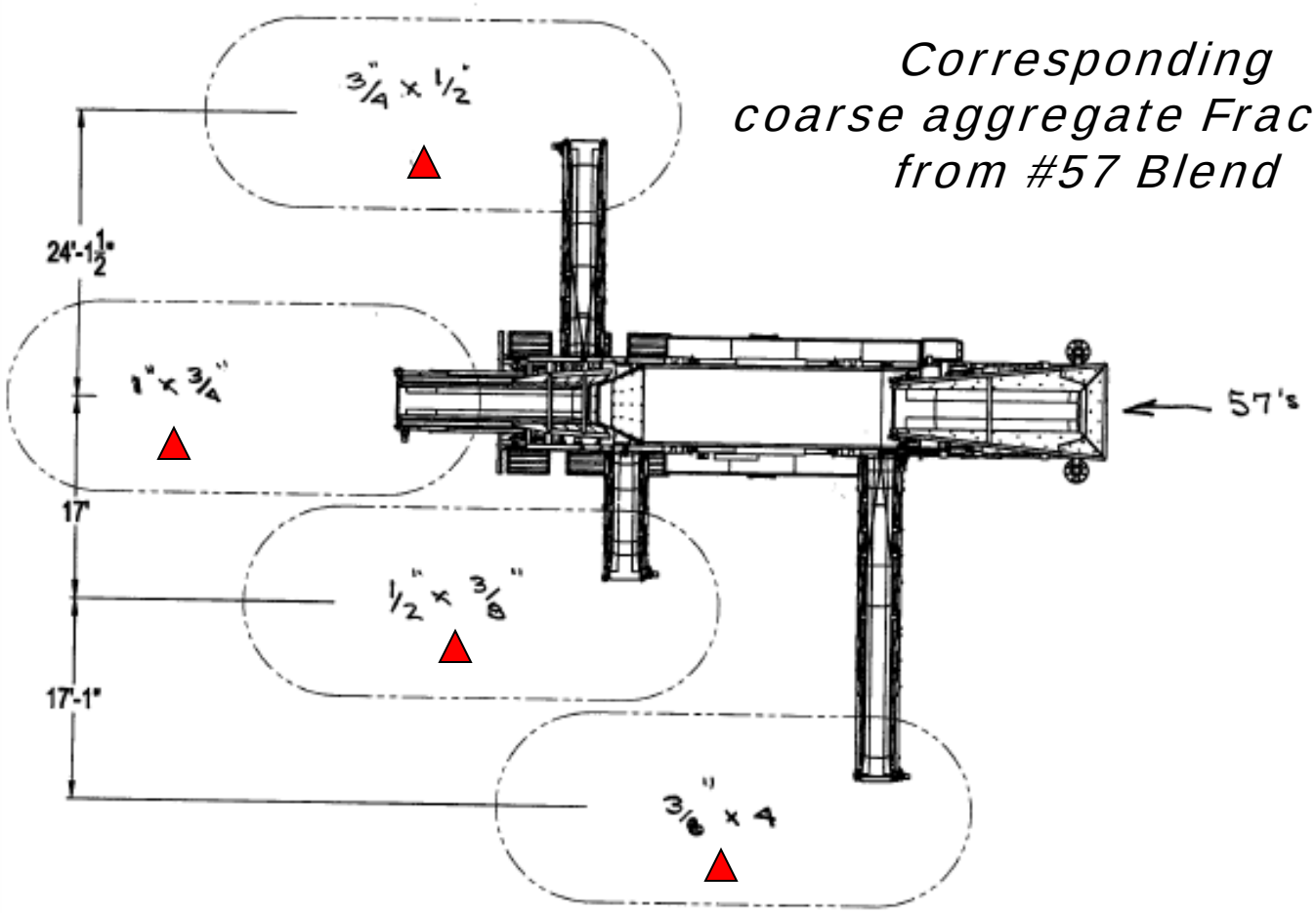
**121.3** ← → **221.0**

Surface area at coarse extremes — Surface area at fine extremes

**A RANGE OF 80% +**


Segregation seen in 57 stockpile
Varying surfaces
Requires Additional Screening for Quality
2009 3 16

These windrows are the same sizes identified from the Max Density Chart *AND* the Haystack Profile

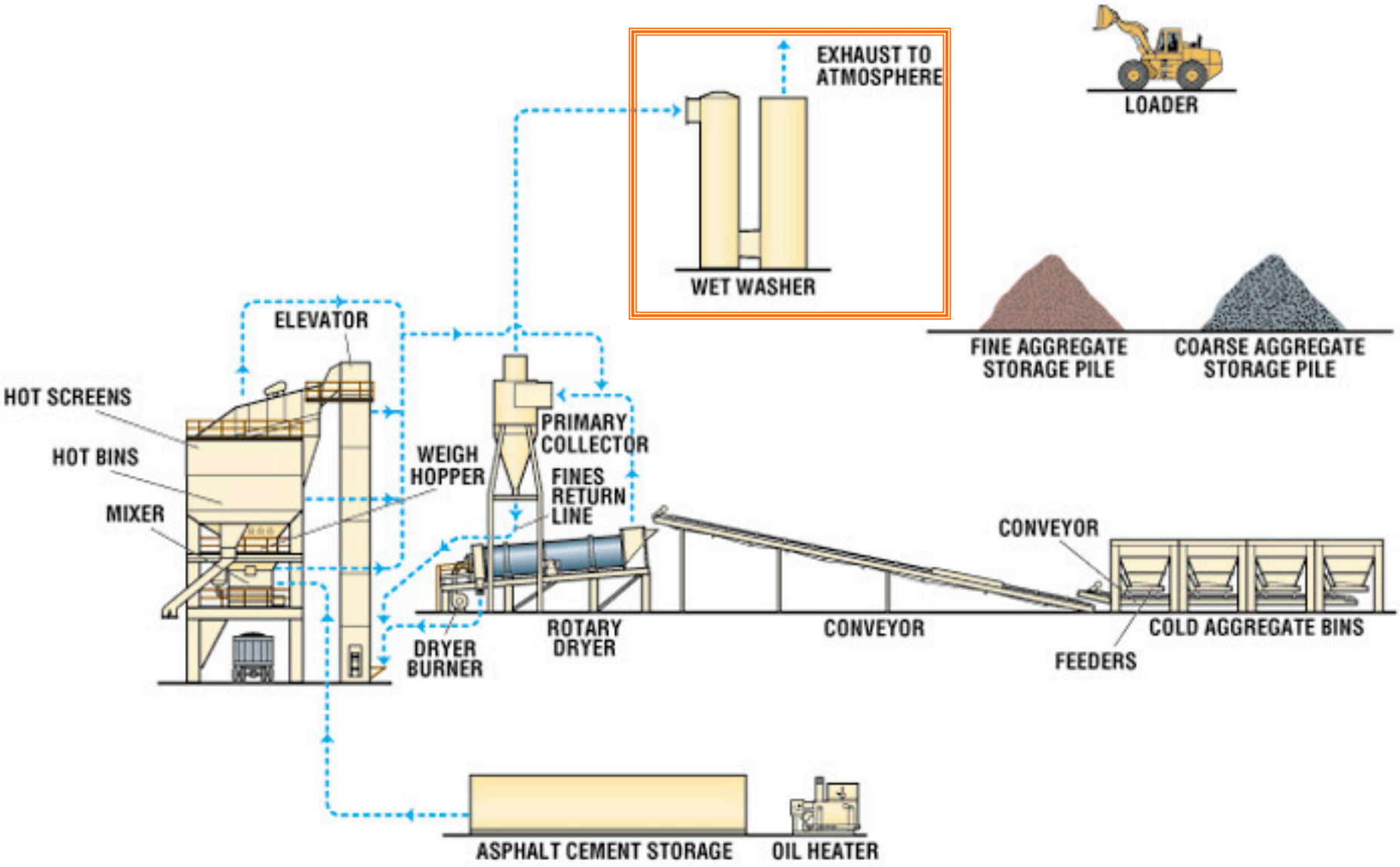



*Corresponding coarse aggregate Fractions from #57 Blend*

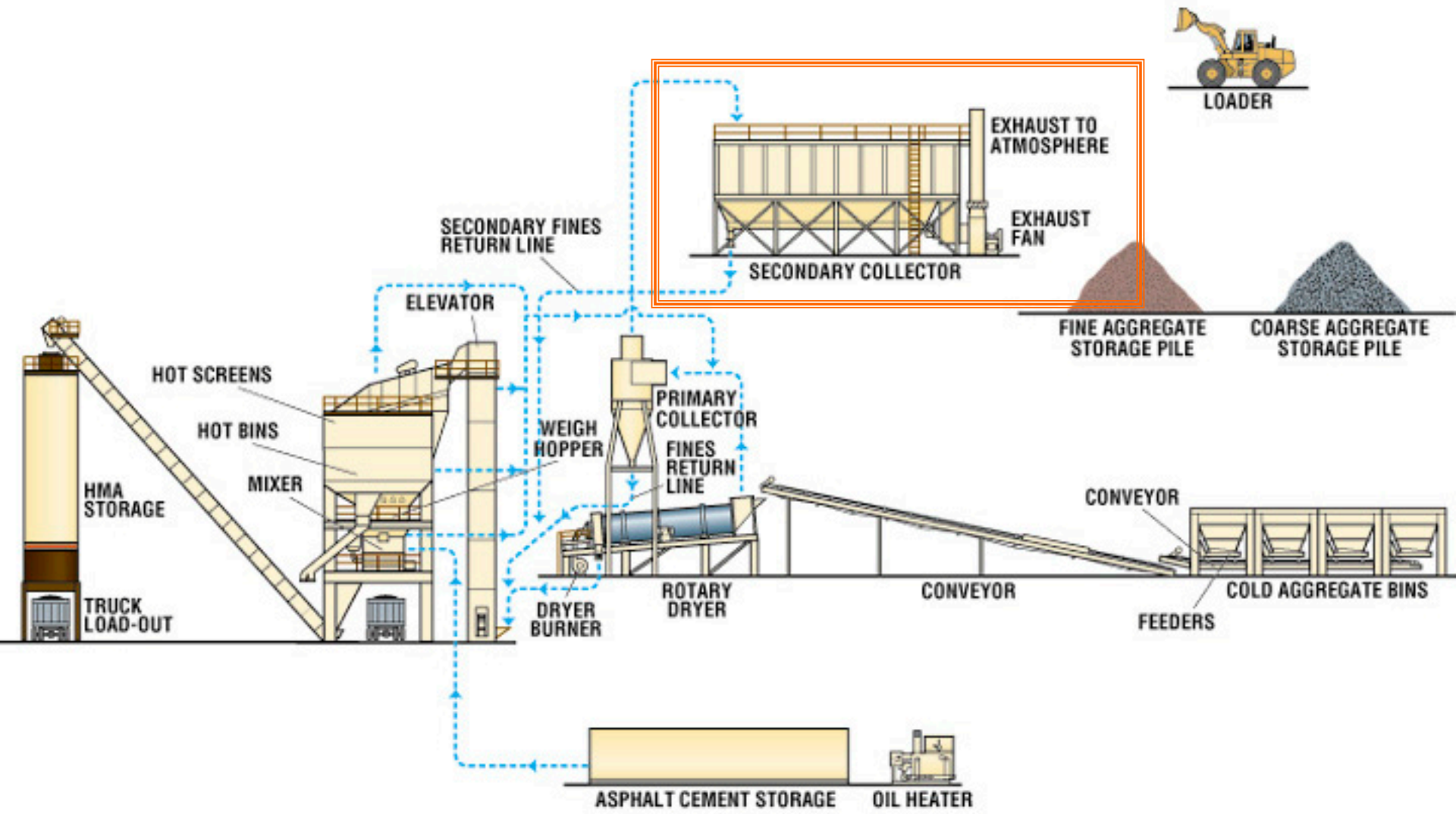
Screening with Kolberg-Pioneer FT6203,
3 screens in place, make 4 windrows from 57's


Screened three-quarter by half


Screened 57's




# PROCESS FLOW DIAGRAM FOR BATCH MIX ASPHALT PAVING PLANTS

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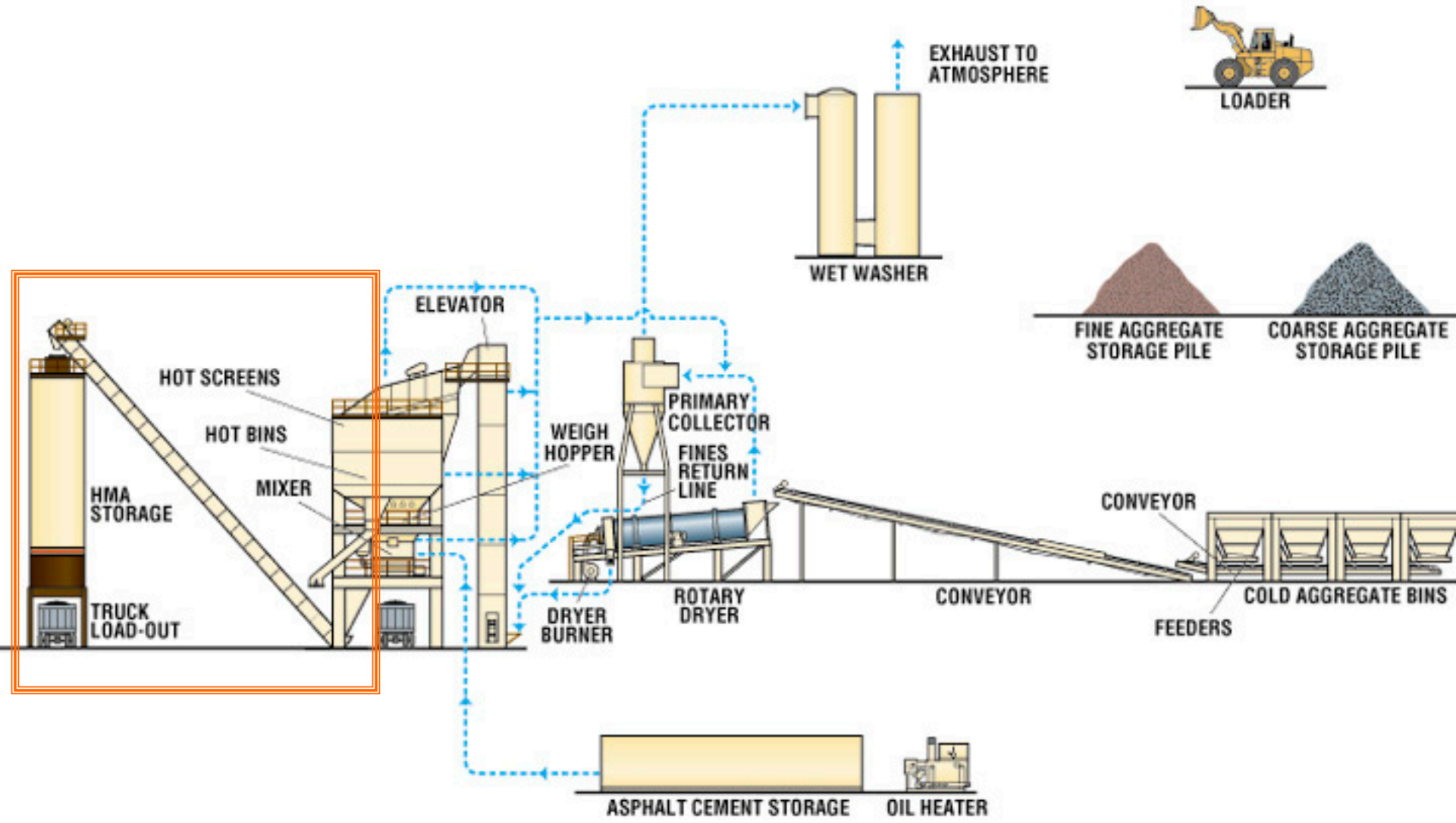
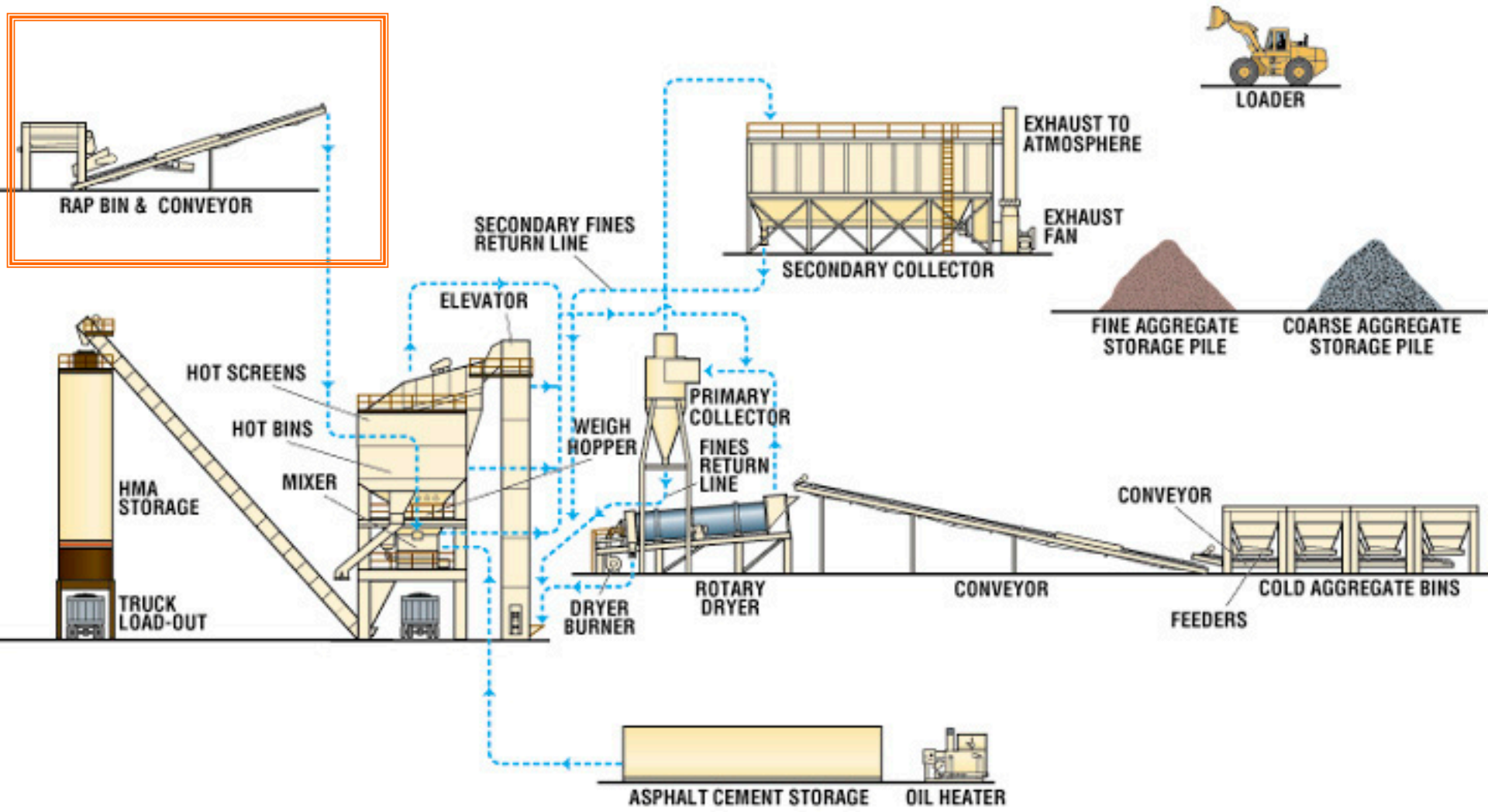



# PROCESS FLOW DIAGRAM FOR BATCH MIX ASPHALT PAVING PLANTS


INDUSTRIAL
BOILER CO.

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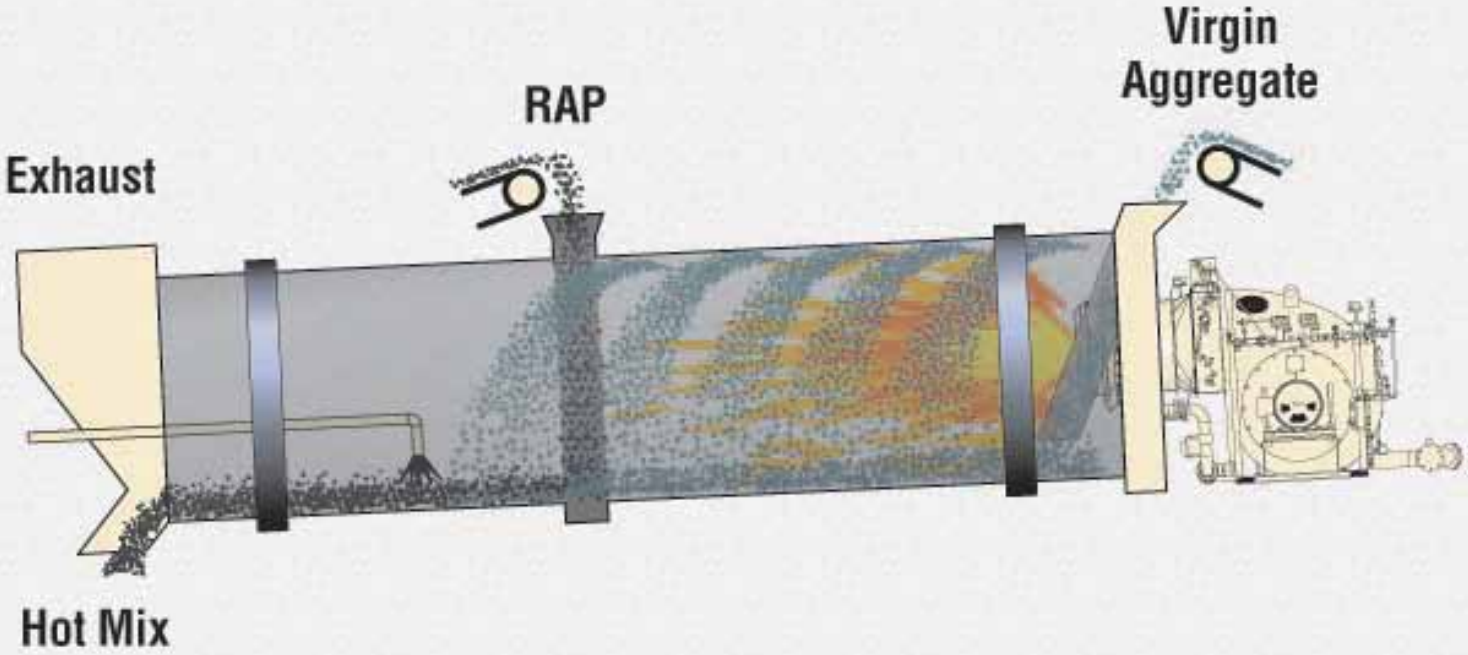
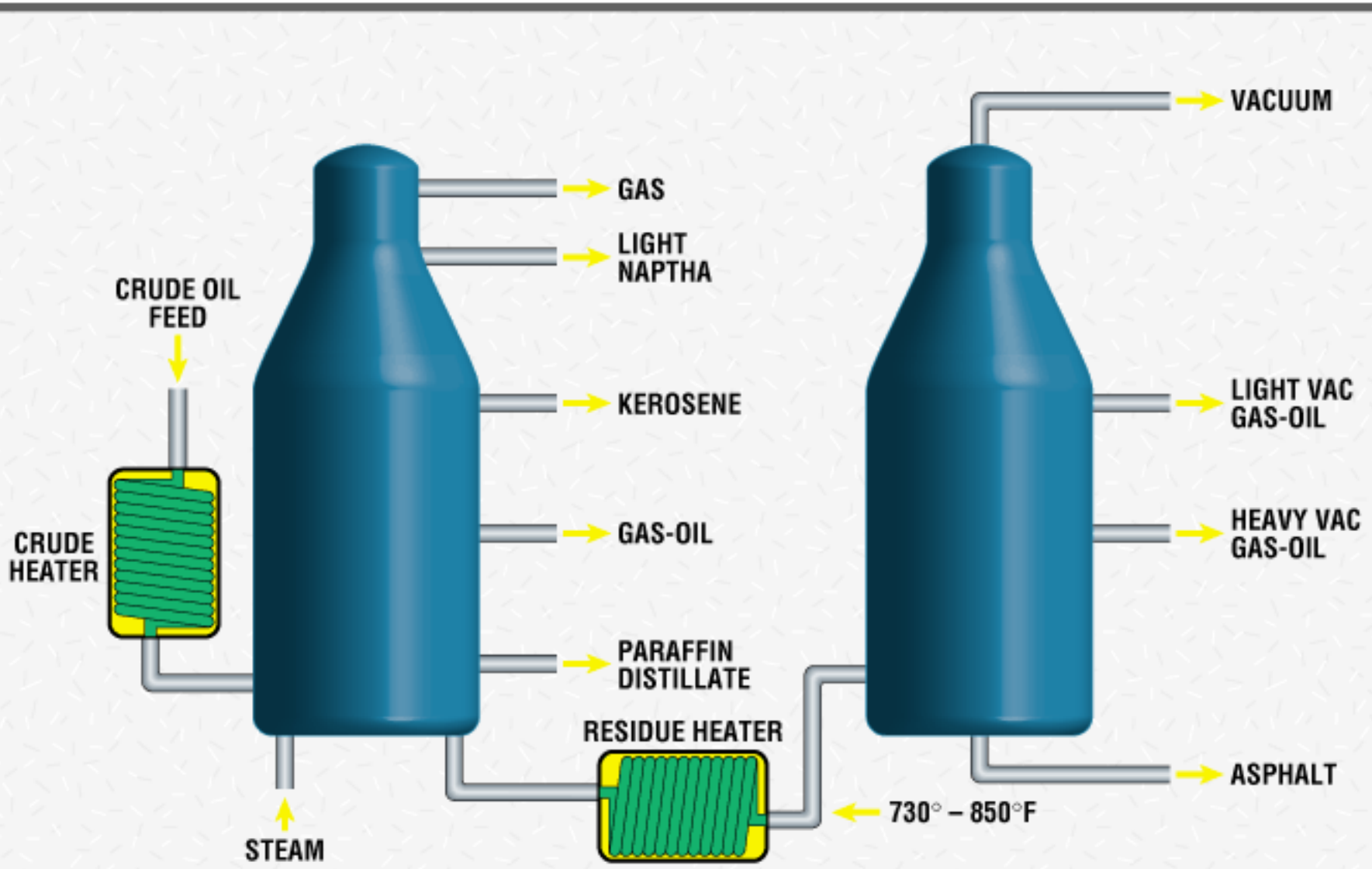
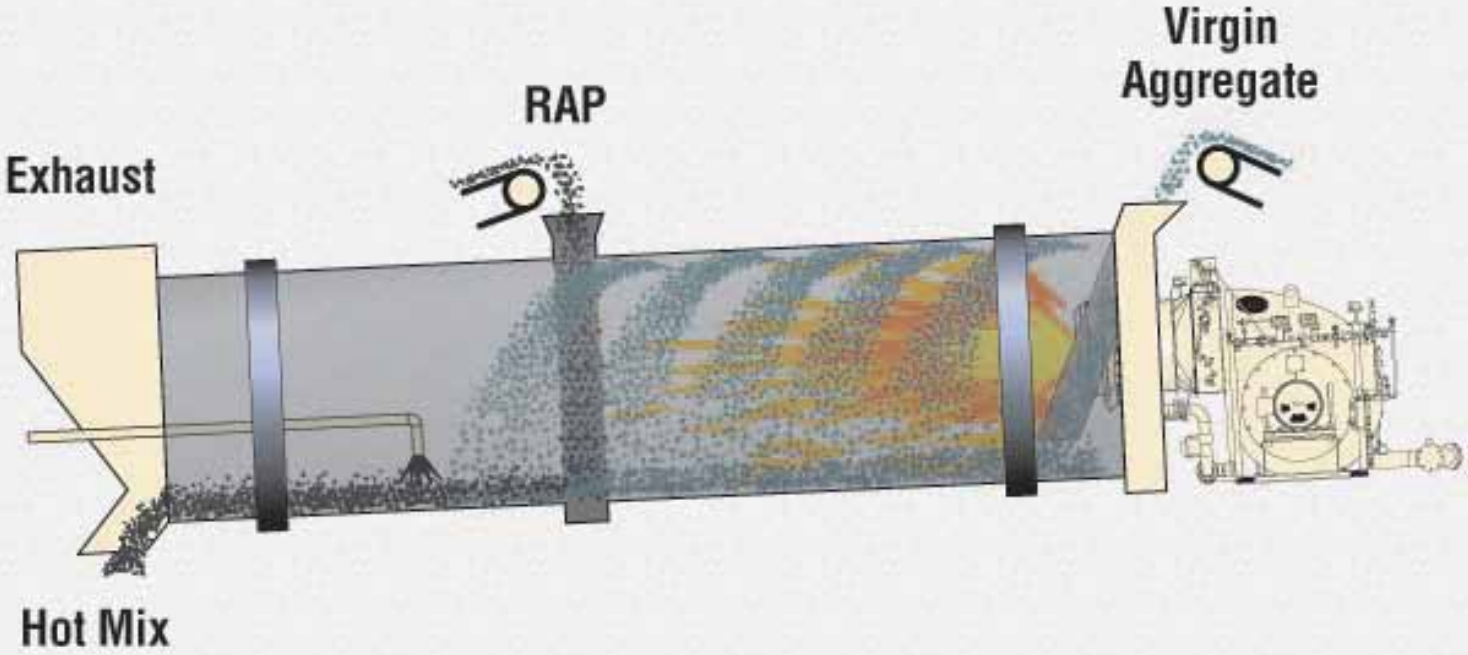


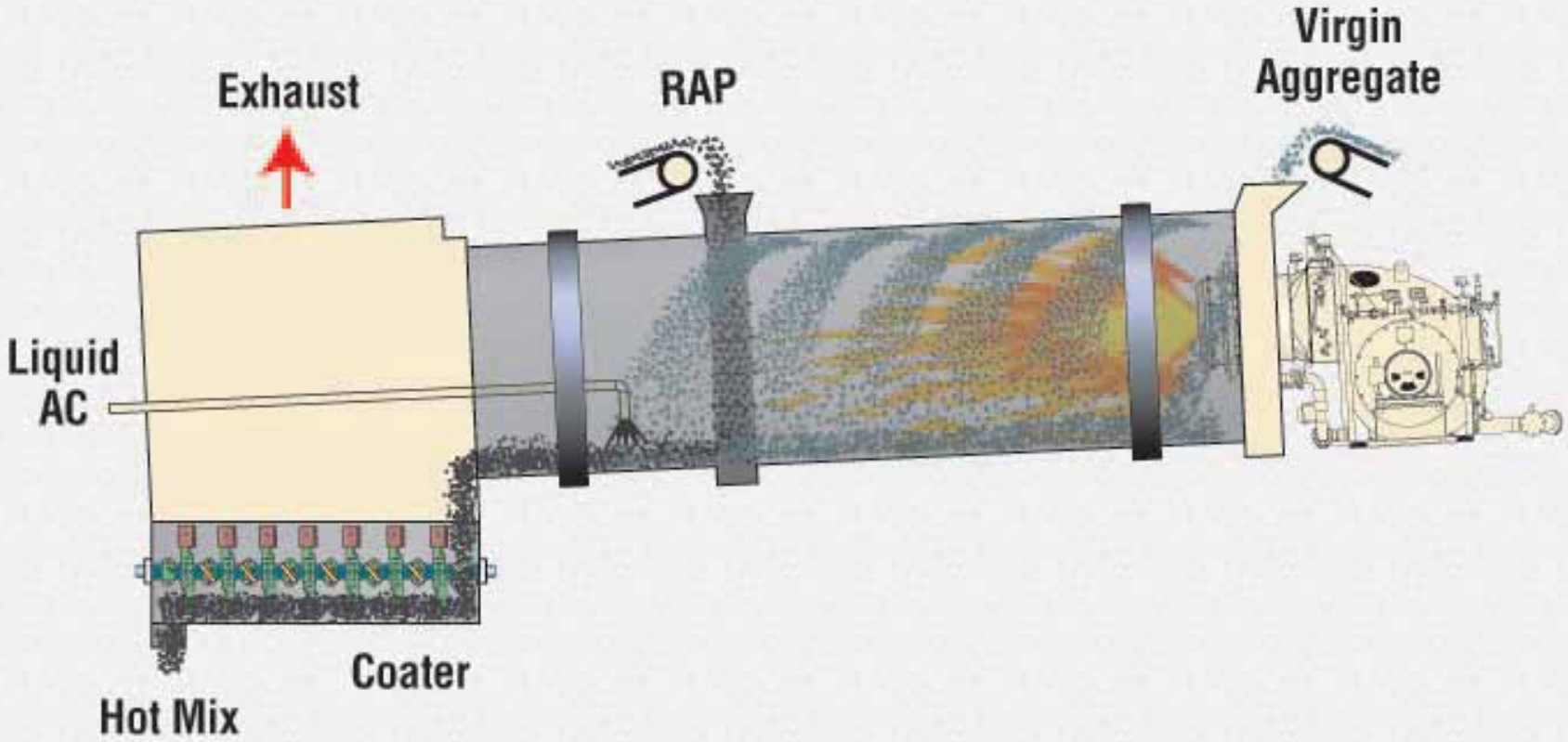

## Parallel Flow Drum Mixer



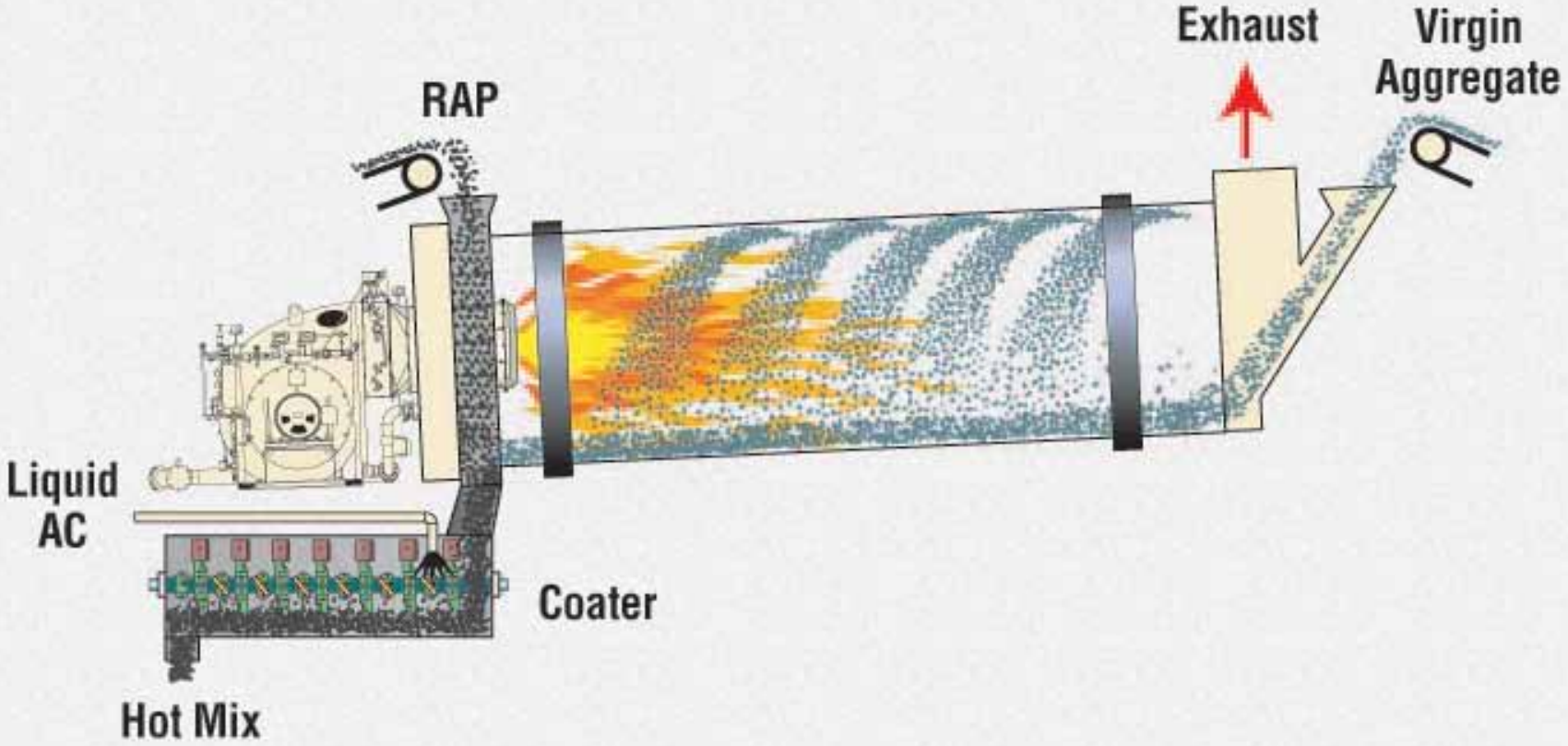

# REFINERY FLOW DIAGRAM




## Parallel Flow Drum Mixer




Parallel Flow Drum Mixer With Coater

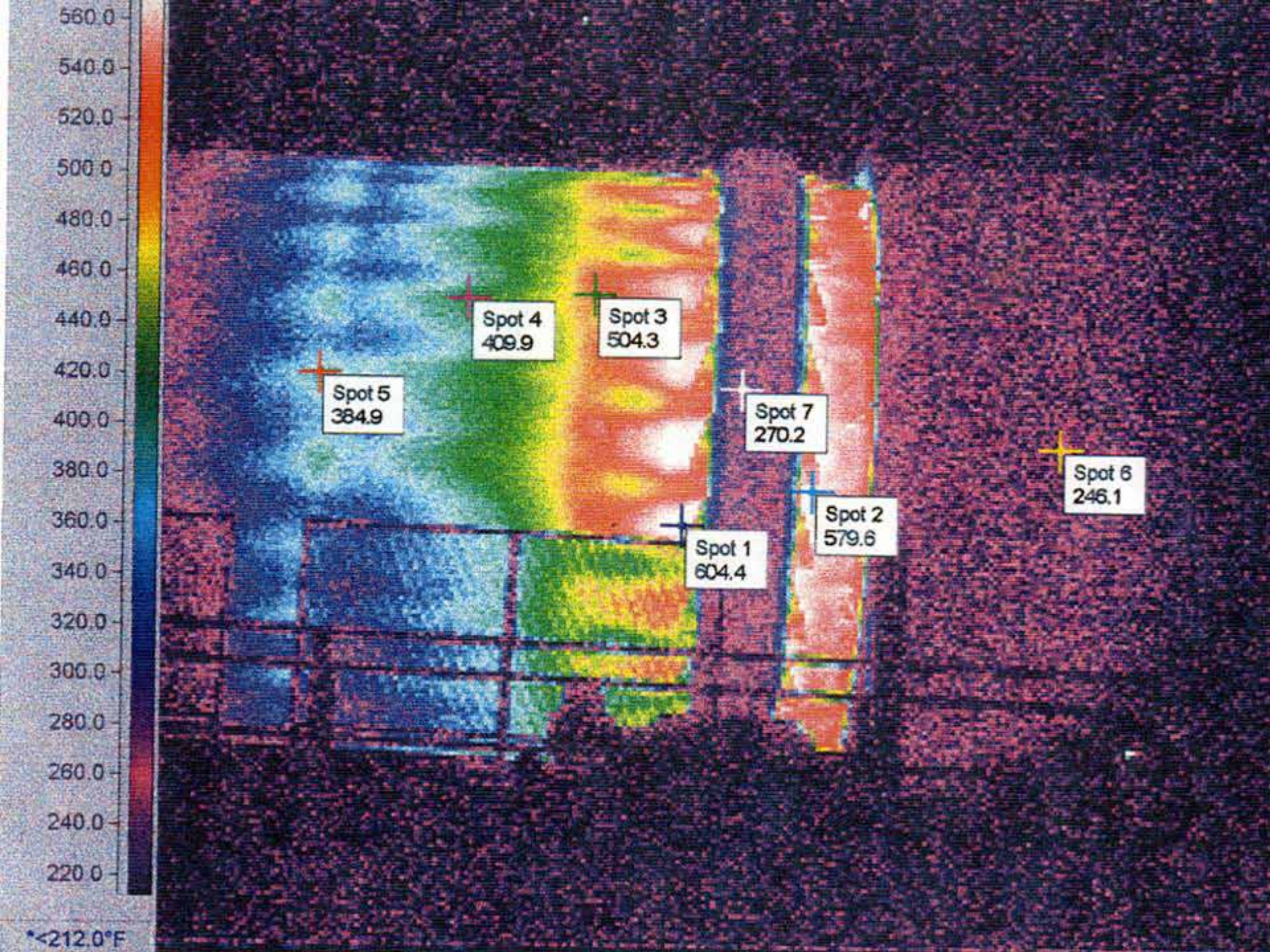


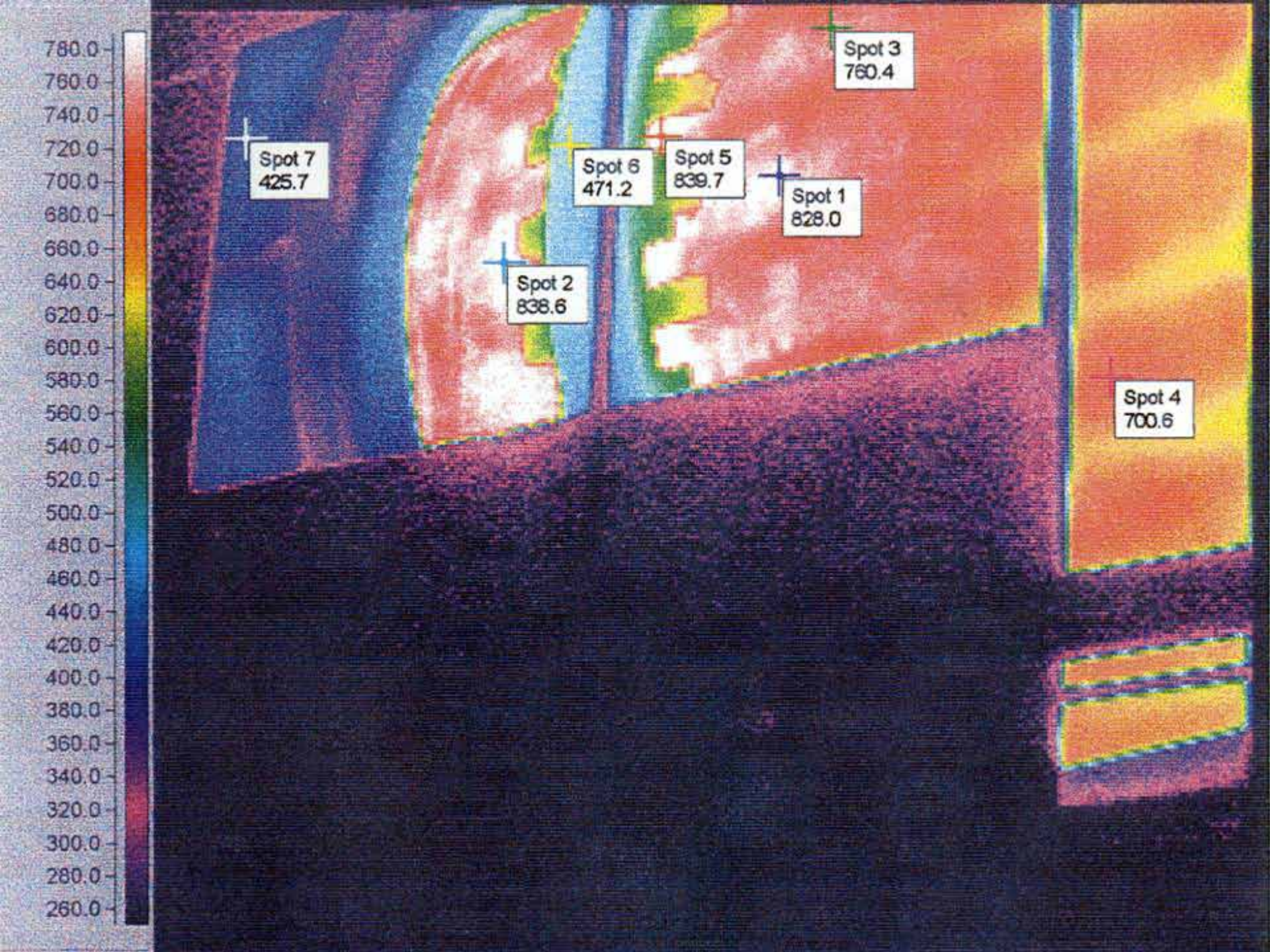

Counterflow Drying Drum With Coater

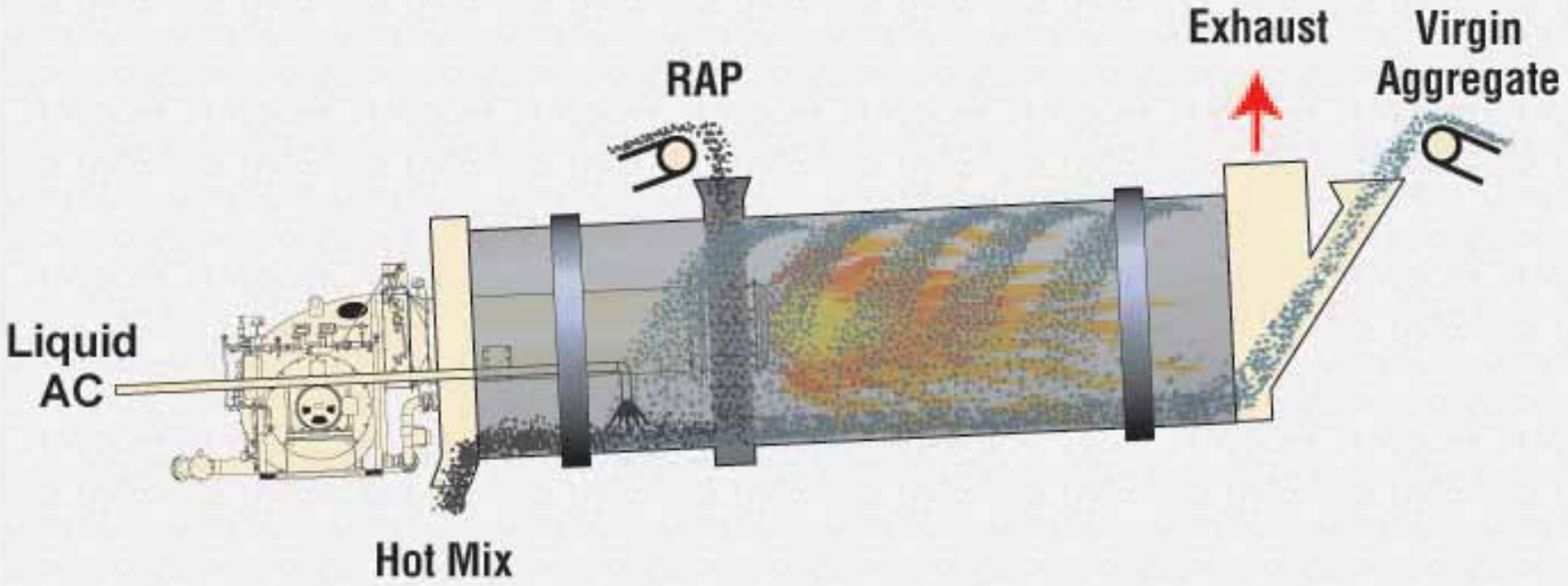
| RAP Content (%) | RAP Moisture Content (%) | Superheat Required (°F) 240°F Mix | 260°F Mix | 280°F Mix | 300°F Mix |
|---|---|---|---|---|---|
| 10 | 0 | 269 | 291 | 313 | 335 |
| | 1 | 274 | 296 | 318 | 340 |
| | 2 | 279 | 301 | 323 | 345 |
| | 3 | 284 | 306 | 328 | 350 |
| | 4 | 289 | 311 | 333 | 355 |
| | 5 | 294 | 316 | 338 | 360 |
| 20 | 0 | 292 | 317 | 342 | 367 |
| | 1 | 303 | 328 | 353 | 378 |
| | 2 | 314 | 339 | 364 | 389 |
| | 3 | 325 | 350 | 375 | 400 |
| | 4 | 336 | 361 | 386 | 411 |
| | 5 | 347 | 372 | 397 | 422 |
| 30 | 0 | 324 | 352 | 330 | 408 |
| | 1 | 343 | 371 | 599 | 427 |
| | 2 | 362 | 390 | 418 | 446 |
| | 3 | 381 | 409 | 437 | 465 |
| | 4 | 400 | 428 | 456 | 484 |
| | 5 | 419 | 447 | 475 | 503 |
| 40 | 0 | 366 | 397 | 430 | 463 |
| | 1 | 424 | 426 | 459 | 492 |
| | 2 | 453 | 455 | 488 | 521 |
| | 3 | 482 | 484 | 517 | 550 |
| | 4 | 511 | 513 | 546 | 579 |
| | 5 | 540 | 542 | 575 | 608 |
| 50 | 0 | 420 | 460 | 500 | 540 |
| | 1 | 464 | 504 | 544 | 588 |
| | 2 | 508 | 548 | 588 | 628 |
| | 3 | 552 | 592 | 632 | 672 |
| | 4 | 596 | 636 | 676 | 716 |
| | 5 | 640 | 680 | 720 | 760 |

NOTE: Calculations assume 10°F loss from dryer to pugmill and 70°F outside air temperature.

## Standard Counterflow Dryer (superheat required)


560.0
540.0
520.0
500.0
480.0
460.0
440.0
420.0
400.0
380.0
360.0
340.0
320.0
300.0
280.0
260.0
240.0
220.0
°<212.0°F
Spot 4
409.9
Spot 3
504.3
Spot 5
384.9
Spot 7
270.2
Spot 6
246.1
Spot 2
579.6
Spot 1
604.4

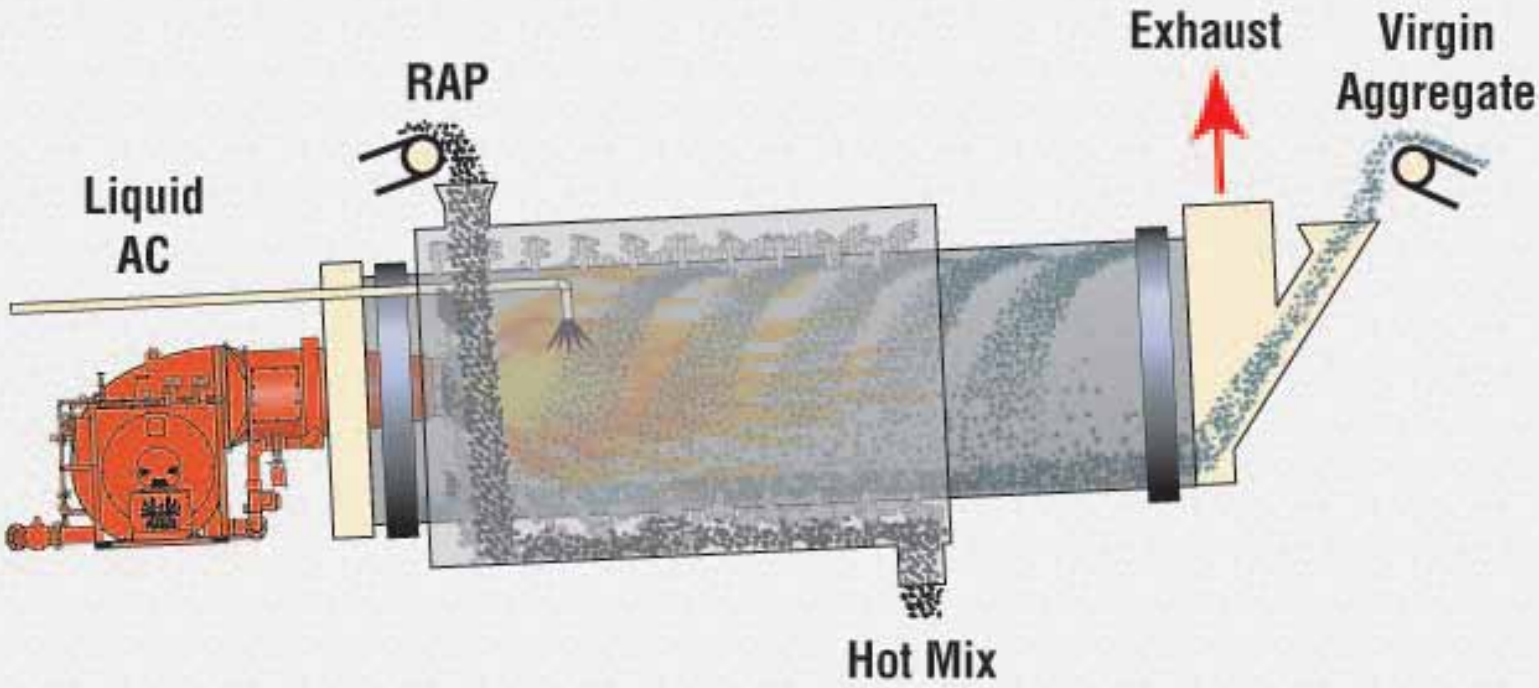

780.0
760.0
740.0
720.0
700.0
680.0
660.0
640.0
620.0
600.0
580.0
560.0
540.0
520.0
500.0
480.0
460.0
440.0
420.0
400.0
380.0
360.0
340.0
320.0
300.0
280.0
260.0
Spot 7
425.7
Spot 6
471.2
Spot 5
839.7
Spot 3
760.4
Spot 1
828.0
Spot 2
838.6
Spot 4
700.6




Counterflow Drum Mixer

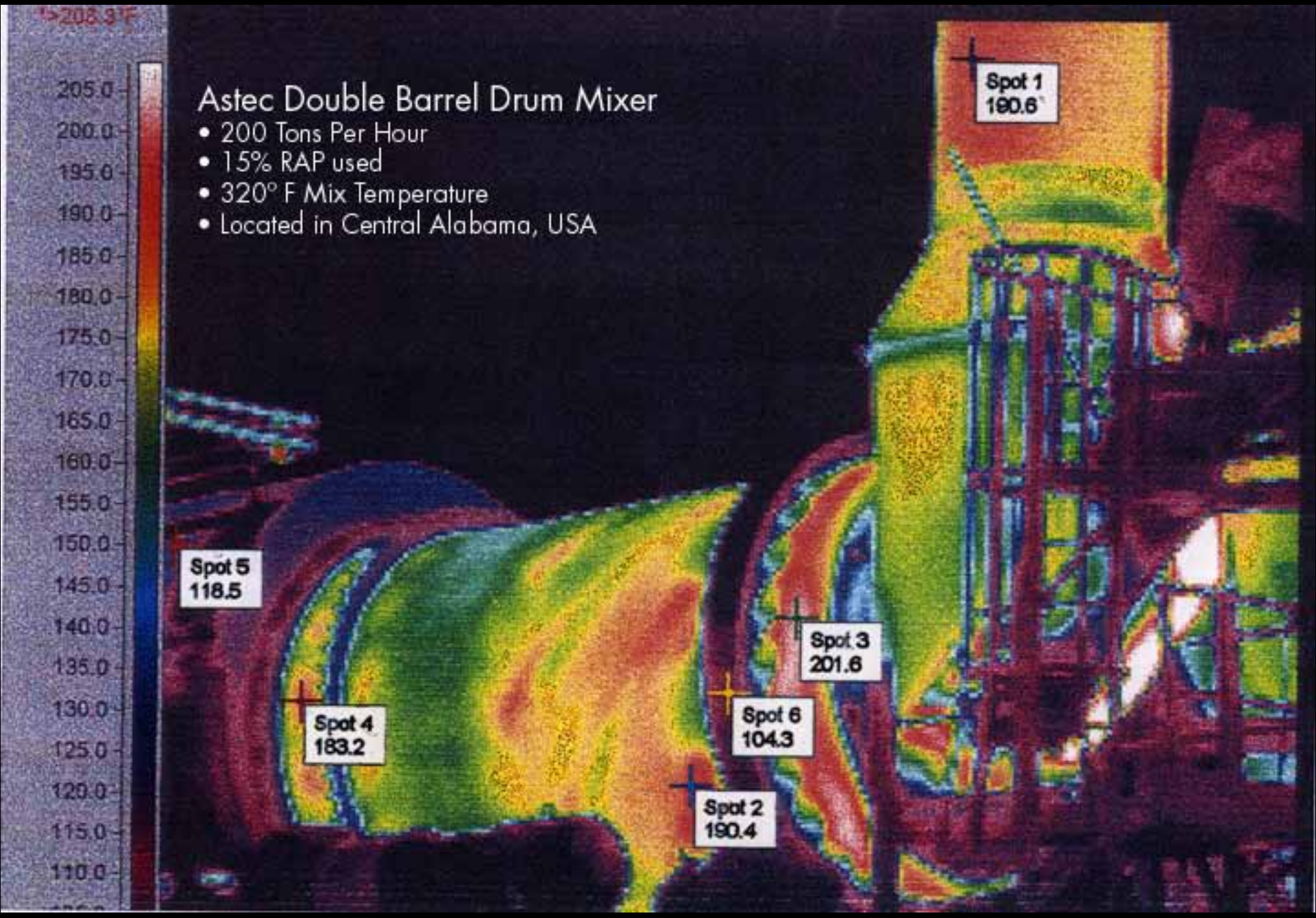

*>482.4°F
540.0
520.0
500.0
480.0
460.0
440.0
420.0
400.0
380.0
360.0
340.0
320.0
300.0
280.0
260.0
240.0
220.0
200.0
180.0
160.0
*<79.9°F
Gencor Counterflow Drum Mixer
• 215 Tons Per Hour
• 20% RAP used
• 305° F Mix Temperature
• Located on the Southeast Coast of Florida, USA
Spot 6
244.8
Spot 5
245.1
Spot 3
300.6
Spot 1
460.1
Spot 8
286.3
Spot 7
204.7
Spot 4
275.5
Spot 2
265.4


*>255.6°F
540.0
520.0
500.0
480.0
460.0
440.0
420.0
400.0
380.0
360.0
340.0
320.0
300.0
280.0
260.0
240.0
220.0
200.0
180.0
*<0.4°F
Gencor Counterflow Drum Mixer
• 200 Tons Per Hour
• 40% RAP used
• 305° F Mix Temperature
• Located on the Southeast Coast of Florida, USA
Spot 8
250.4
Spot 6
285.2
Spot 7
375.0
Spot 5
361.2
Spot 4
424.8
Spot 3
540.0
Spot 2
243.5
Spot 1
272.3

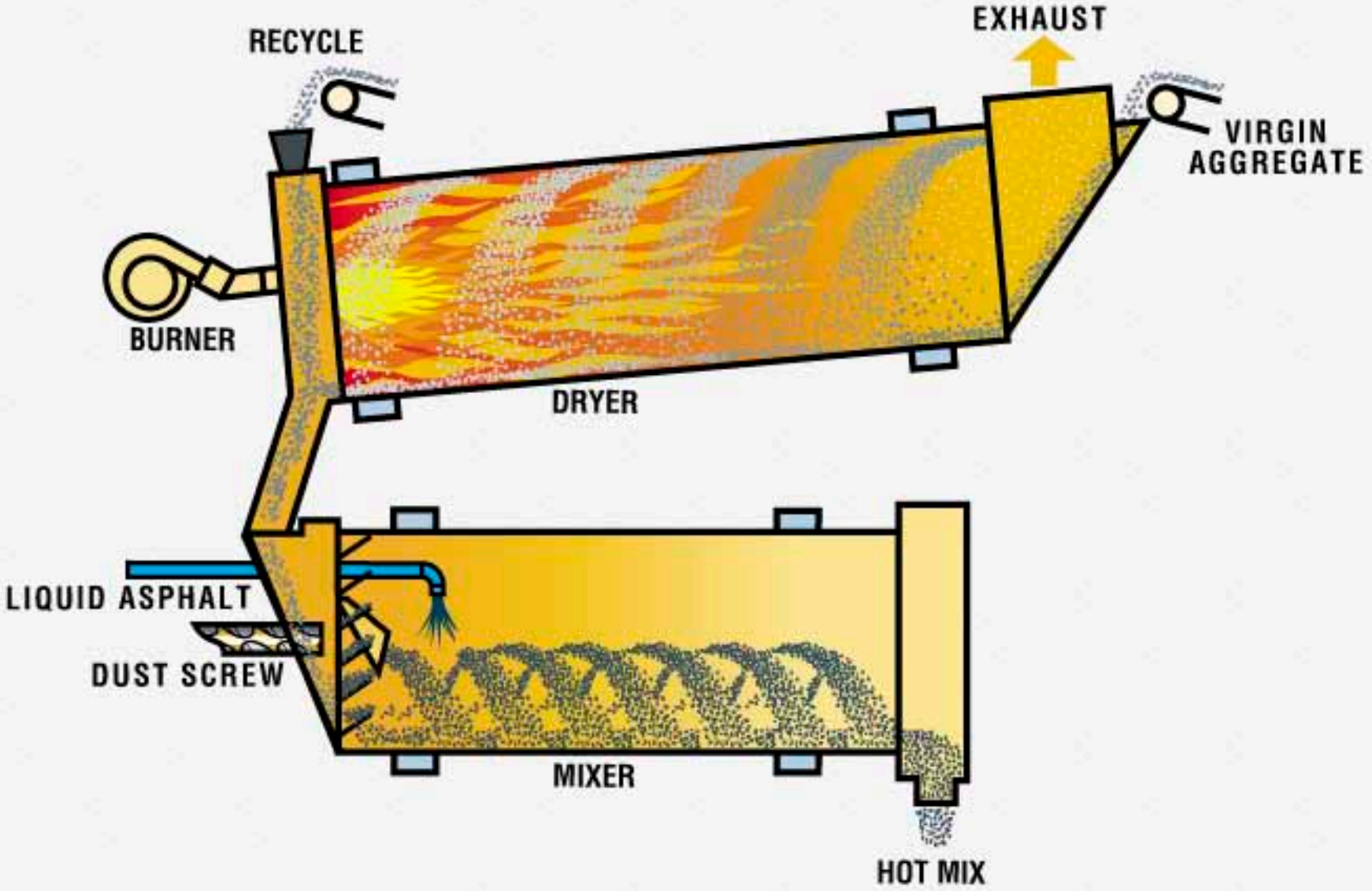



## Double Barrel® Combination Dryer/Mixer

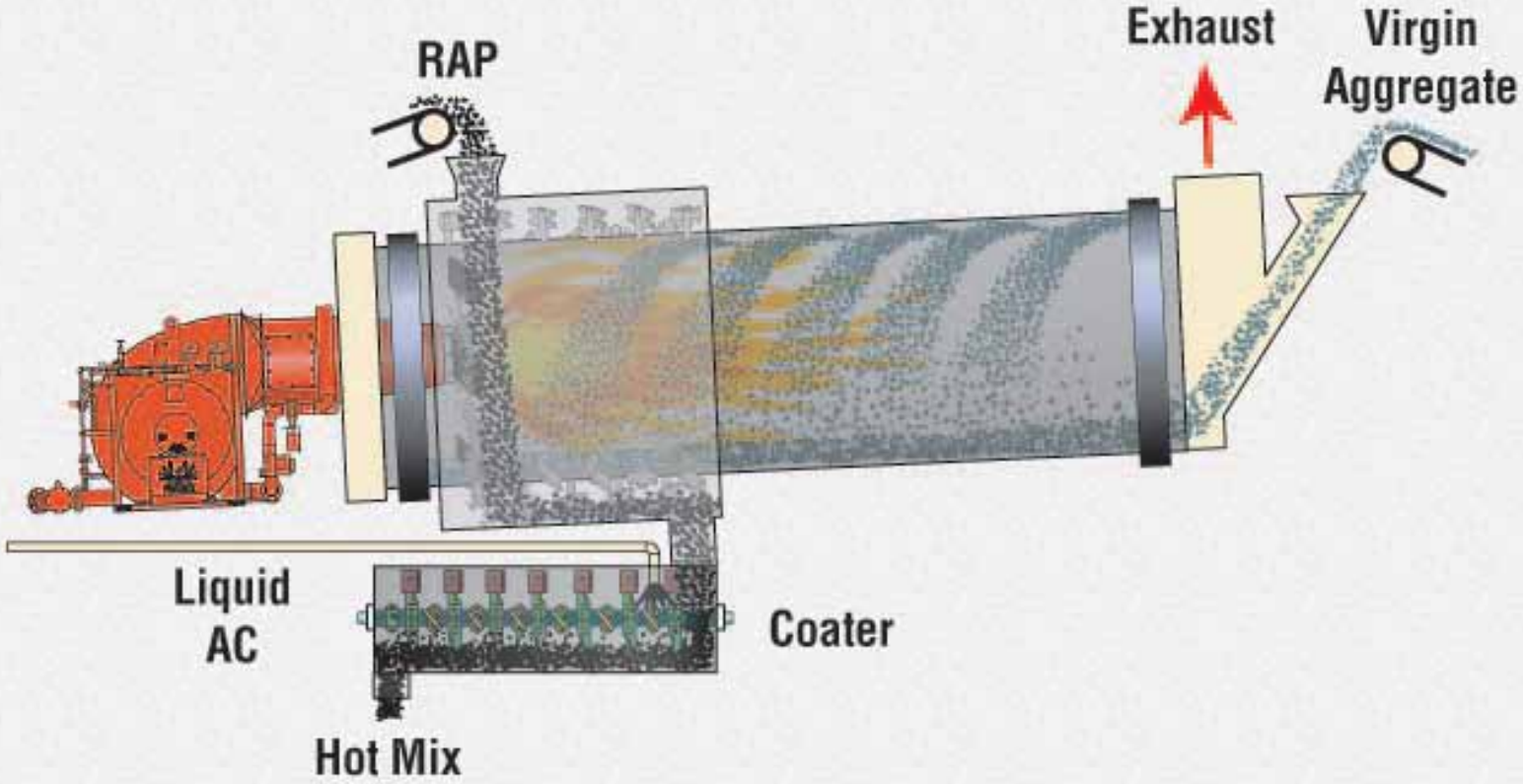

ASTEC
DOUBLE BARREL GREEN
ASTEC
NORTHWEST
1-559-1900


>208.9°F
205.0
200.0
195.0
190.0
185.0
180.0
175.0
170.0
165.0
160.0
155.0
150.0
145.0
140.0
135.0
130.0
125.0
120.0
115.0
110.0
Astec Double Barrel Drum Mixer
• 200 Tons Per Hour
• 15% RAP used
• 320° F Mix Temperature
• Located in Central Alabama, USA
Spot 1
190.6
Spot 5
118.5
Spot 3
201.6
Spot 4
183.2
Spot 6
104.3
Spot 2
190.4


*>248.0°F
240.0
230.0
220.0
210.0
200.0
190.0
180.0
170.0
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
*<80.6°F
Spot 4
226.1
Spot 1
246.5
Spot 7
248.0
Spot 3
162.1
Spot 5
161.4
Spot 2
190.9
Spot 6
91.7
Astec Double Barrel Drum Mixer
• 145 Tons Per Hour
• 30% Rap used
• 300° F Mix Temperature
• Located In Central Florida, USA

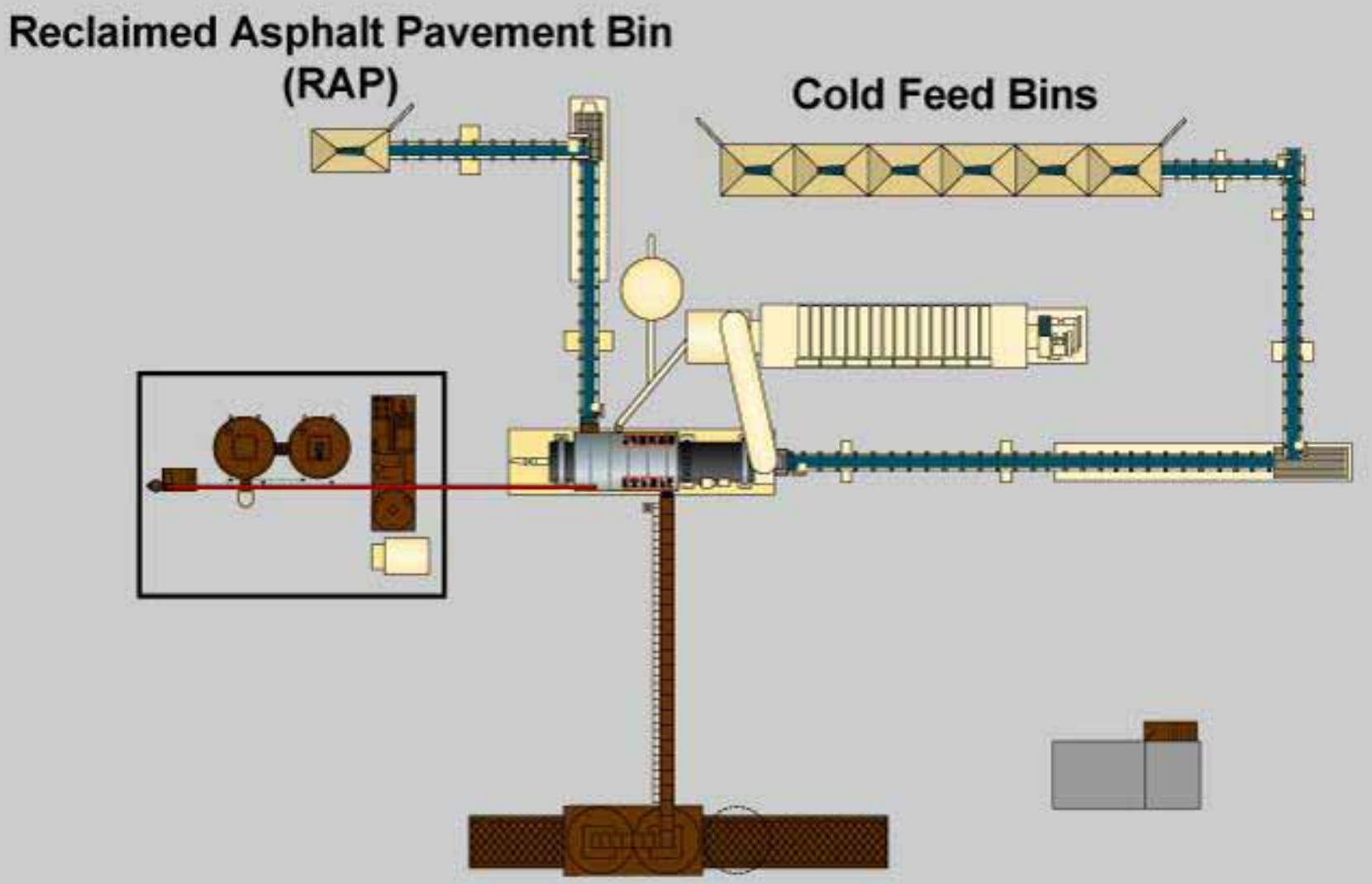



# COUNTER FLOW DRYER AND ROTARY MIXER

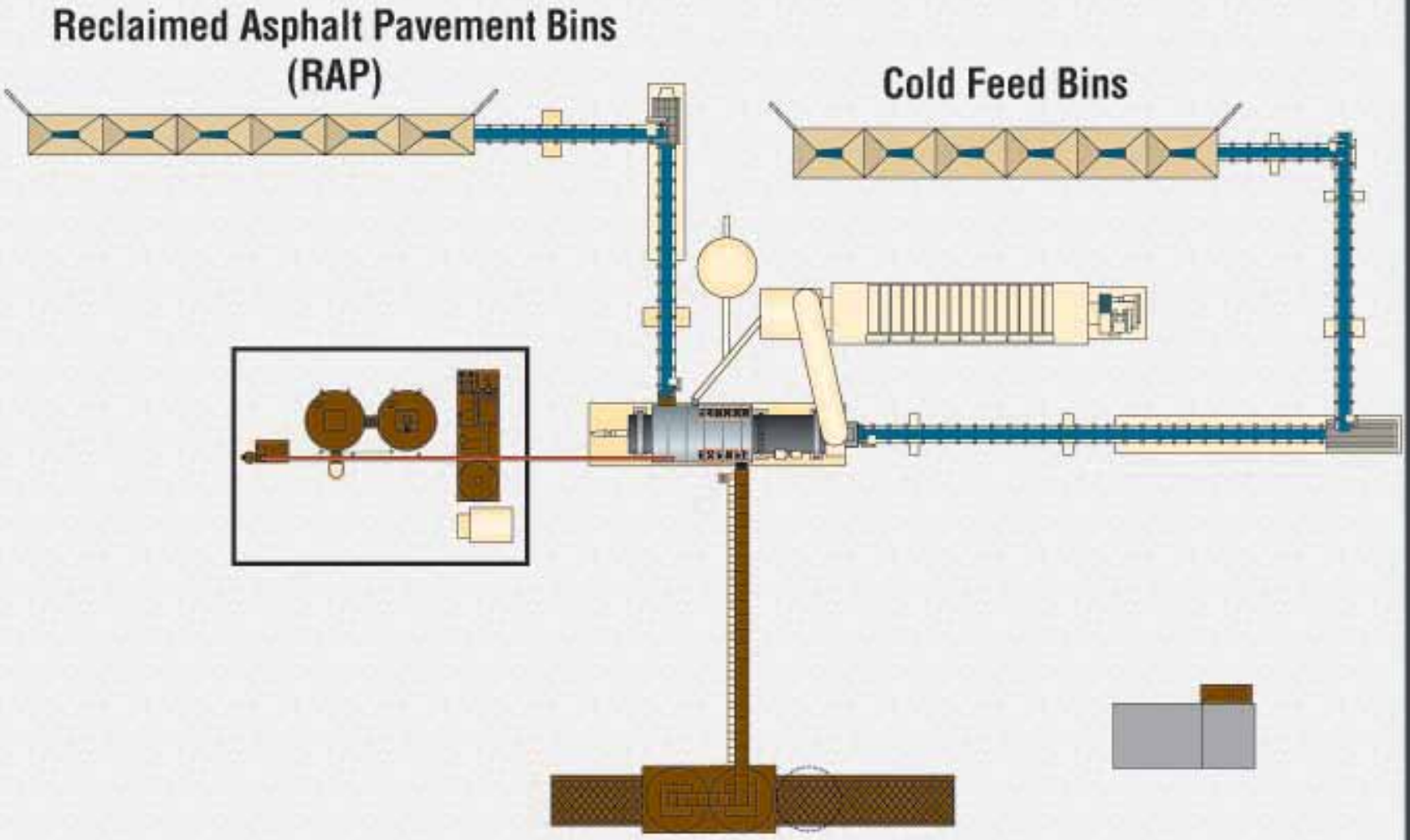



## Double RAP™ Dryer With Coater


DOUBLE
RAP
GREEN
ASTEC

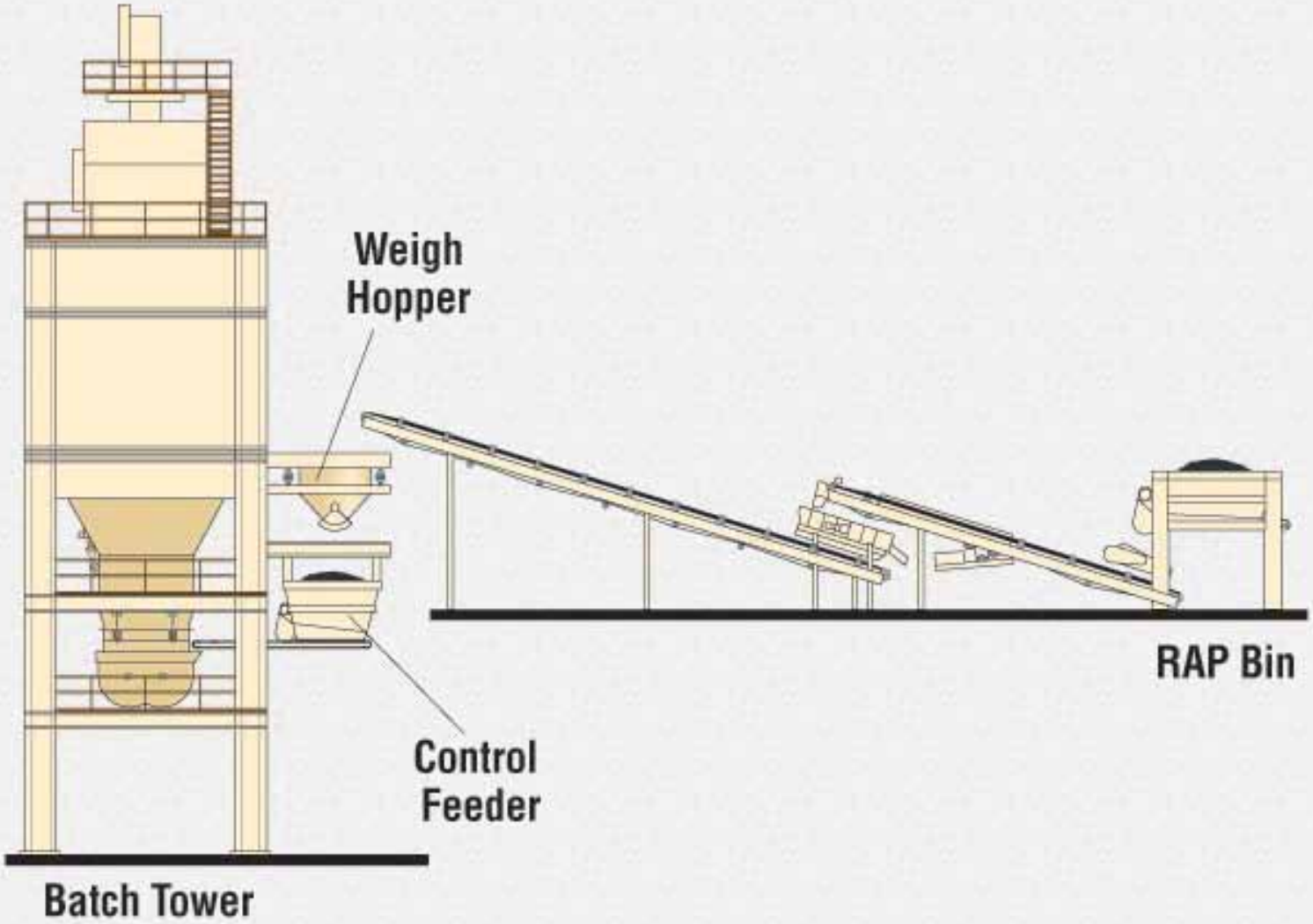



1980-1990's HMA Facility with Single RAP Bin



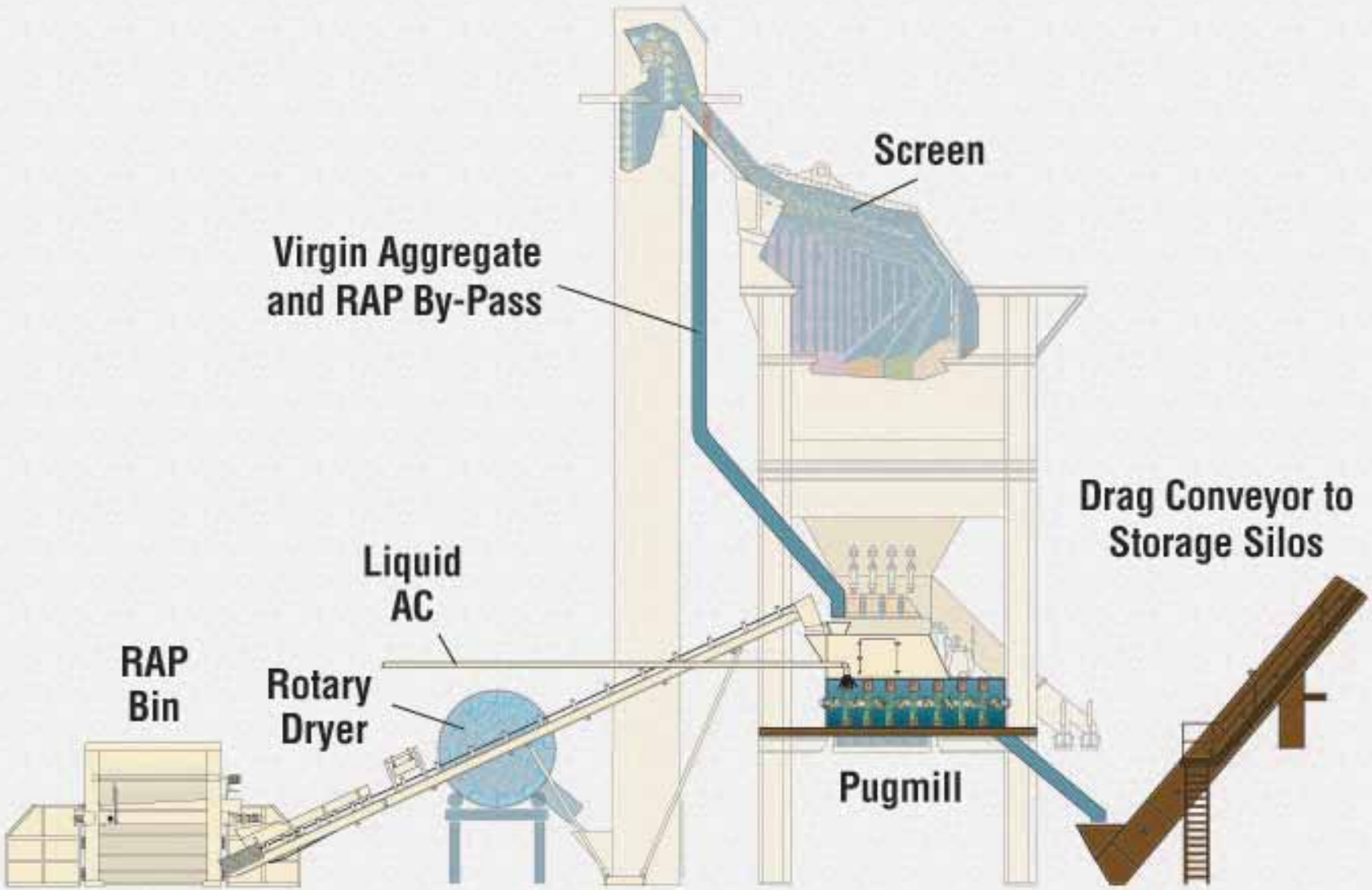

Today's HMA Facility with Multiple RAP Bins


2007 6 7

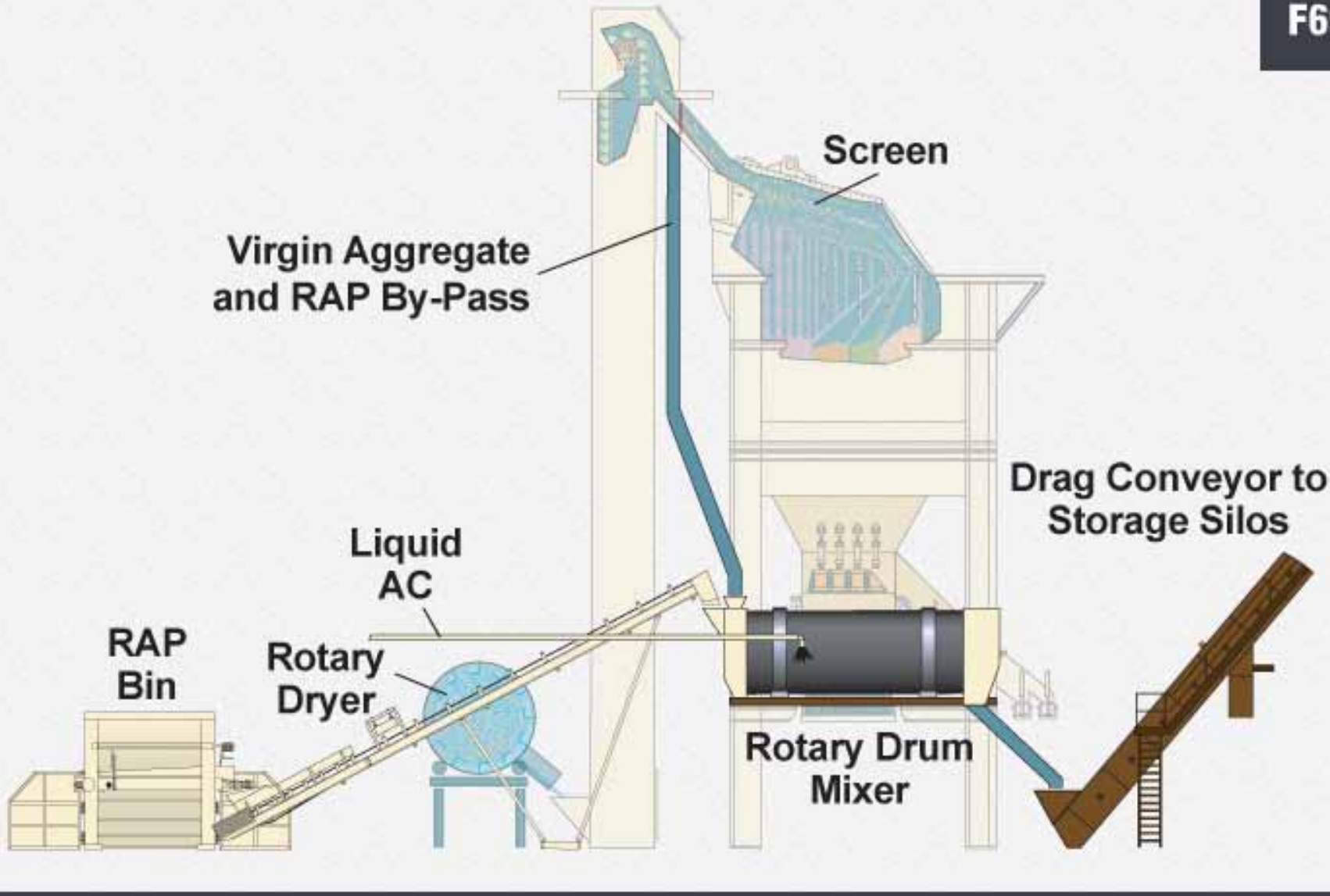



RAP Delivery System for Batch Plants


HEIGHT
11'5"




Batch Plant with Pugmill Mixer




Batch Plant with Drum Mixer

Virgin Aggregate and RAP By-Pass

Screen

Fifth Bin

Double RAP Drum Dryer/Mixer

Virgin Aggregate to Screen Only

RAP

Virgin Aggregate and RAP to Fifth Bin

## Batch Plant with Double RAP Dryer

# Sustainability in HMA Pavements

Brief USA Update:

RAP

WMA

Equipment Technologies

# Average Use of RAP in the United States

1910.....approximately 10%
1925.....0
1970.....0
1976.....3%
1980—85.....15% (some 50%)
2000.....15%
2010.....25-30% (some 50%)
2011.....25-30% (some 60%)
2011 NOTE: Some over 60%

1/2 x 0 (12mm x 0)

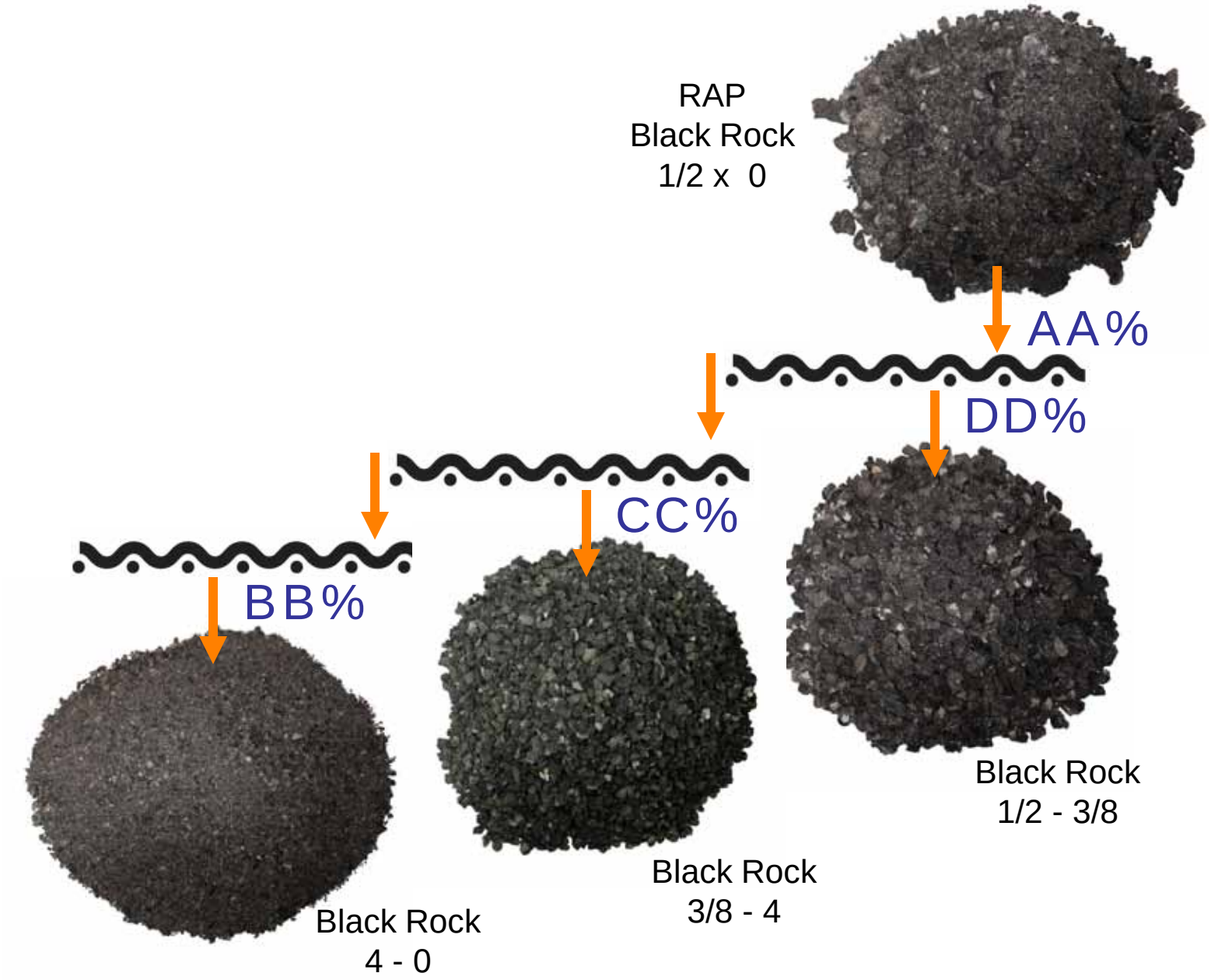
6% AC

1/2 x 4 (12mm x 6mm)

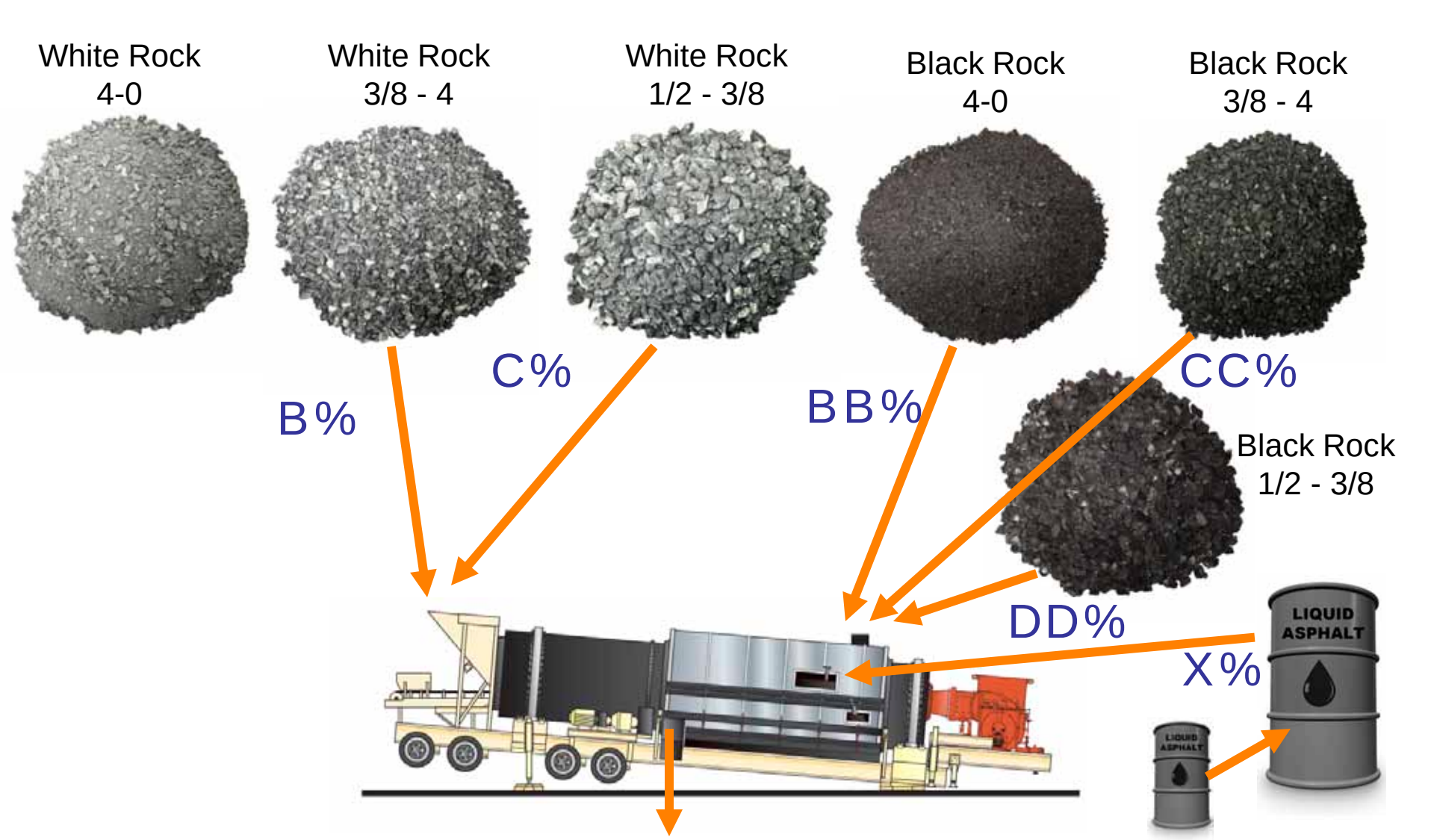
4% AC

4 x 0 (6mm x 0)

7% AC




PROCESSED RAP SCREENED TO ORIGINAL INGREDIENTS




# SUPERPAVE MIX WITH PROCESSED RAP - CHOICE #2

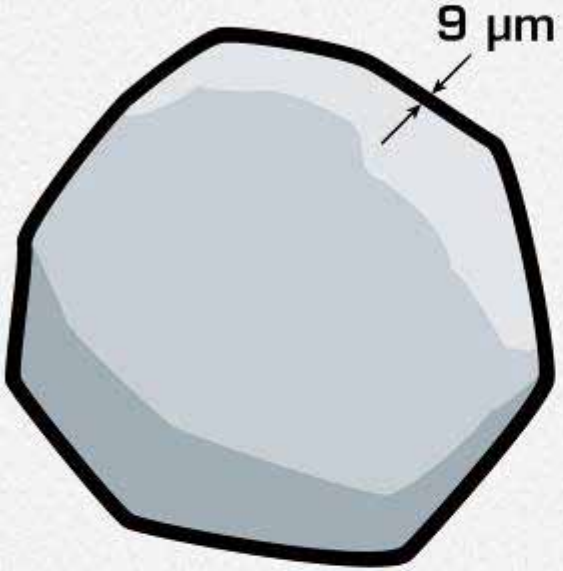
# Use of WMA Pavement in the United States

2005/6.....Test Projects (additives)
2007.....Test Projects (+ foam)
2008.....5 Million Tons AGS
2009.....10 Million Tons AGS
2010.....20 Million Tons AGS
2011.....40 Million Tons AGS

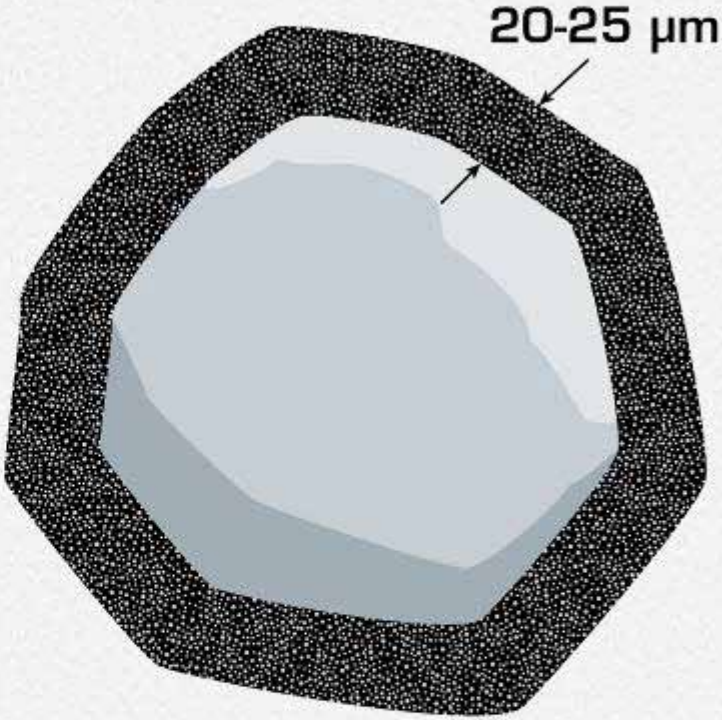
Estimated Total Tons WMA using AGS:
75 Million Tons by 2011 Yr. End

# **G2** GREEN SYSTEM

# BATCH GREEN SYSTEM

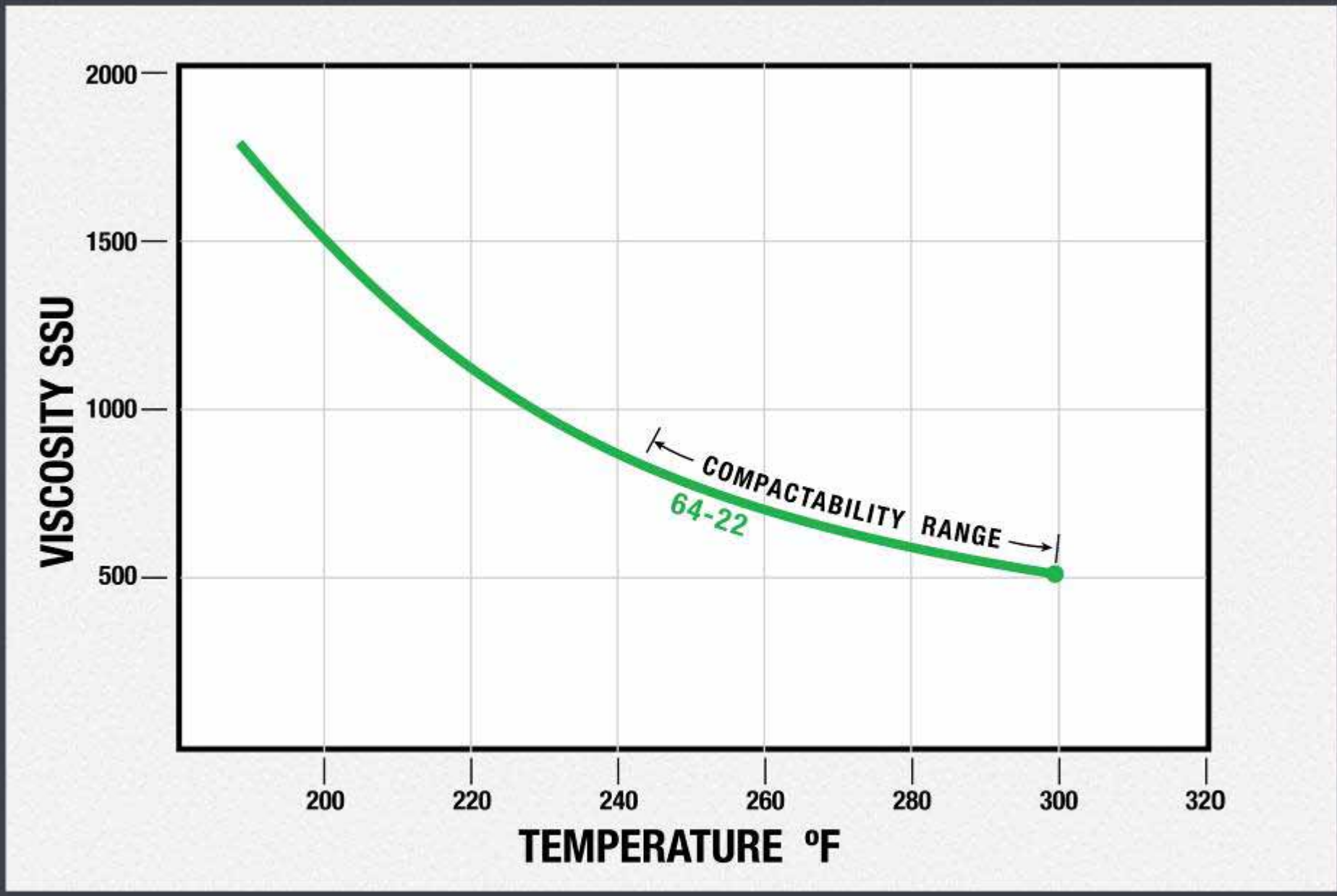



NORMAL
COATING

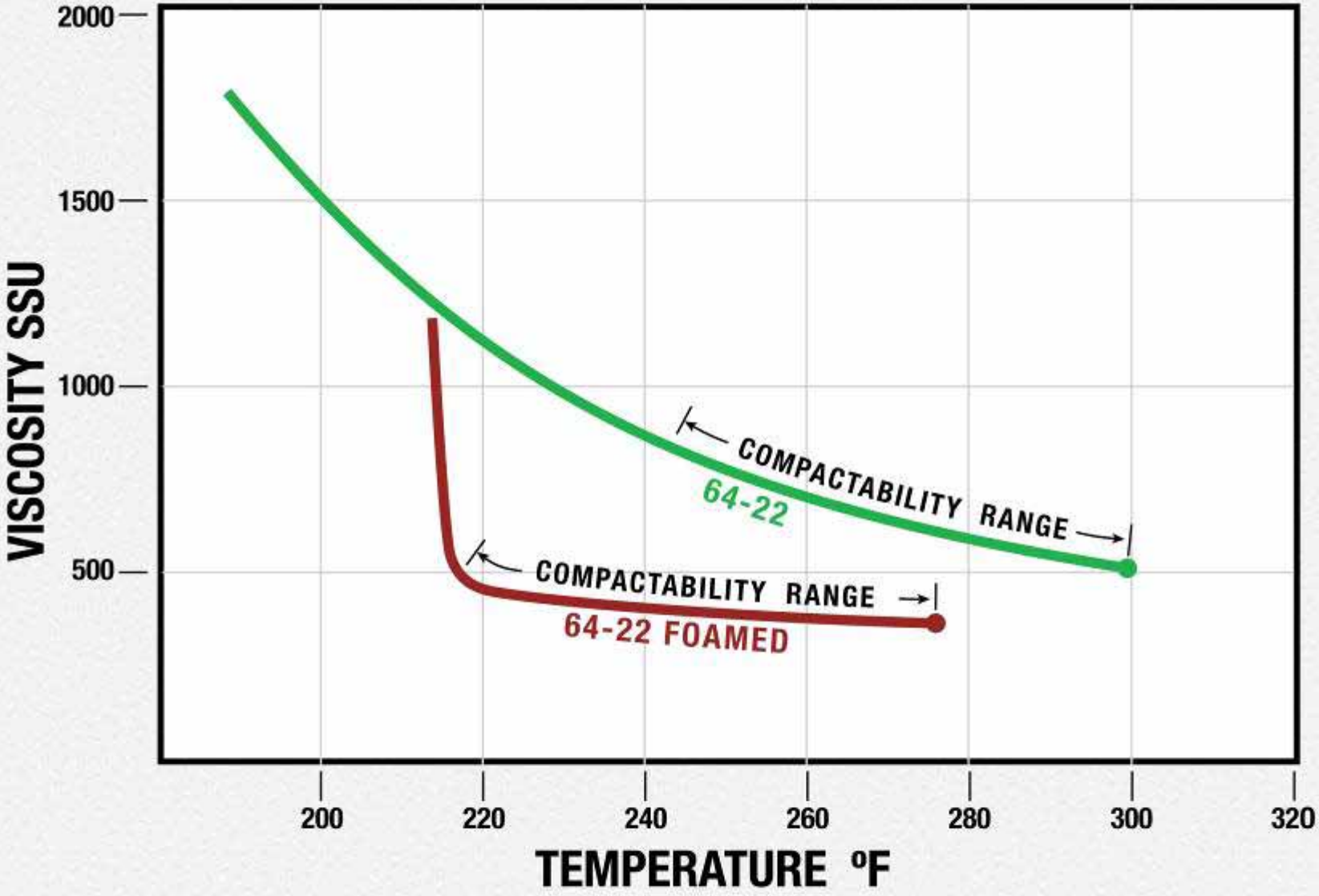



DB GREEN FOAM
COATING

# COATING THICKNESS




VISCOSITY / TEMPERATURE PG 64 -22 (Approx.)




VISCOSITY / TEMPERATURE PG 64 -22 (Approx.)

# No Smoke – No Smell…Why?

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

# Benefits of High RAP & Warm Mix


## For the Producer / Contractor

- Improved Workability
- No Smoke – No Smell
- High Percentage Recycle Mix with Standard Grade of Asphalt
- 14% Less Fuel
- 14% Higher Production
- Reduces Cost


# For the Worker

- **Comfort & Safety**

## For the DOT/Public

- Comfort & Safety of workers
- Improve Mixes

# Why will we have a Longer Life Pavement?

- Less oxidation of mix
- More uniformity of compaction
- With fractionating RAP…more uniform

## For the DOT/Public

- Comfort & Safety of workers
- Improve mixes
- Sustainability

# Why Sustainability?

- By Milling & Recycling – 100% of the material can be re-used
- Reduce new aggregate requirement by 245,000,000 tons/year…annually (from 15% to 50%)
- Reduce oil consumption by 80,000,000 bbl/year…approximately 7 days of imported oil

## For the DOT/Public

- Comfort & Safety of workers
- Improve mixes
- Sustainability
- Green

# It's Green!

- Use 14% less fuel due to 50°F lower temperature
- No volatiles
- Use more recycle

## For the DOT/Public

- Comfort & Safety of workers
- Improve mixes
- Sustainability
- Green
- Reduce Cost

# What we have done to date

- **Installed over 400 units to create hot foam mechanically … est. 600 units of all types operating in USA**
- **Produced approximately 75 million tons from 0 to 50% RAP with warm mix**
- **Stored in silo for 4 days**
- **Produced 76-22 (Polymers) and placed at 270ºF**
- **Produced rubber mix at 270ºF**

# Conclusions:

1. **HMA is 100% Recyclable**
2. **Milling corrects road profile, corrects drainage, eliminates raising shoulders and guardrails, and maintains bridge clearances…and generates RAP**
3. **By fractionating RAP and using Warm Mix (hot foam) with 50% RAP, it will produce a rut resistant, longer life pavement. It can be produced with a standard grade of AC. Density can be achieved with one less roller and centerline joint density is substantially improved**
4. **More miles can be paved at substantially less cost**
5. **Greenhouse emissions and imported oil are greatly reduced**

# Equipment

- New Sustainable AND Economical Technologies are key:
  - High RAP Plants for low cost per ton
  - Tier 4 Mobile Equipment
  - Alternative Fuels for Asphalt Plants
  - Alternative Energy for Bitumen Heating

# Thank You (& G ’Day)

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