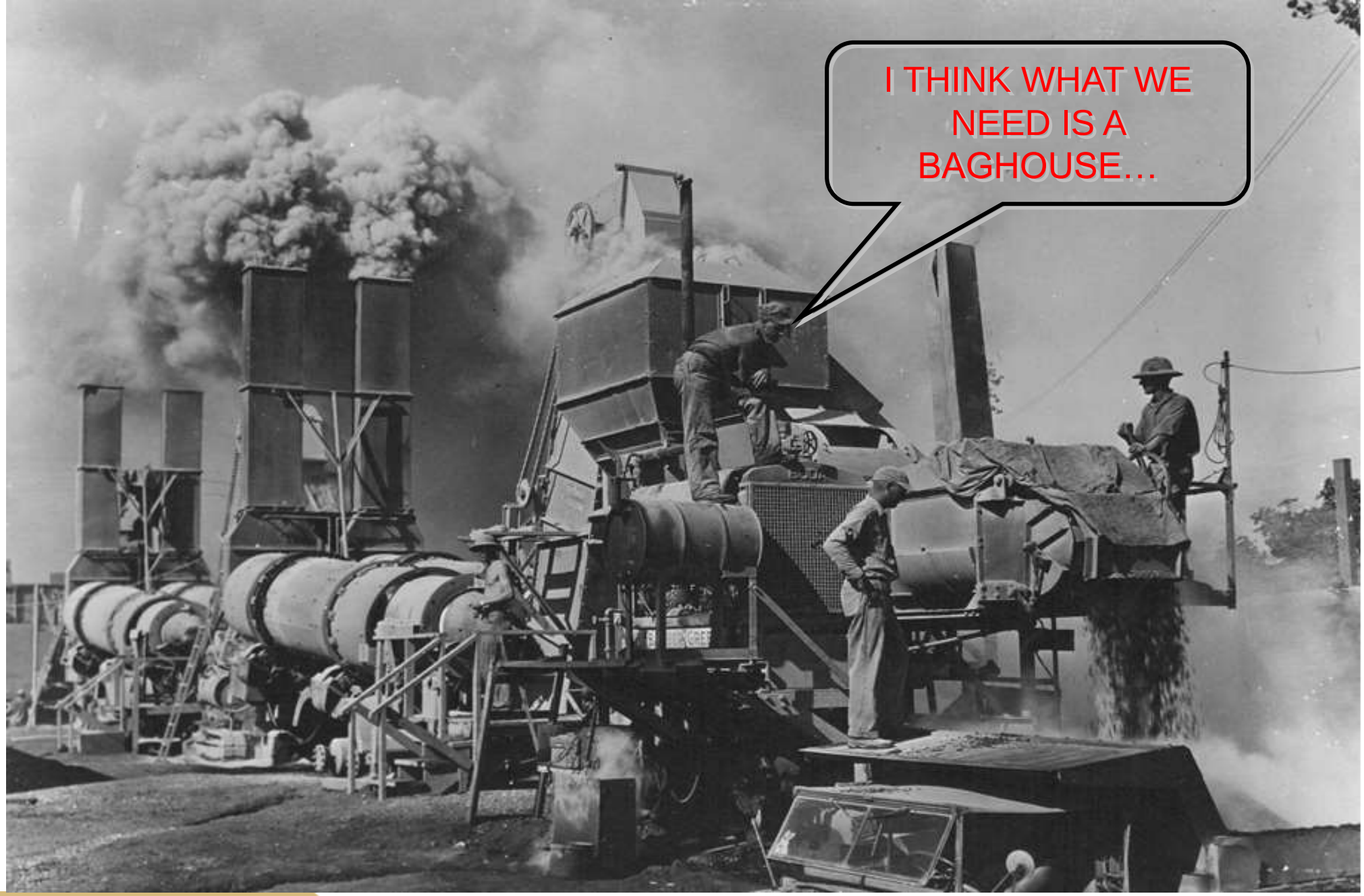
BAGHOUSE OPERATIONS

W. Chase Walker
Lead Engineer: Baghouses and Green Systems

ASTEC INDUSTRIES, INC.



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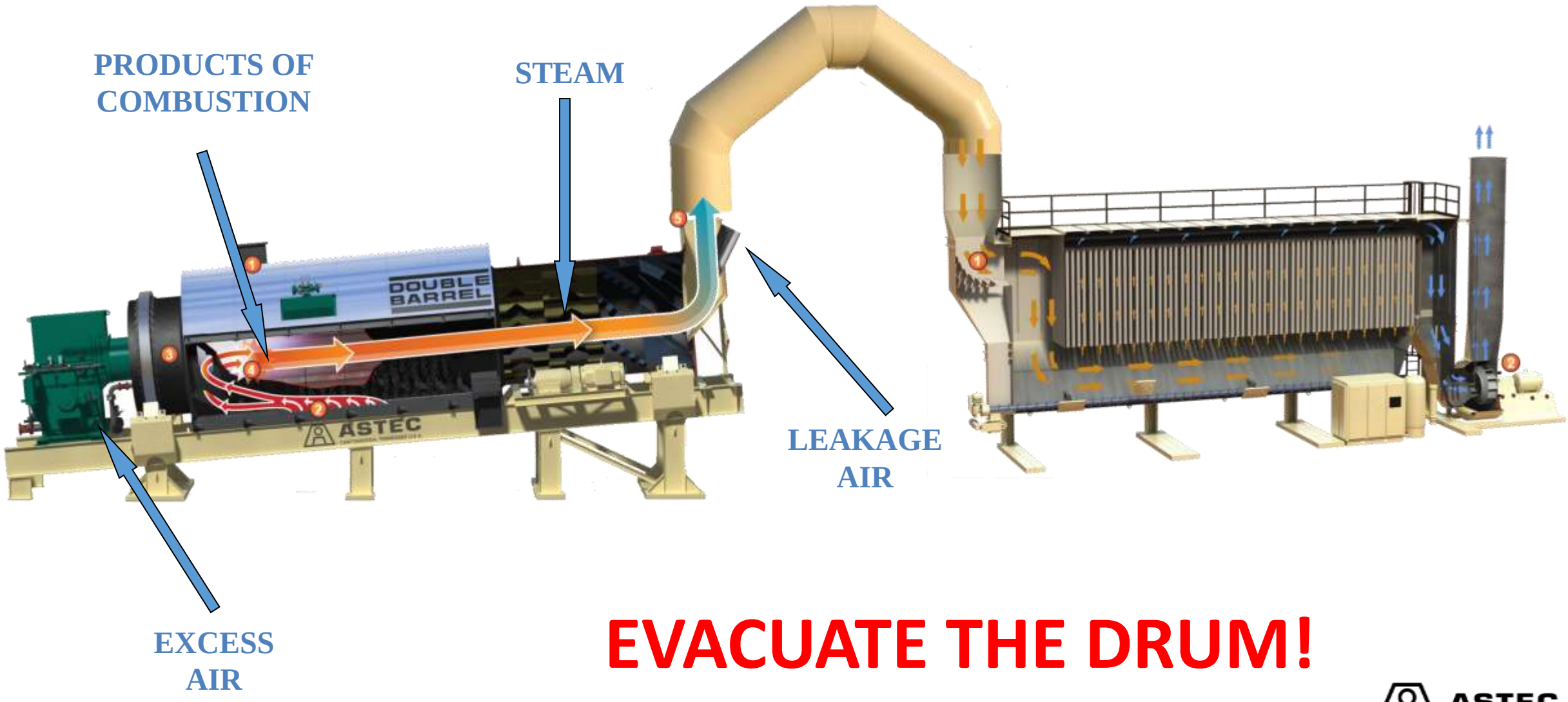
What is the function of the exhaust system?



EVACUATE THE DRUM!

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COMMON TERMS

AIR-TO-CLOTH RATIO: GAS VELOCITY THROUGH THE BAG FABRIC

BLINDED: CONDITION OF REDUCED BAG PERMEABILITY

CAN VELOCITY: UPWARD GAS VELOCITY IN THE HOPPER BELOW THE BAGS

DIFFERENTIAL PRESSURE: DIFFERENCE IN PRESSURE BETWEEN TWO POINTS IN SYSTEM; INDICATION OF RESISTANCE TO AIRFLOW THROUGH THE SYSTEM

DUST CAKE: PARTICULATE MATTER BUILDUP ON OUTSIDE OF BAGS

GRAIN: UNIT OF WEIGHT EQUAL TO 1/7000 OF A POUND

INTERSTITIAL VELOCITY: UPWARD GAS VELOCITY BETWEEN BAGS MEASURED AT BOTTOM OF BAGS

RE-ENTRAINMENT: RE-DEPOSITING OF DUST ONTO ADJACENT BAG AFTER PULSING

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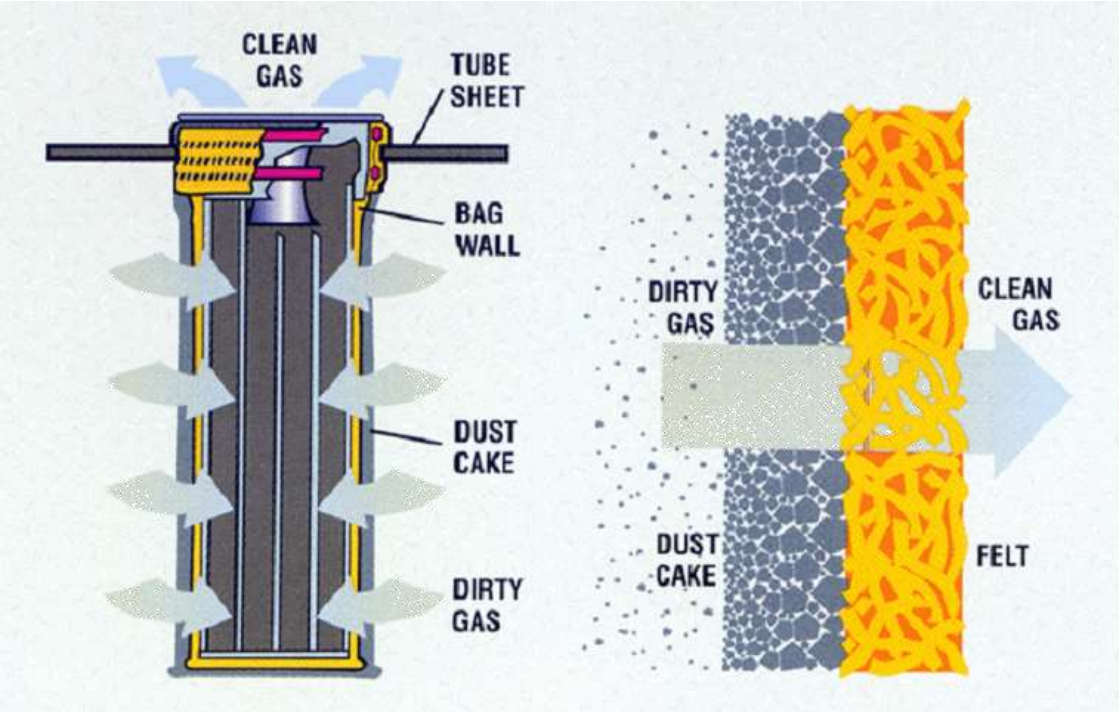
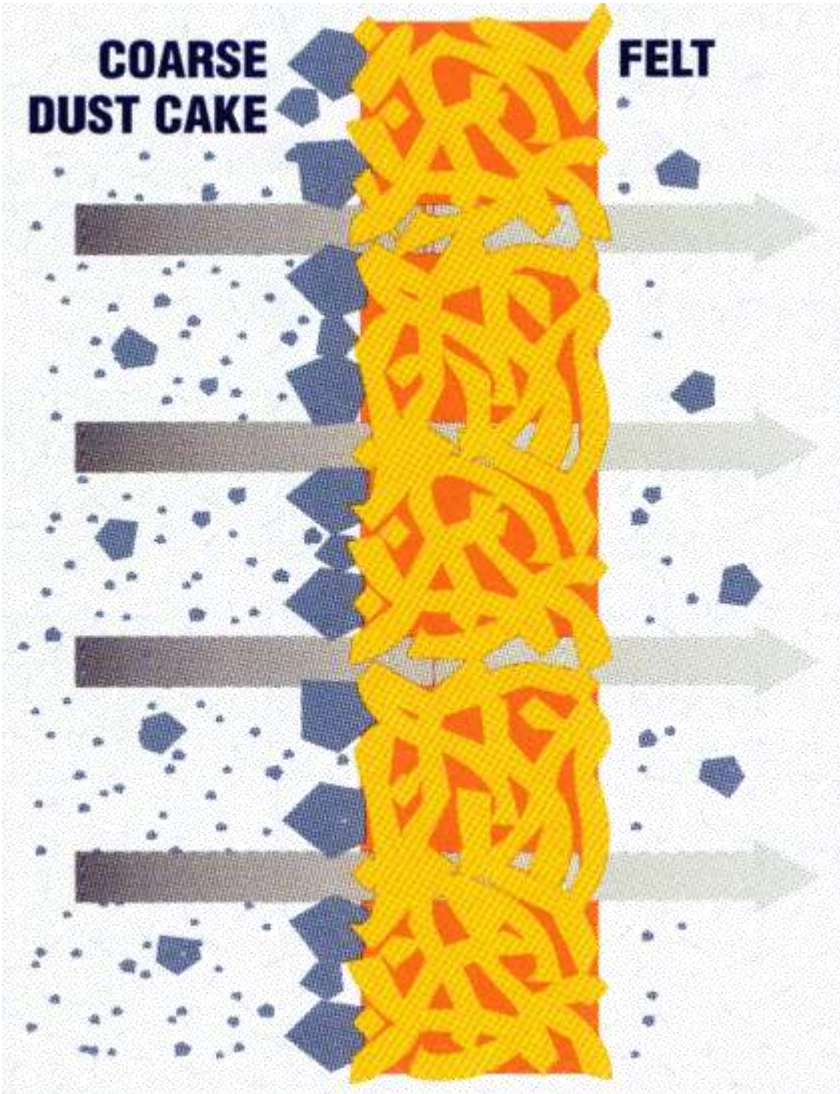
DUST CAKE FUNCTION





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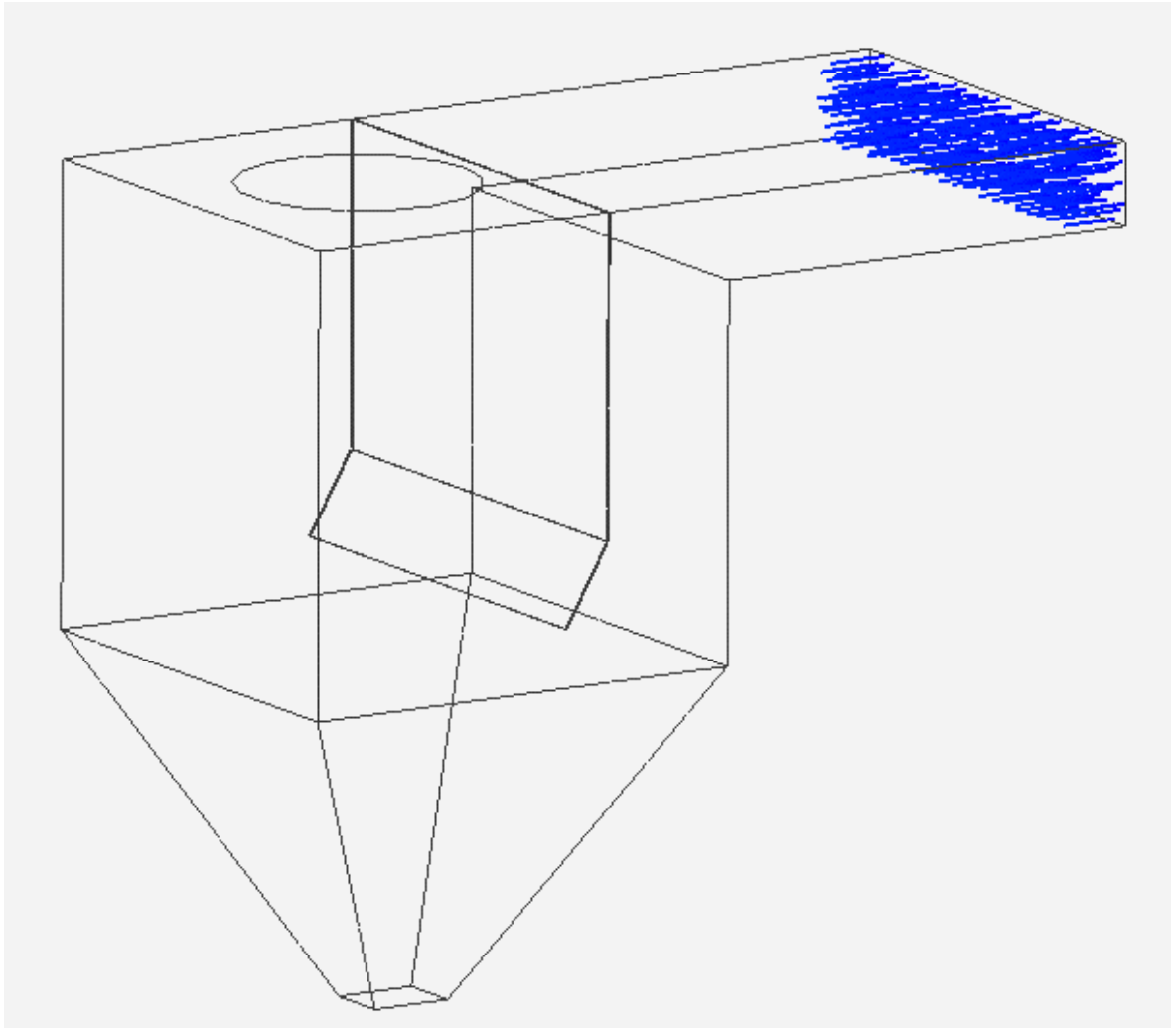
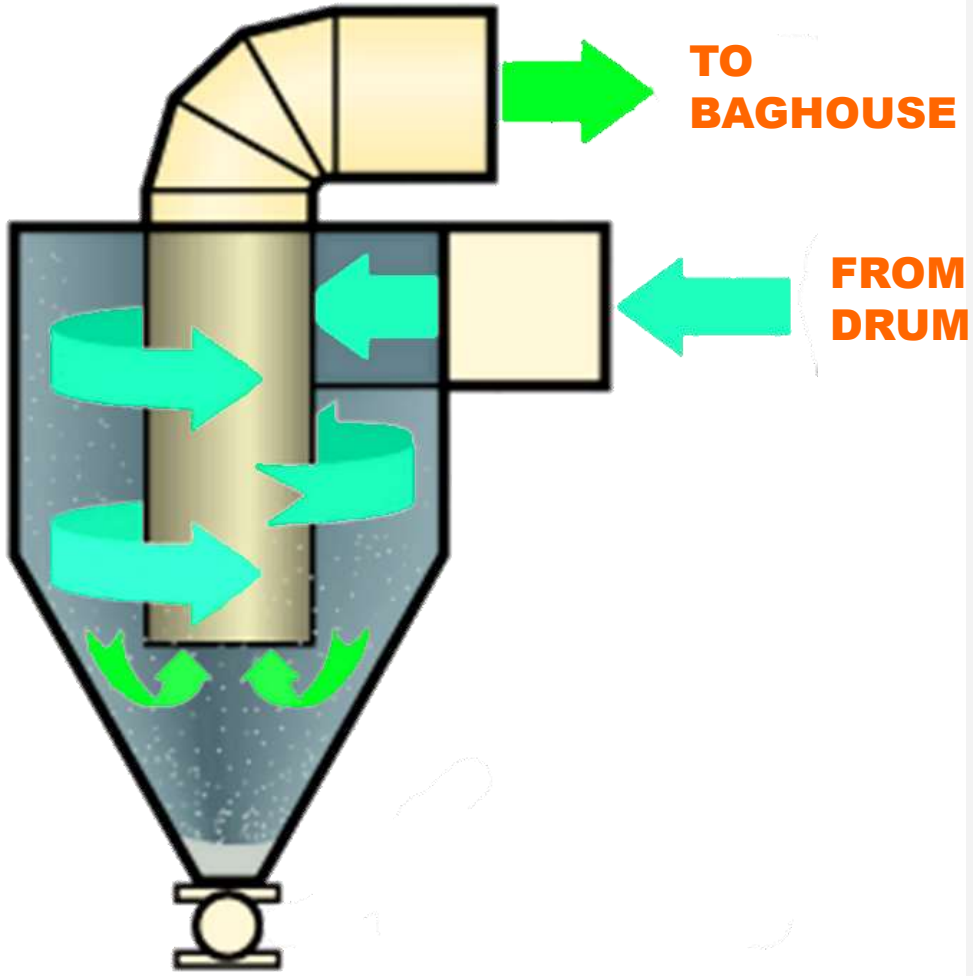
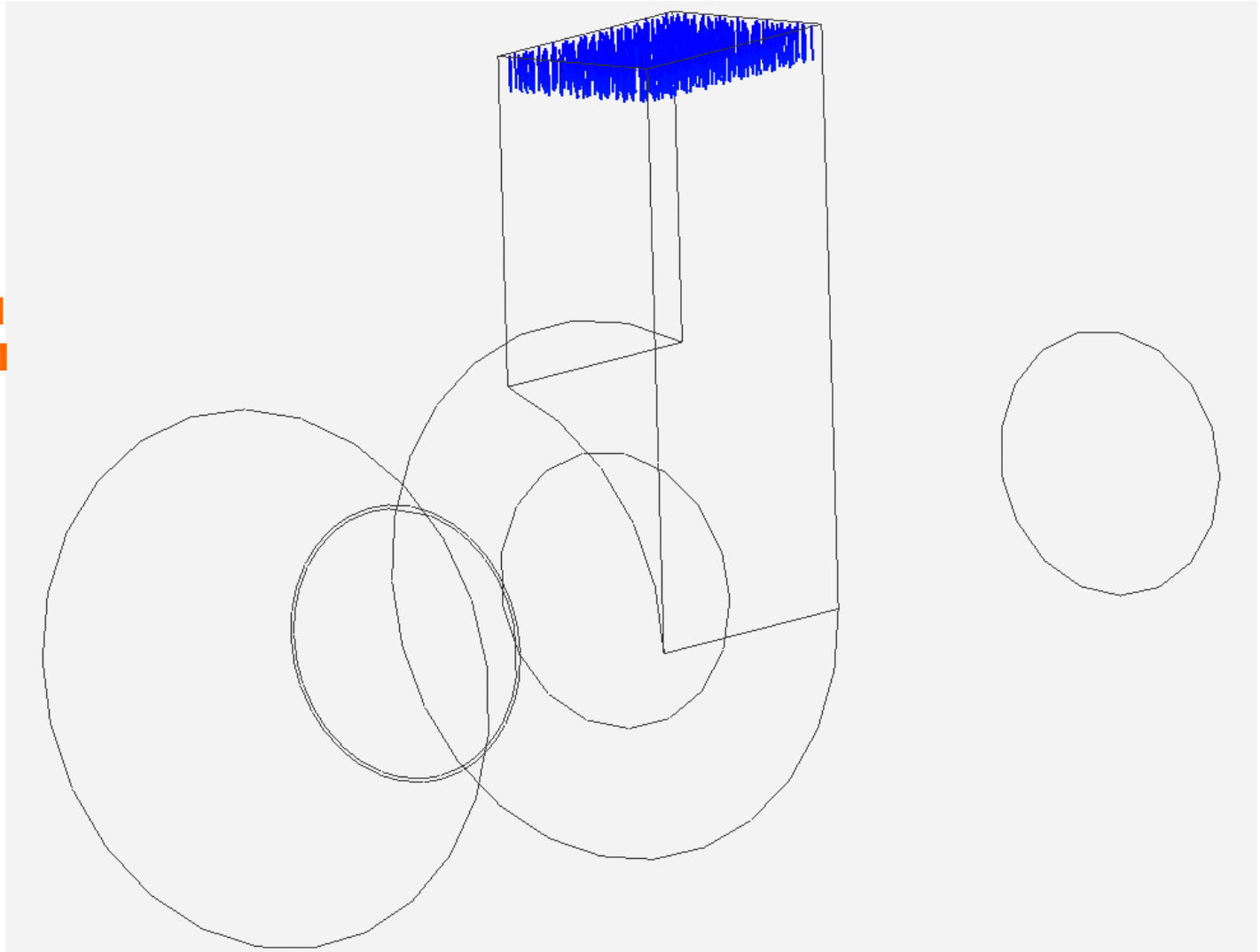
Primary Collectors: Knockout Box



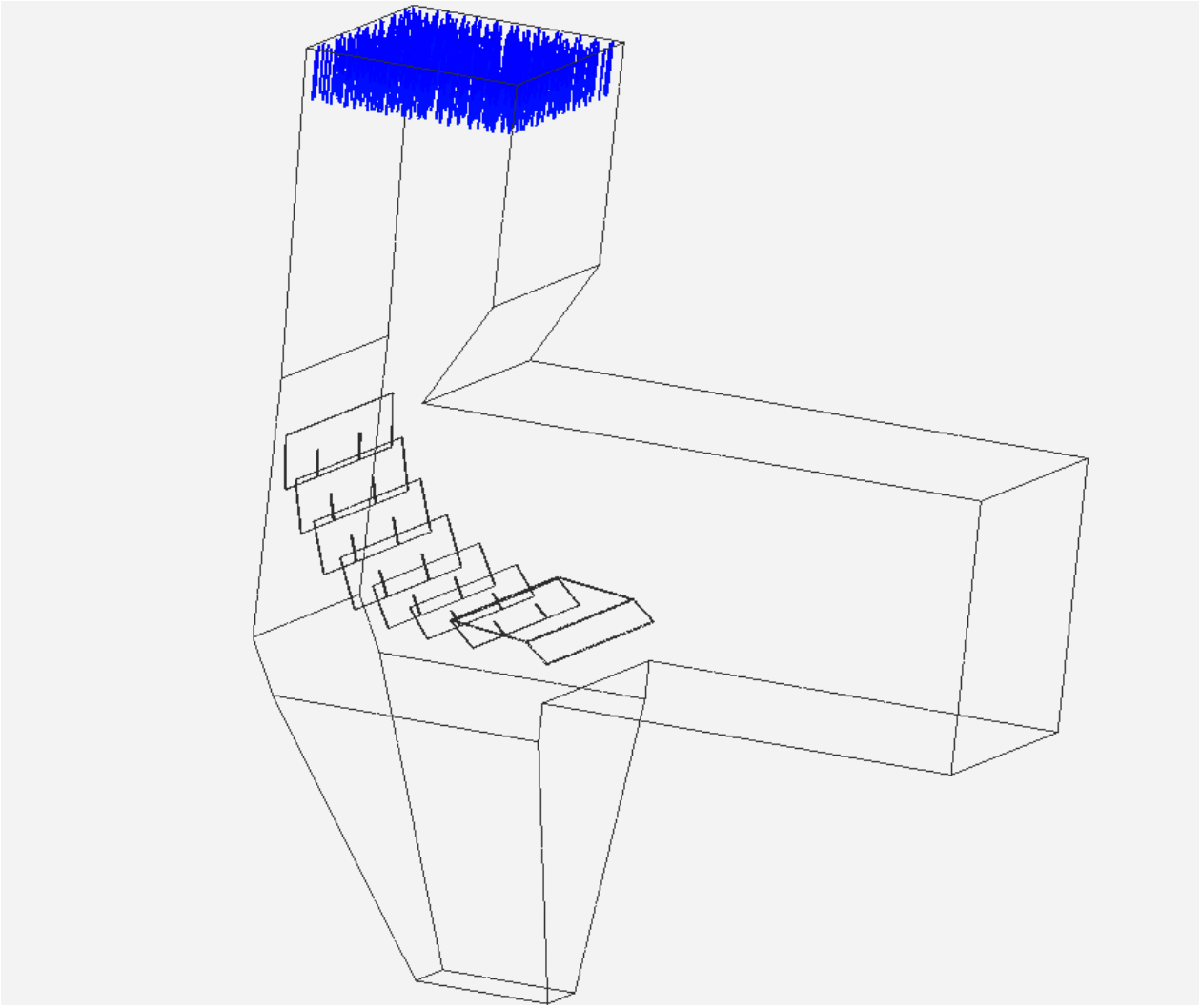
- Low internal gas velocities
- Effective for removal of large particles only
- May have baffle plate to enhance particle removal

Primary Collectors: Cyclones





Primary Collectors: Inertial Separator



Let's Talk Felts…

REQUIREMENTS:

- **HIGH FILTRATION EFFICIENCY**

40 CFR Part 60 - Subpart I

§ 60.90 Applicability and designation of affected facility.
(a) The affected facility to which the provisions of this subpart apply is each hot mix asphalt facility. For the purpose of this subpart, a hot mix asphalt facility is comprised only of any combination of the following: dryers; systems for screening, handling, storing, and weighing hot aggregate; systems for loading, transferring, and storing mineral filler, systems for mixing hot mix asphalt; and the loading, transfer, and storage systems associated with emission control systems.
(b) Any facility under paragraph (a) of this section that commences construction or modification after June 11, 1973, is subject to the requirements of this subpart.

§ 60.92 Standard for particulate matter.
(a) On and after the date on which the performance test required to be conducted by § 60.8 is completed, no owner or operator subject to the provisions of this subpart shall discharge or cause the discharge into the atmosphere from any affected facility any gases which:
(1) Contain particulate matter in excess of 90 mg/dscm (0.04 gr/dscf).
(2) Exhibit 20 percent opacity, or greater.

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Let’s Talk Felts…

Dust carryout: up to 10% of production rate!

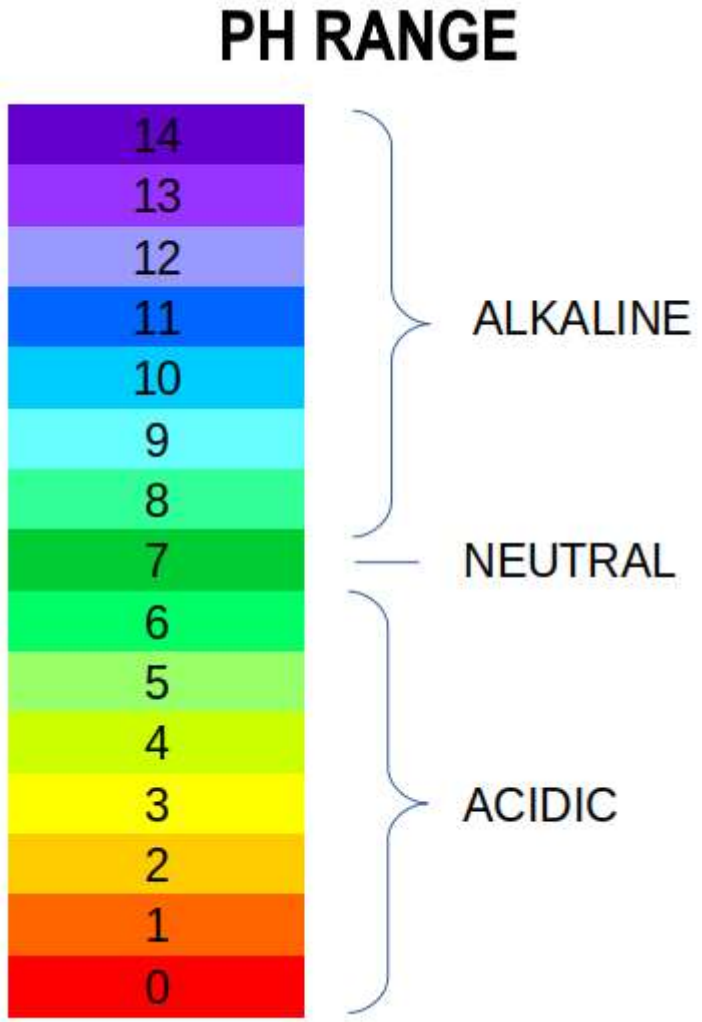
What’s the big deal?

BAGHOUSE PERFORMANCE!

Let’s Talk Felts…

REQUIREMENTS:

- **HIGH FILTRATION EFFICIENCY**
- **CHEMICAL RESISTANCE**



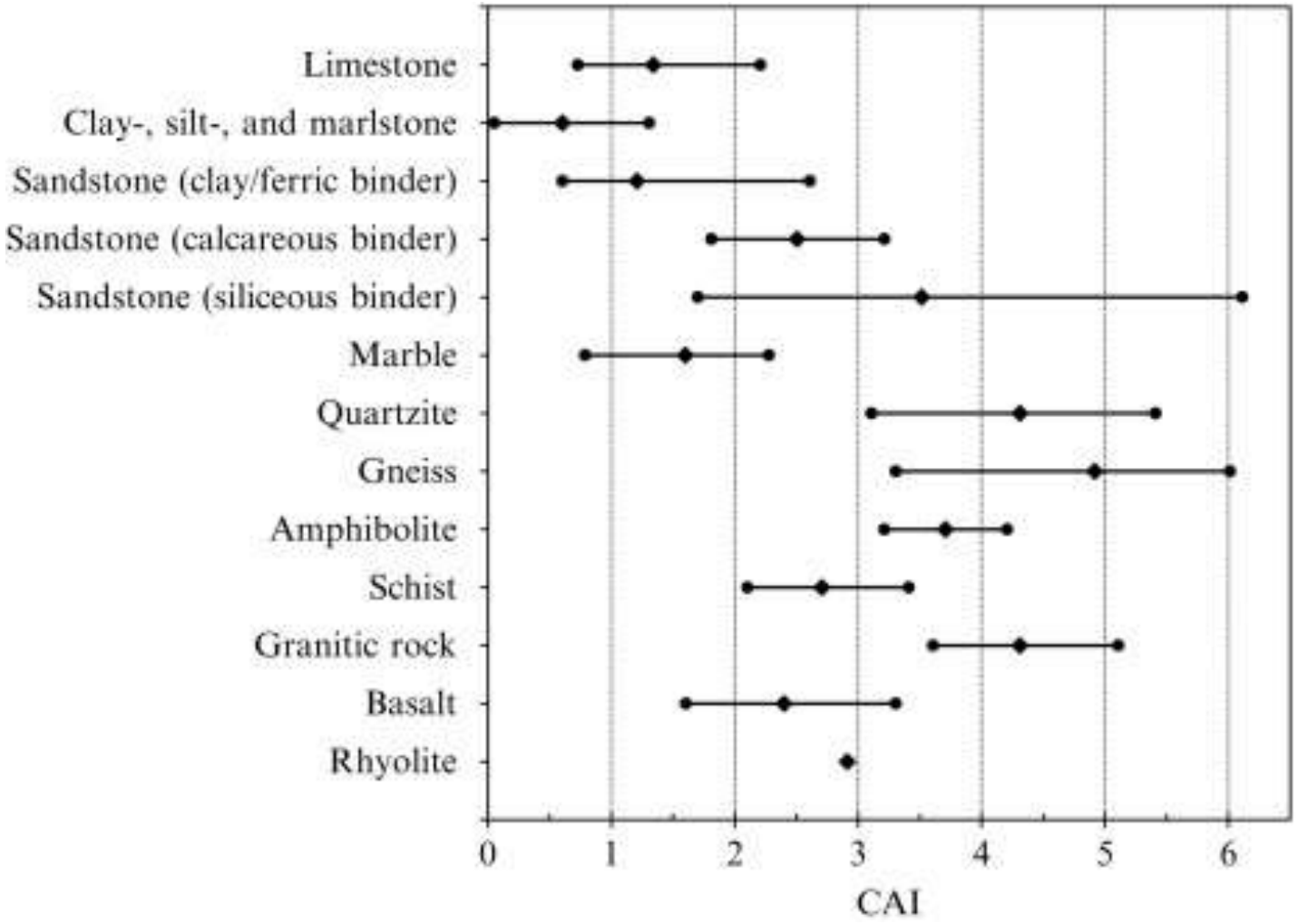
Baghouse fines are alkaline for most aggregates.

Acids that form are typically from compounds in liquid fuels, such as sulfur.

Let's Talk Felts…

REQUIREMENTS:

- **HIGH FILTRATION EFFICIENCY**
- **CHEMICAL RESISTANCE**
- **MECHANICAL STRENGTH**



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Let's Talk Felts…

REQUIREMENTS:

- HIGH FILTRATION EFFICIENCY
- CHEMICAL RESISTANCE
- MECHANICAL STRENGTH
- TEMPERATURE STABILITY

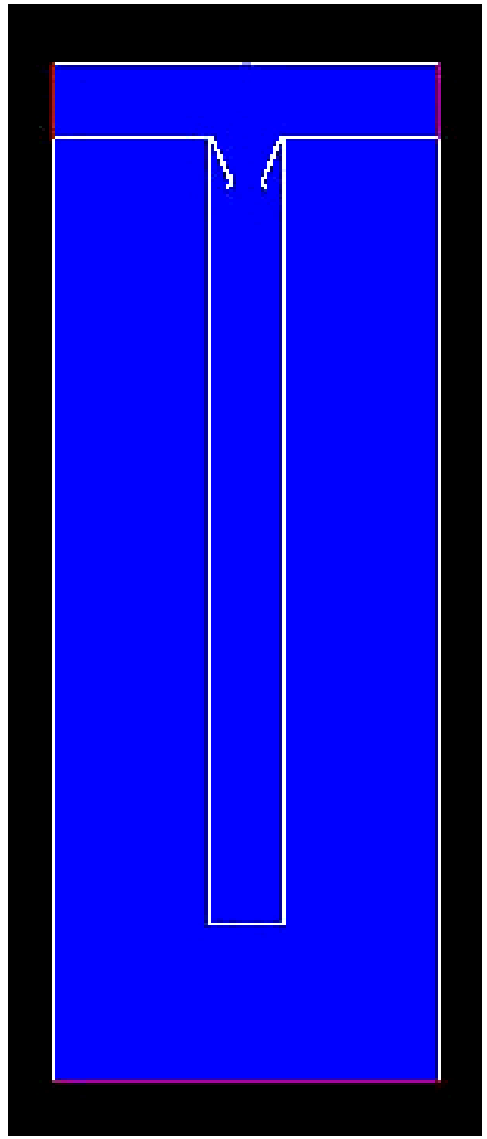
HYDROLYSIS


HYDROLYSIS

Let's Talk Felts…

When in doubt… Keep it low!

- Over-cleaning reduces bag life !
- Aggressive pulsing breaks up dust cake
- Maintain adequate dust cake thickness: 3-5inWC



It's better to pulse more often at a lower pressure!

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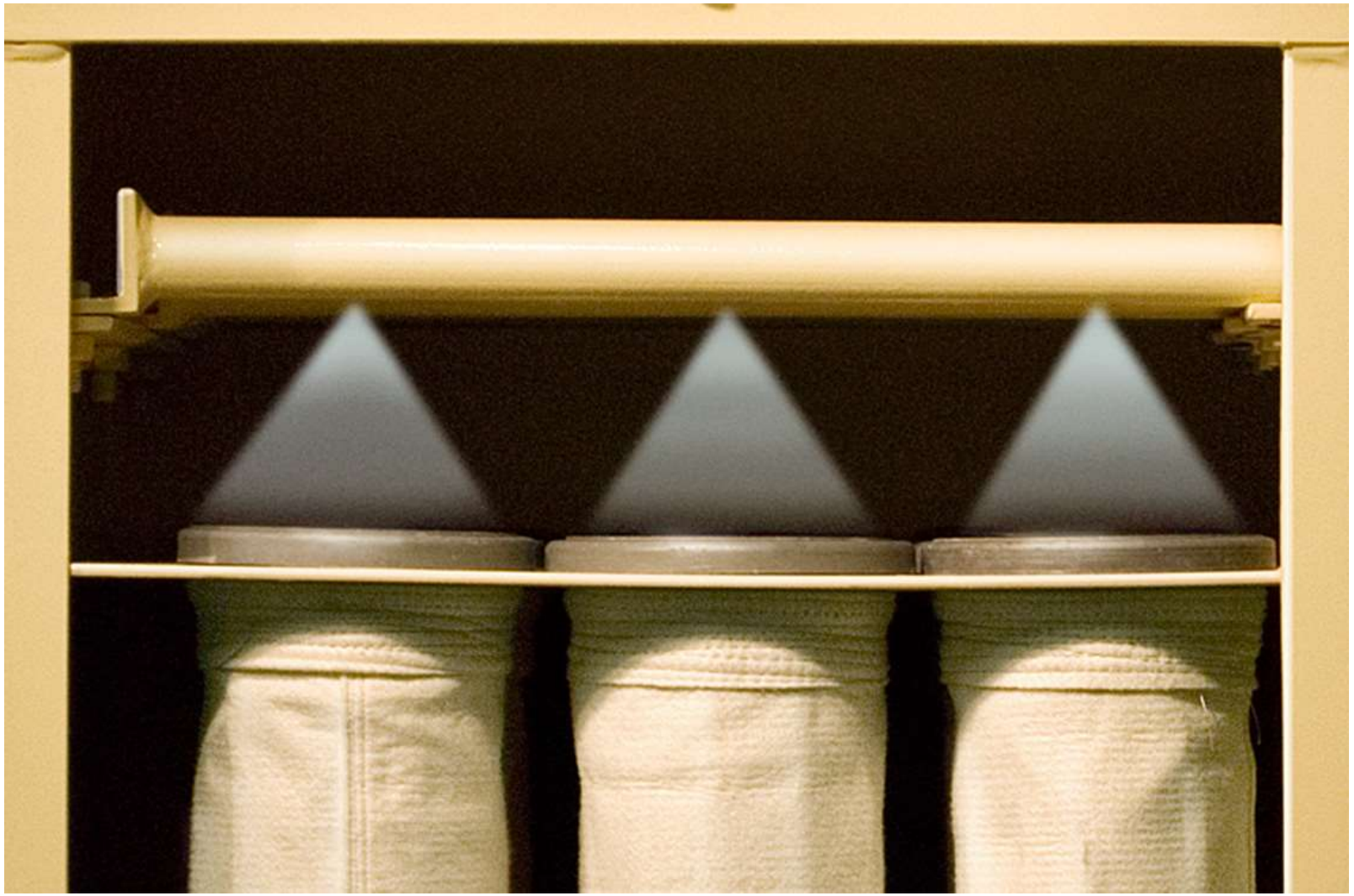
Let’s Talk Cleaning…

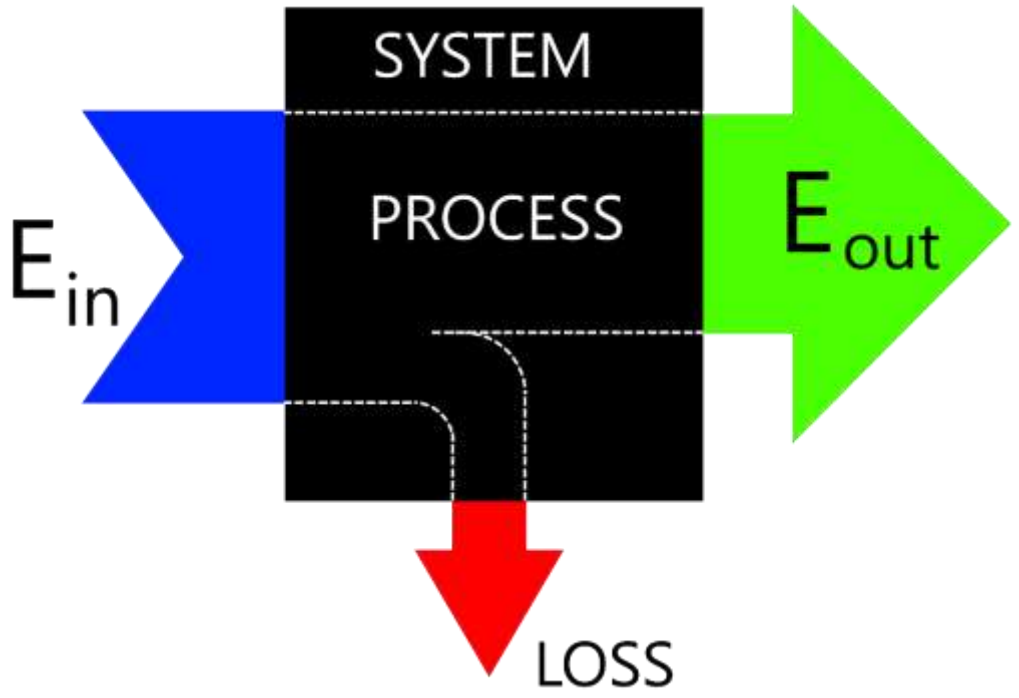


- Blowpipes must properly align with the bags
- Inspect holes annually for deformation
- Use only dry, compressed air

DEFINING "EFFICIENCY"

"Efficiency" is a often misused term

EFFICIENCY is the ratio of the *useful* work performed by a machine or process to the total energy expended or heat taken in



THIS BOX REPRESENTS THE DRYER ON YOUR PLANT…

WHAT GOES IN, MUST COME OUT

WHAT GOES IN, MUST COME OUT

Mass + Energy = **Mass + Energy**

DEFINING "EFFICIENCY"

Plant efficiency is all about how *effectively* a facility handles 9 physical factors that influence production rate

MAXIMIZING PRODUCTION

9 PHYSICAL FACTORS that influence facility ***production rate*** and ***profitability***.

MAJOR FACTORS

- Aggregate moisture
- Leakage air
- Mix temperature
- Stack Temperature
- Site elevation

MINOR FACTORS

- Excess air
- Radiation loss
- Ambient conditions
- Material Temperature

Equipment Design Balances Component Sizes with Production Requirements

Equipment Design

- **Drum Diameter**
- **Baghouse Capacity**
- **Burner Output (MMBTU / MW)**
- **Feed/Storage Capacity**
- **System Diff Pressure**

- **300F mix temperature**
- **5% composite aggregate moisture**
- **240F stack temperature**
- **Virgin materials only**
- **Facility located at sealevel**
- **Standard ambient temperature 68F**

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MAXIMIZING PRODUCTION

AT A WELL-MAINTAINED FACILITY, PRODUCTION IS PREDOMINANTLY LIMITED BY **2 PLANT COMPONENTS**:

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Things that REDUCE Production

Operational

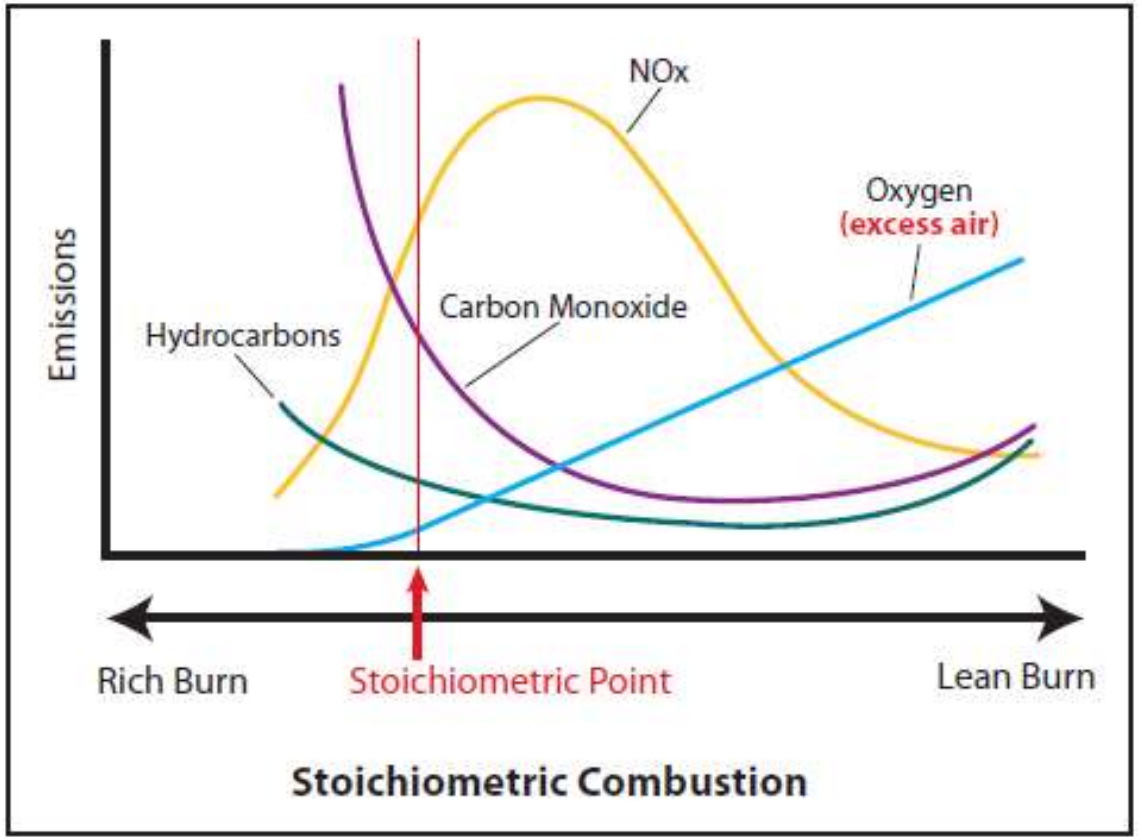
- Burner Output
- Moisture Content
- High Stack Temp
- Leakage Air
- High Baghouse ΔP

- Burner tuning

How much excess air does my burner need?

$CH_4 + 2O_2 + 2N_2 \rightarrow CO_2 + 2H_2O + 2N_2 +$ HEAT

TUNE THE BURNER!



Things that REDUCE Production

Operational

- Burner Output
- Moisture Content
- High Stack Temp
- Leakage Air
- High Baghouse ΔP

- Burner tuning
- As aggregate moisture increases, production decreases

HOW MUCH HEAT DO WE NEED?

Heating Requirements	% BTU's Needed
Water to 212° F	**6.60**
Saturated Water to Saturated Steam	**45.09**
Saturated Steam to Exhaust Steam	**0.58**
Aggregate	44.67
Excess Air	3.06

EXHAUST TEMPERATURE: 240ºF

5% AGGREGATE MOISTURE

MIX TEMPERATURE: 300ºF

52% of Fuel Required to Process the Water

HOW MUCH HEAT DO WE NEED?

Heating Requirements	% BTU's Needed
Water to 212° F	**5.88**
Saturated Water to Saturated Steam	**40.18**
Saturated Steam to Exhaust Steam	**0.52**
Aggregate	50.29
Excess Air	3.14

10.5% Reduction in Fuel Consumption!

EXHAUST TEMPERATURE: 240ºF

4% AGGREGATE MOISTURE

MIX TEMPERATURE: 300ºF

46.6% of Fuel Required to Process the Water

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Things that REDUCE Production

Operational

- Burner Output
- Moisture Content
- High Stack Temp
- Leakage Air
- High Baghouse ΔP

- Burner tuning
- As aggregate moisture increases, production decreases
- High stack temperatures reduce production

High Stack / Mix Temperature…

What's the problem?

1. **Reduces** baghouse filter bag life
2. **Lowers** production capacity (6 TPH for every 10ºF)
3. **Increases** heating costs (20% for 50 F)

300F mix	126 scf/ton	116 scf/ton
350F mix	126 scf/ton	140 scf/ton

DRYING

HEATING

20% INCREASE

PRODUCTION

242 scf/ton	
266 scf/ton	

10% INCREASE

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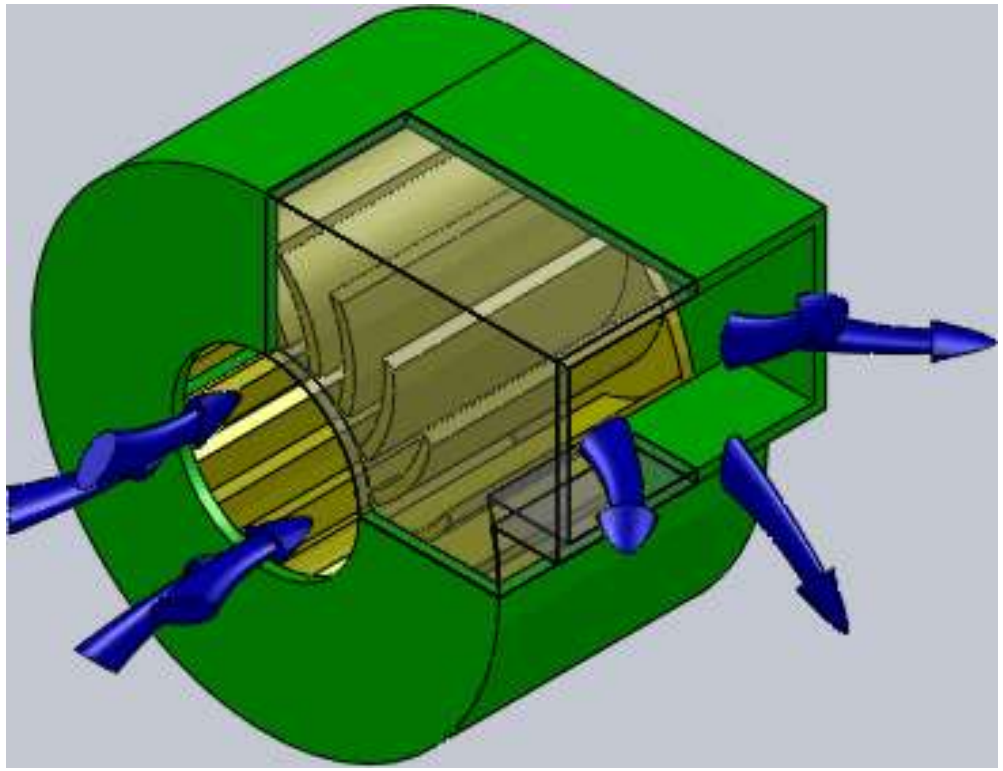


The exhaust fan has a fixed VOLUMETRIC capacity.

Higher moistures or stack temps increase the

V O L U M E

of the gases that the exhaust fan must pull through the system.

The *same mass* of gas being moved takes up more of the available capacity of the fan

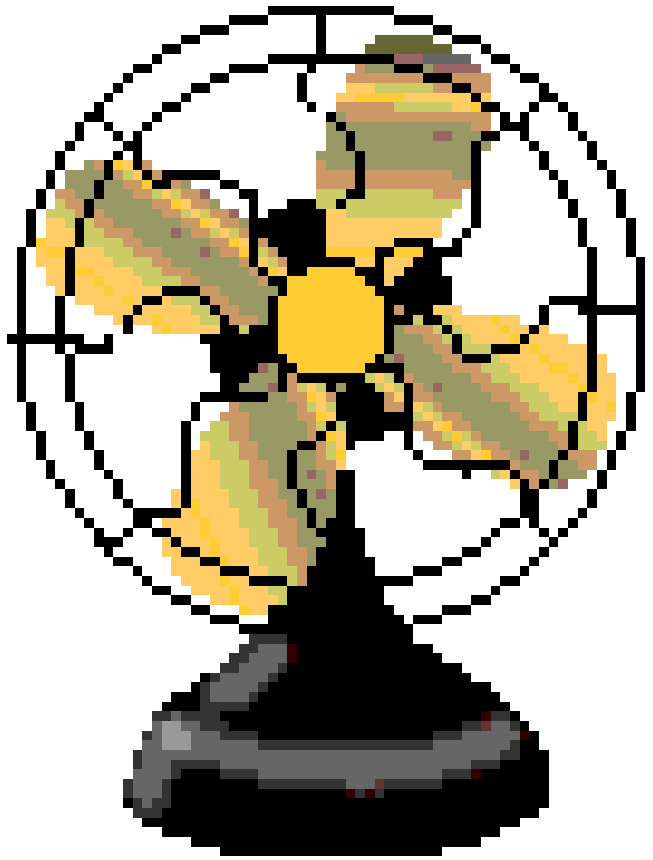
Things that REDUCE Production

Operational

- Burner Output
- Moisture Content
- High Stack Temp
- Leakage Air
- High Baghouse ΔP

- **Burner tuning**
- **As aggregate moisture increases, production decreases**
- **High stack temperatures reduce production**
- **Leakage air *uses up* baghouse capacity**

Leakage Air



Any air that is pulled into the exhaust system from outside that does not participate in the production process.

- The fan can only move its rated CFM.
- Leakage adds to the CFM the fan must move.
- Leakage Air “uses up” fan capacity.

INVESTIGATE LEAKAGE POINTS!

Worn or Missing Drum Seals

Replace Drum Seals

Unsealed Duct Joints

Seal Duct Joints

Material Inlet Chutes (aggregate & RAP)

Install Inlet Chute Diaphragm Seals

Patch or Replace Holes in Ductwork

Replace Ductwork

Improper Burner Adjustment or Open-Fire Burner

Tune Burner As Required

Bolted Connections

Seal Bolted Connections

Worn Airlocks

Replace Worn Airlocks

Worn / Missing Flop Gates

Replace / Repair Flop Gates

Loose Doors

Tighten Doors / Replace Seals

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Things that REDUCE Production

Operational

- Burner Output
- Moisture Content
- High Stack Temp
- Leakage Air
- High Baghouse ΔP

- Burner tuning
- As aggregate moisture increases, production decreases
- High stack temperatures reduce production
- Leakage air *uses up* the baghouse capacity
- High ΔP *reduces* baghouse capacity

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HIGH BAGHOUSE ΔP…

… is NOT like Leakage Air, high aggregate moisture, or high stack temperatures

REDUCES **fan capacity instead of “using it up”.**

Performance Data

HOW MUCH AIRFLOW IS THERE?

Max. RPM	Design 14	Design 17	Design 22	Design 26
	1092	1481	1780	2027

LOSS OF OVER 80 TPH

13,800 CFM decrease

4" SP increase

490 BCS

Outlet Area: 13.80 ft² | Wheel Diameter.: 49" | Tip Speed (FPM): 12.83 x RPM

CFM	OV	10" SP		11" SP		12" SP		13" SP		14" SP		16" SP		18" SP		20" SP		22" SP	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
33120	2400	1036	66.83	1080	74.23	1124	82.03	1166	89.81										
35880	2600	1050	71.63	1092	79.29	1133	87.13	1173	95.08	1213	103.38								
38640	2800	1066	76.64	1106	84.48	1145	92.47	1184	100.84	1222	109.32	1296	126.69						
41400	3000	1085	82.10	1123	90.15	1161	98.54	1198	107.03	1234	115.59	1305	133.45	1375	152.22	1442	171.25		
44160	3200	1106	87.85	1143	96.35	1179	104.92	1214	113.51	1249	122.42	1318	140.91	1384	159.76	1449	179.36	1513	199.76
46920	3400	1128	93.75	1164	102.65	1199	111.63	1233	120.62	1267	129.91	1333	148.75	1397	168.13	1459	188.01	1521	208.95
[illegible]	3600	1152	100.13	1186	109.13	1220	118.46	1253	127.82	1286	[illegible]	1350	157.00	1411	176.57	1472	197.27	1531	218.35
52440	3800	1177	106.84	1210	116.15	1243	125.81	1275	135.51	1307	145.51	1368	165.36	1428	185.87	1487	207.05	1544	228.49
55200	4000	1204	114.23	1236	123.83	1267	133.48	1298	143.47	1329	153.77	1389	174.58	1447	195.70	1503	216.96	1559	239.21
57960	4200	1233	122.40	1263	131.97	1293	141.88	1323	152.13	1352	162.34	1410	183.66	1467	205.70	1522	227.89	1576	250.57
60720	4400	1262	130.81	1291	140.64	1320	150.77	1349	161.25	1377	171.69	1433	193.46	1488	215.94	1541	238.57	1594	262.13
63480	4600	1293	140.10	1321	150.21	1348	160.24	1376	170.91	1403	181.53	1457	203.68	1510	226.53	1562	249.97	1613	273.89
66240	4800	1324	149.68	1351	160.05	1378	170.67	1404	181.19	1431	192.37	1483	214.84	1534	238.01	1584	261.74	1634	286.45
69000	5000	1356	159.91	1382	170.53	1408	181.39	1434	192.50	1459	203.46	1509	226.18	1559	250.03	1608	274.49	1656	299.41
71760	5200	1389	170.83	1414	181.71	1439	192.80	1464	204.11	1488	215.24	1537	238.66	1585	262.69	1632	287.29	1679	312.88
74520	5400	1422	182.15	1447	193.63	1471	204.94	1495	216.46	1518	227.74	1565	251.41	1612	276.06	1658	301.28	1703	326.94

Chart data based on Standard Conditions – 70F dry air at sea level (29.92 Hg)

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Mudballs

- High Baghouse ΔP
- Low Exhaust Temps

BAD DAY!!!

MOISTURE SOURCES:

- **Aggregate Drying**

  400TPH @ 5% H_2O → 20 TPH of H_2O

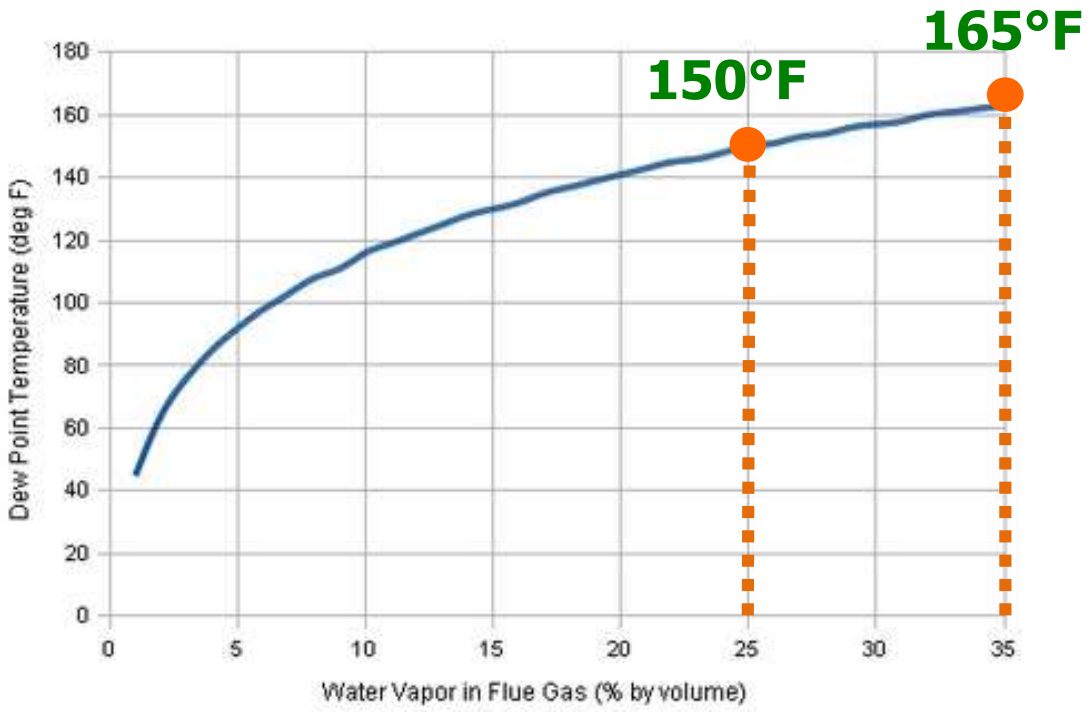
- **Combustion**

  $CH_4 + 2O_2 + 2N_2 \rightarrow CO_2 + 2H_2O + 2N_2 + HEAT$

- **Atmospheric Moisture**

  Dependent on Location and Leakage Air

Flue Gas Dew Point Temperature



- % Moisture by Volume (%M_V): Measure of the volume of water vapor contained in a volume of air, regardless of temperature
- Relative Humidity (RH): Measure of the amount of water vapor that air *can* hold at a given temperature; maximum value of 100%
- Dew Point (T_d): Temperature at which water vapor begins to condense and relative humidity is 100%. A measure of actual water content.

Actual Dew Point is dependent on the composition of the Flue Gas Stream – O_2 %, CO_2%, N_2%, H_2O %etc.

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HYDROCARBON CONTAMINATION

LIQUIDS DON'T BURN –
ONLY VAPORS BURN.

BAGHOUSE PRECOAT

Recommended for ALL new bags with fuel oils!

- Hydrated Lime
- Pulverized Limestone
- Bagged Precoat

NEVER use QUICKLIME

CALL TO GET QUANTITIES OF EACH

BLINDED BAGS

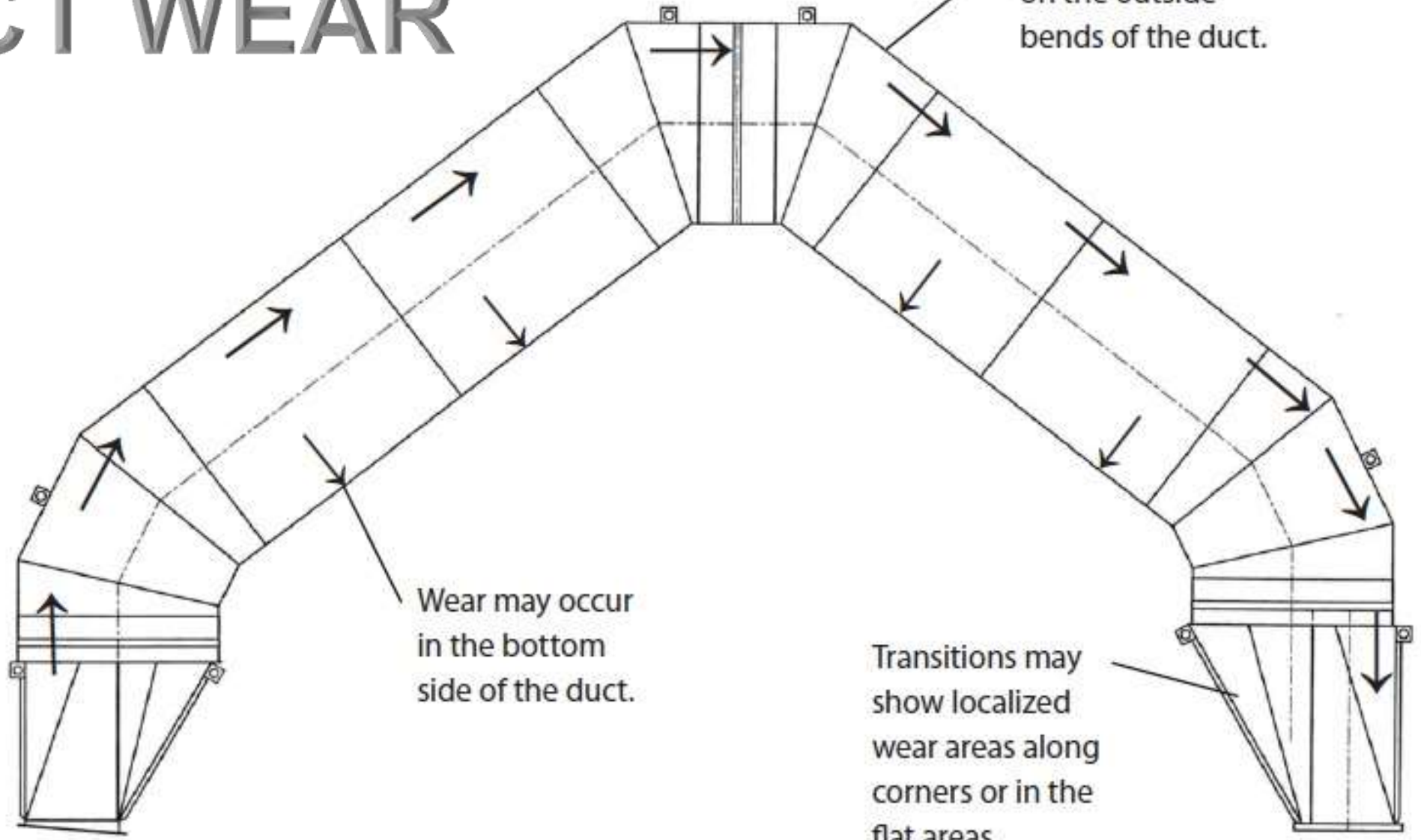
CRITERIA:

- BAG WEIGHT *DOUBLE* THAT OF NEW FELT AFTER CLEANING
- PERMEABILITY < 2 CFM AT 0.5 INWC
- DUST PENETRATION > 50% THROUGH FELT

WATCH OUT FOR...

Things that DAMAGE Equipment

DUCT WEAR


Wear is most likely on the outside bends of the duct.
Wear may occur in the bottom side of the duct.
Transitions may show localized wear areas along corners or in the flat areas.

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There it is!

Non-Critical Corrosion

- Typically has causes that are *more* easily fixed such as:
  - Low stack temperatures
  - Baghouse leaks in the form of:
    - Deteriorated Door Seals
    - Broken or cracked welds
- The corrosion in the baghouse shown here was solved by removing flights in the drum, and increasing the temperature in the baghouse by roughly 30 degrees.
  - The customer typically saw aggregate moistures near 8-10%

Critical Corrosion

- Typically has causes that originate from somewhere other than the baghouse itself.
  - Corrosive compounds from various sources:
    - Asphalt Cements
    - Aggregates
    - RAP
    - Additives
    - Fuels
- White / Yellow residues are a tell-tale sign of critical corrosion.
- Critical corrosion needs to be solved at the source of the corrosion, not by simply modifying baghouse temperature.

Corrosive Residues

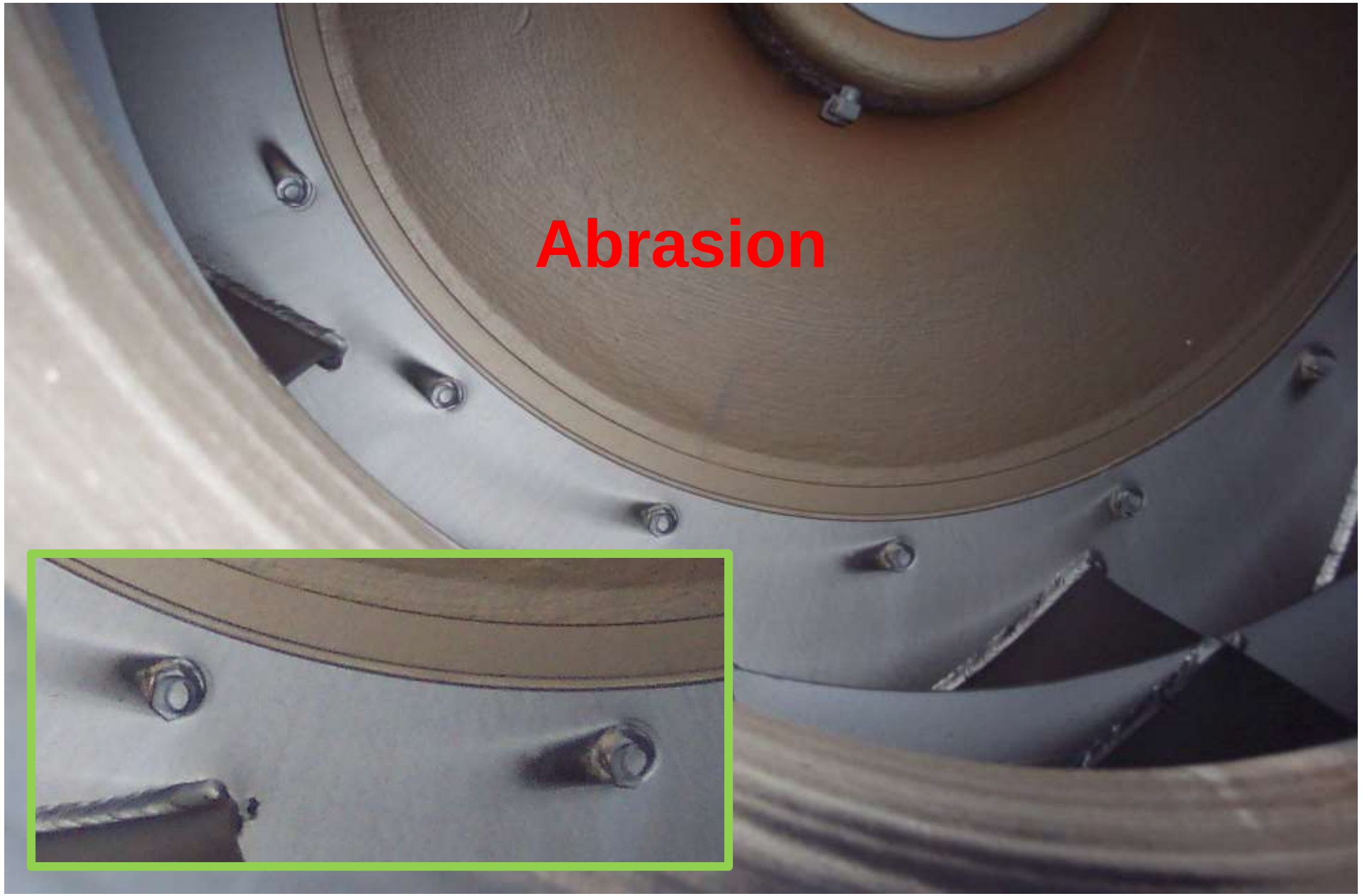
Sulfur residues have a similar, but yellow appearance

Chloride re
have a ch
white appe


Abrasion


This should throw a RED flag.
What else should you inspect?

Inspect the Fan Wheel!


Abrasion