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Establishing Best Practice Compressed Air Flows

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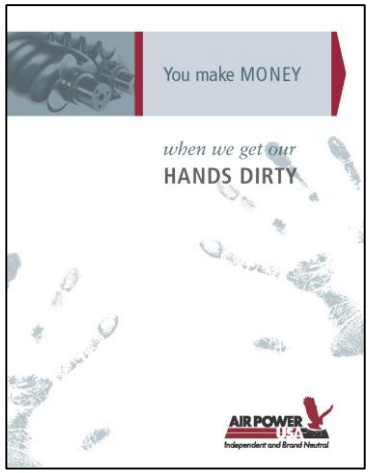

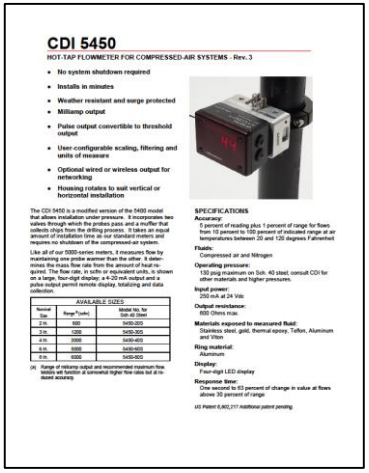

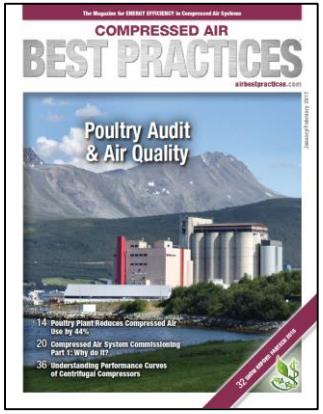

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All materials presented are educational. Each system is unique and must be evaluated on its own merits.

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Establishing Best Practice Compressed Air Flows

Introduction by Rod Smith, Publisher
Compressed Air Best Practices® Magazine

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About the Speaker

Hank van Ormer, Air Power USA

- Founded Air Power USA in 1986
- Over 50 years of experience in the compressed air and gas industry

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Establishing Best Practice Compressed Air Flows – Measuring and Monitoring to the Manufacturing Processes

Air Power USA – Hank van Ormer
February 22, 2017

AIR POWER USA
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Introduction

- Every production process has an optimum set of operating conditions
  - Specifically – flow, pressure and in some cases relative humidity
- Pressure and flow are related and supplying “extra pressure” to any process will create immediate excess flow – which increases the energy cost to produce the air at a higher pressure. The process uses more volume (scfm) with no increase in productivity – This is often called **ARTIFICAL DEMAND**

Energy Cost of Compressed Air

Example: 100 psig / $.06 kWh / 8,000 hours per year

Compressed air with a typical single-stage lubricant-cooled rotary screw air compressors is calculated as follows:

1 scfm = ± @ $100 / scfm year

1 psig / 100-hp = ± $160 year

A change in air compressor input energy only occurs when there is an actual compressor discharge pressure change at the compressor – **not the system pressure**.

Artificial Demand at the Process

Excess pressure in the system and / or to the process will create extra flow wherever it occurs.

- This excess is often termed “artificial demand”
- Increase in flow (100 psig class) about 1% per psig change up or down
- For a process that takes about 500 scfm –

  Extra air volume at +10 psig = 50 scfm or $5,000 year

  Extra input energy at +10 psig discharge pressure = $1,600 year

The extra flow generated by the extra pressure is much MORE expensive than the extra energy to produce the pressure!

Net Result

Measure, monitor, and control the pressure and flow to each air using sector and air using process.

The net result:

- Operate in the most energy efficient manner
- Improve productivity and product quality – reduce scrap
- Establish solid baselines for effective benchmarking
- Establish critical “red flags” for each process to assure **“Best Practice Flow”**

Measure and Monitor the Total System

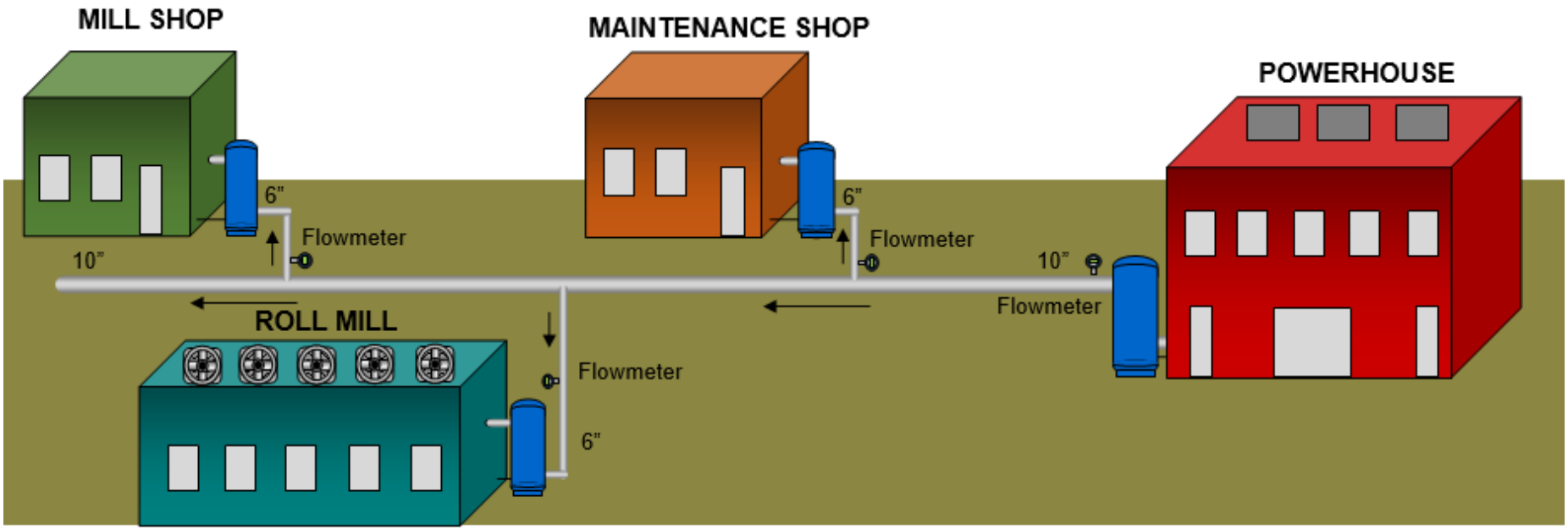
To evaluate the true system dynamics we need to know not just how much air is being produced and delivered, but where it is going.

Important questions to ask:

- Who is using it?
- How does this actually compare to the estimate or calculated estimate?
- How does the current flow volume compare to past measurements?
- What is the operating pressure – at rest and at cycle?
- Who monitors and how?

Measure and Monitor the Total System

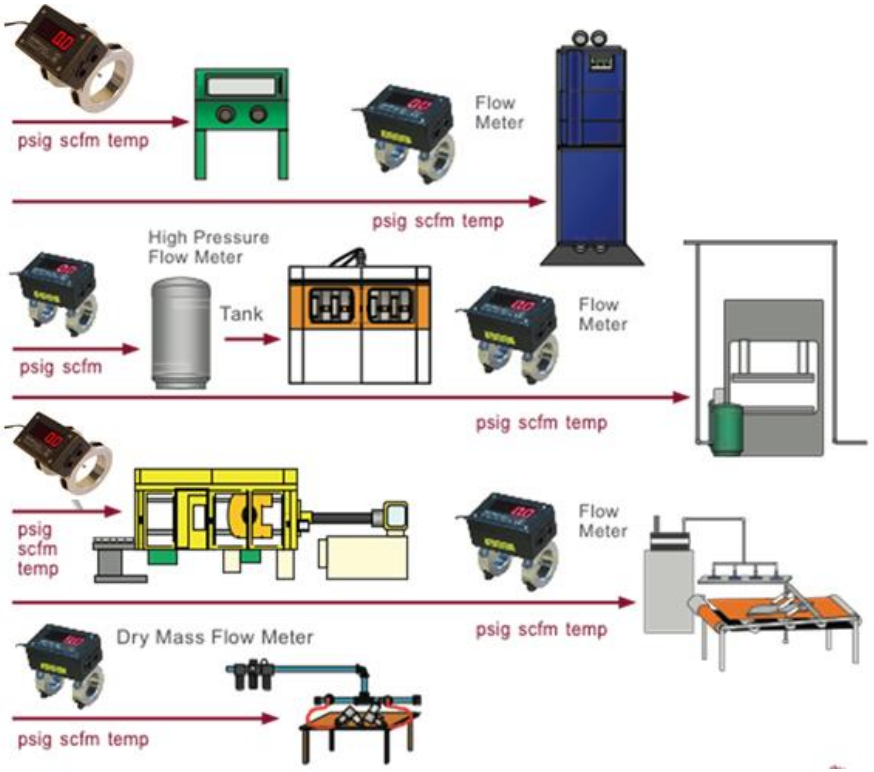
Measure and monitor flow to separate production sectors and buildings



Measure Flow to Each Independent Process

Flow to each independent sector – pressure and temperature

- Add pressure dewpoint if critical
- Assign optimum compressed air use of sector and monitor compared to budget
- Implement a program to operate at the lowest effective pressure and flow.



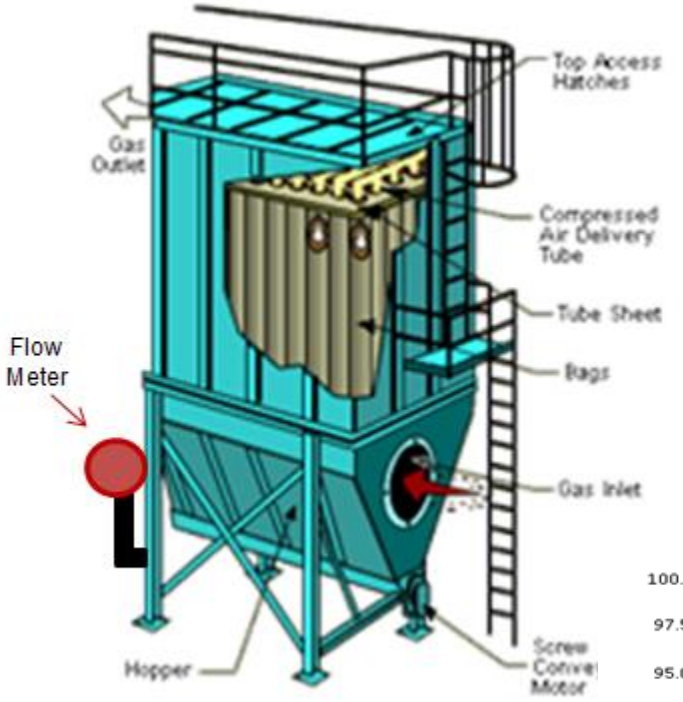
Typical Process Applications

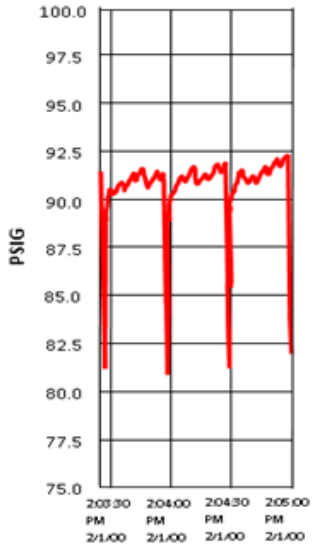
Dust Collectors –

Installed without adequate storage - ran for years with continuing problems

- Pressure differential control when used created:
  - Short bag life
  - Poor filtration
  - Interrupted process

Uncontrolled use – 146 scfm / $14,600 yr.



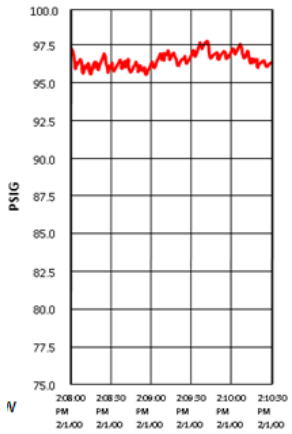


Installed flow meter – measured flow shows major pressure and flow drop at pulse.

Dust Collector – Solution and Result

Installed flow meter identified the problem

Storage to control pressure drop with flow meter installed permanently ahead of new storage receiver.

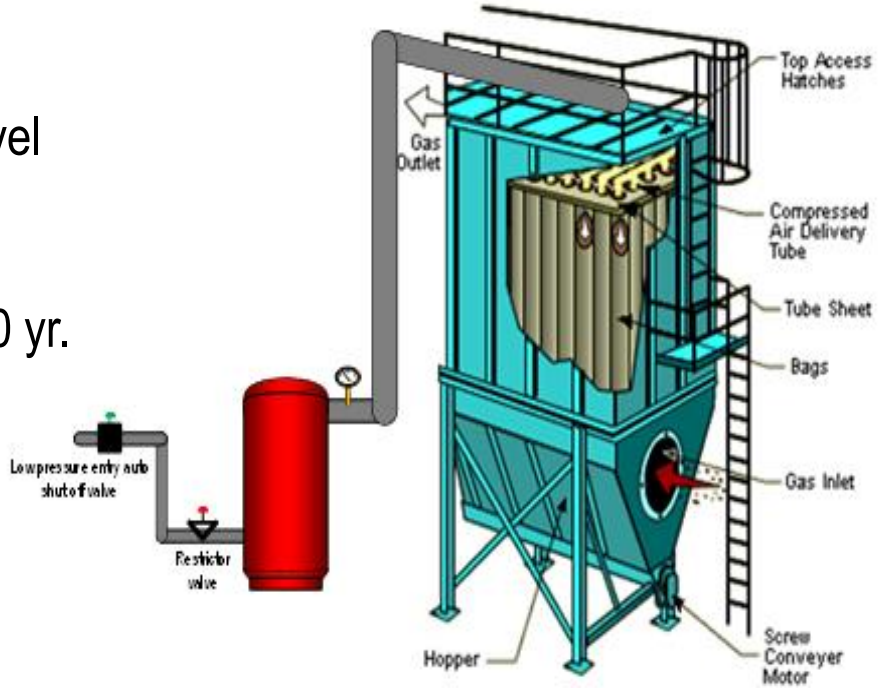


Pressure differential control now works

- Bag life 3 to 4 times longer @ $10K annual savings
- Filtration always within regulation level
- Nearby process – No ISSUES
- Controlled air use – 49 scfm / $4,900 yr.

Total annual energy savings: $9,700

Red flag when valves stick!



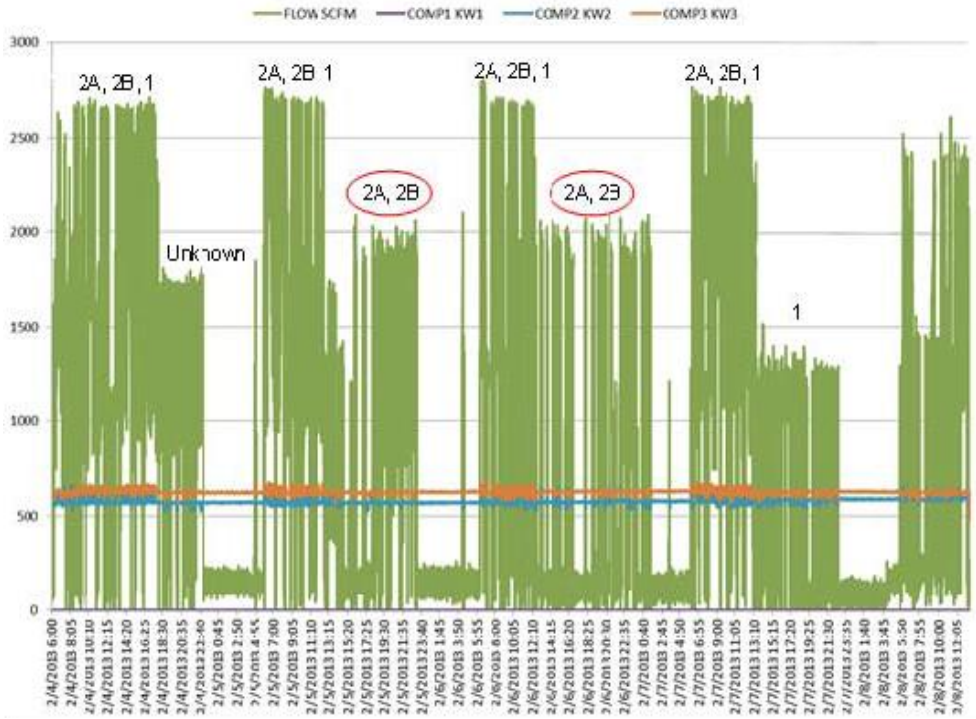
Identify System Dynamics

Example: PET Blow Molding

Due diligence is required along with measurement. Identify (calculate) the blow mold operating demand.

Blow Mold Line / Model	#1 SBO30 (24 oz) 48,000 bph	#3 SBO20 (2 Liter) 22,000 bph	#2A SBO20 (20 oz) 30,000 bph	#2B SBO20 (20 oz) 30,000 bph
Blow Air (scfm) -- 32 Bar	1007	1042	524	524
Pre-blow (scfm) -- 7 Bar	406	184	208	208
Stretch (scfm) -- 7 Bar	270	474	180	180
Service(scfm) each -- 7 Bar	125	100	100	100
Air Required at 464 psig / 32 Bar (scfm)	1007	1042	524	524
Air Required at 100 psig / 7 Bar (scfm)	801	836	488	488
Total Delivered at 464 psig / 32 Bar (scfm)	1808	1878	1012	1012
Projected Blow Air Recovered (scfm)	**(403)**	**(416)**	**(210)**	**(210)**
Projected Maximum High Pressure of Air Use (scfm) with Recovered Blow Air	**1405**	**1461**	**802**	**802**

Identify System Dynamics

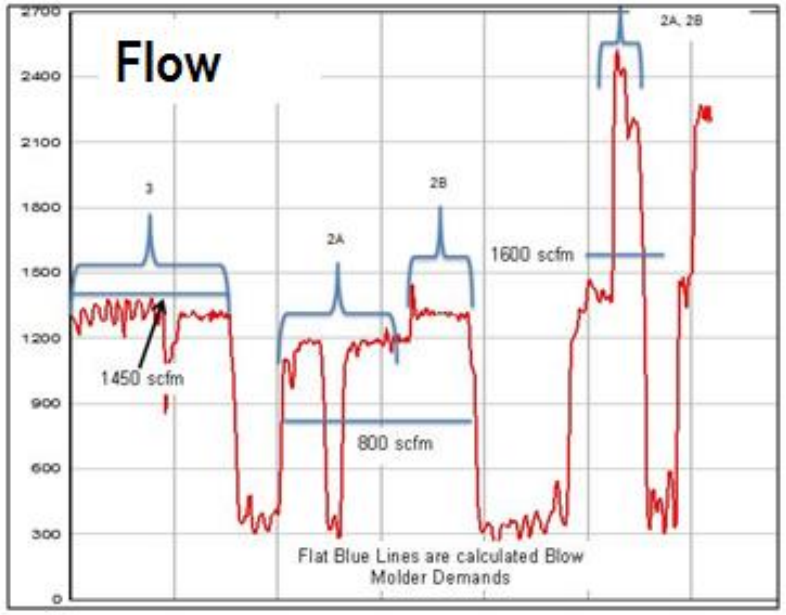


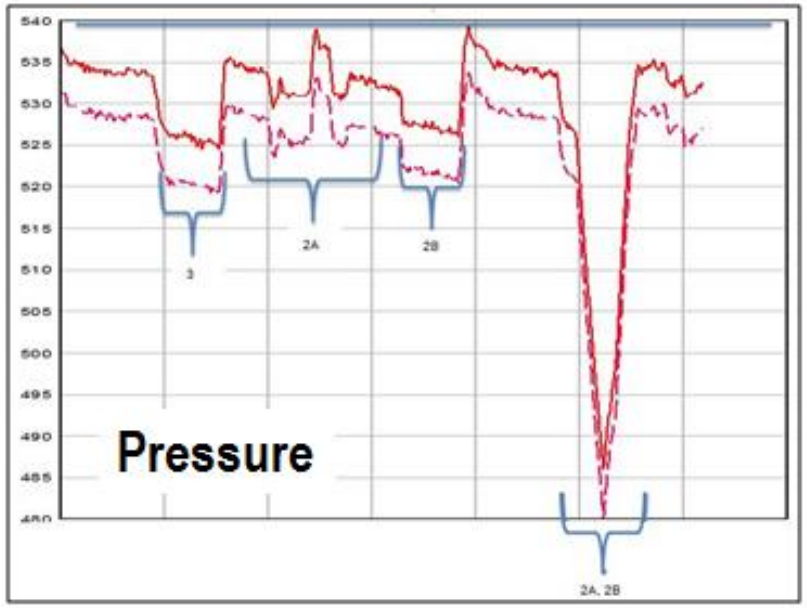
Blow Mold Line	Calculated SCFM	Measured / Actual SCFM
#5	1,405	1,380
#4	1,461	1,390
#2A*	**802**	**1,100**
#2B*	**802**	**1,100**
*Net flow includes 40% blow air savings per blow mold OEM (manufacturer) specifications.		

Flow measurement graph indicates blow mold lines 2A and 2B are consistently using more than the calculated demand

Identify System Dynamics

A more refined look using 5-second data points for flow and pressure.

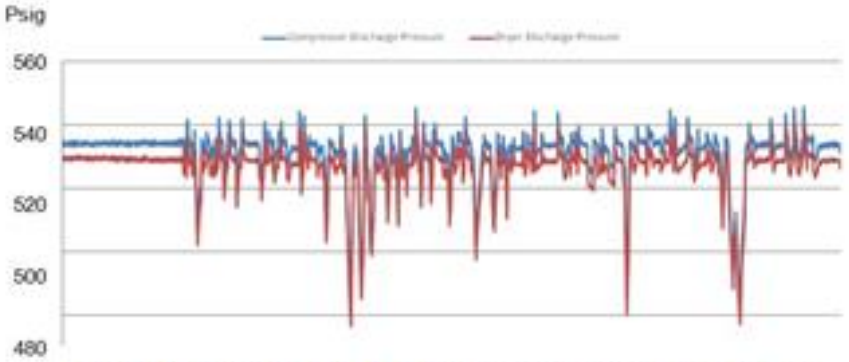




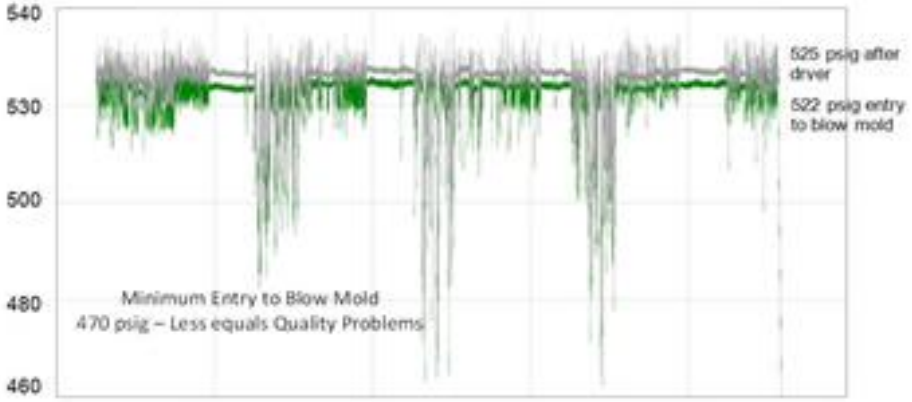
Average demand from blow mold lines 2A and 2B is about 2500-2700 scfm.
Minimum pressure to blow mold lines – 470 psig
With both units running the entry pressure to the blow mold falls to **LESS** than 400 psig.

Identify the Cause – Additional Refinement

Trended pressure data – 1 second intervals – before and after the dryer/ filter



Note: This eliminates the filters and dryers as probable cause of flow restriction.



Observation:

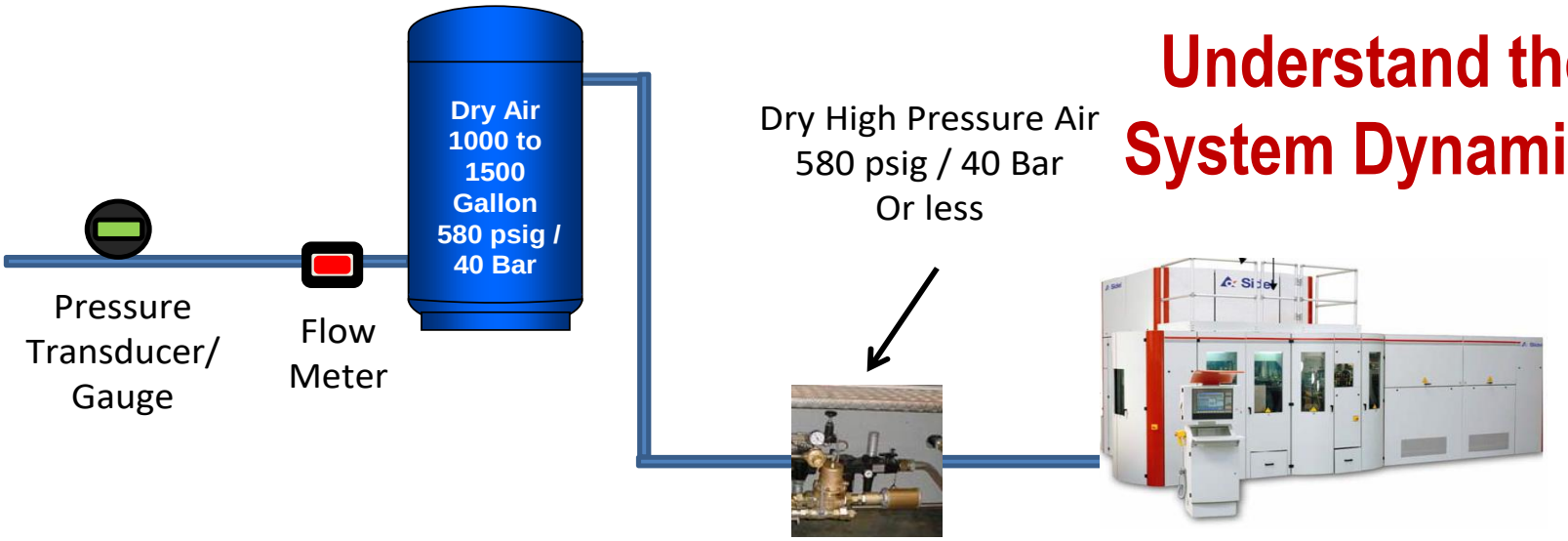
This occurred with 3 blow molds on and when one stopped. The blow mold restarts up to full demand in about 1-minute – the compressor took about 3-minutes to go from full idle to full load – during that time the pressure falls – often causing poor quality product and potentially unplanned shutdowns.

Calculate & Identify Proper System Storage

Calculated proper storage was added to the total system and at the entry to each blow mold and the problem was resolved.

Operating KPI's for pressure and flow were created and monitoring instruments installed – data trended, collected and analyzed with vast improvements.

- Monitor pressure and flow to each blow mold
- Compare to calculated and established values



Industrial Sandblasting

- Perceived to be “inexpensive to operate” and only uses “compressed air” and reusable media
- Air use depends on pressure, nozzle type and size and **BLAST** time
- All of this adds up to what is the total average flow per minute - scfm

Opportunity – Automatic Blasting Cabinets

A nozzle has the most effective removal with the proper media.

As the nozzle wears larger – it uses more compressed air with less effective removal -- therefore is in BLAST mode longer.

- All nozzles blasting air when not all are used.
- Nozzles left on with no parts to blast. Operator off site waiting for next job – working on something else.
- Automatic blasting cabinets exacerbate this situation.
- Old nozzles well-worn continue in use..."they still work".
- **What is the magnitude of these opportunities?**

Cost Analysis and Solution

Example:

Blasting with two, #5 (5/16") "new" ceramic nozzles at 80 psig

Air use is 137 scfm at 35% utilization

Annual operating cost = $13,700 x .35 = **$1,795 year**

As the nozzle wears to 3/8" at 80 psig – the air use climbs to 196 scfm and the blast time increases from 35% to 48% due to pattern deterioration.

New annual operating costs = $19,600 x .48 = **$9,408 year**

Solution:

A flow meter installed on the airline tied into an alarm switch is set to alert operators at 150 scfm (10% increase). This system worked to inform operators of nozzle wear and potential pattern deterioration before it occurred. Also alarms when air is on and no product is present.

Summary

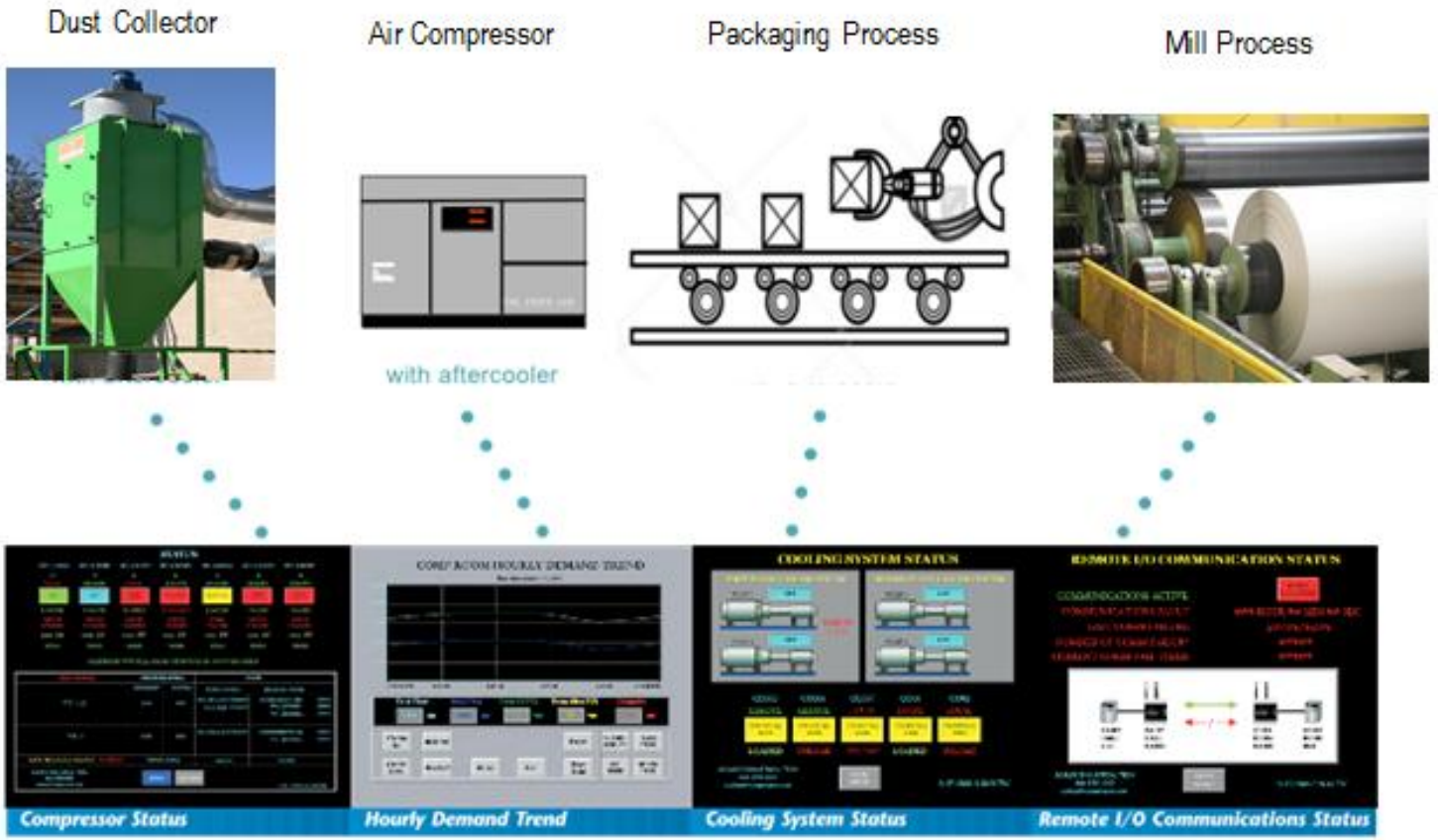
MEASURE FEED LINES TO PRODUCTION PROCESSES

Measure and monitor air use

- Flow in scfm
- Pressure – lowest effective psig /Bar
- Identify total leaks – when operating and at rest
- Establish optimum air use per process – set as “red flag”
- Monitor and/or “red flag” significant only pressure during cycles
- Dewpoint – if critical

Trend and Collect Data

Central Compressor Management Control

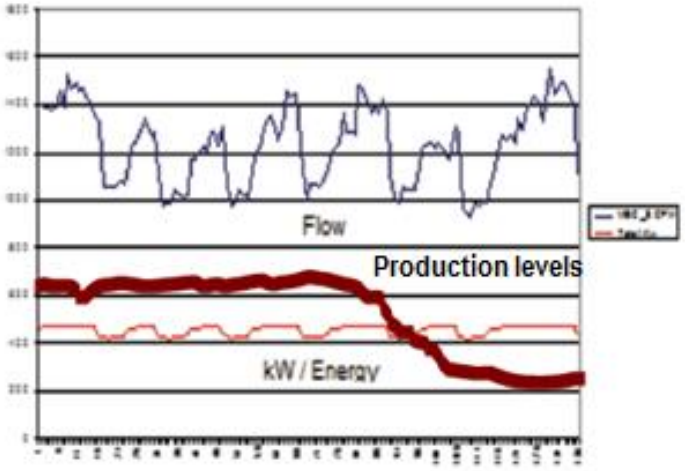


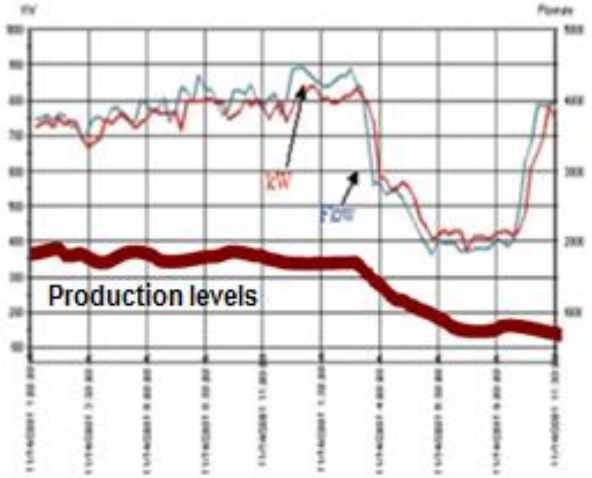
The path to compressed air optimization is finalized with proper sustainability, measurement and monitoring.

Connect Back to Supply-Side Controller

- Uncontrolled system – flow changes but kW does not change proportionally
- Energy and flow don't follow production

- Control management systems can significantly improve efficiency to minimize energy costs
- KW, Flow and production are proportional





If you do not manage, You cannot save.
If you do not monitor, you cannot manage.

Thank you for the opportunity to present.

Air Power USA

Hank van Ormer – Technical Director

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About the Speaker

Roger Dennison, CDI Meters

- Spent 20 years in energy consulting before founding CDI Meters, Inc.
- His first flow meter, the CDI 5200, was introduced in 2002.

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Application of Clamp-On Insertion Flowmeters

Roger Dennison-CDI Meters, Inc.

February 22, 2017

CDI METERS

Thermal Mass Flowmeters

- Meter mass flow of air
- Sense heat dissipation
- Little sensitivity to pressure
- Temperature compensated

CDI METERS

Limitations

- Not for use where water droplets present
- Do not indicate direction of flow

CDI METERS

Clamp-On Insertion Design

- Separate probes
- Small holes in pipe
- Gasket to seal
- Easy installation

CDI METERS

Range of Application and Required Adjustments

- Temperature: 20 to 120 degrees F
- Pressure: 0 to 650 psig; consult CDI above 200 psig
- Adjustments for pressure or pipe area may be required
- Most installations require no adjustment

CDI METERS

Locating the Meters

- Ample upstream pipe
- Think visibility
- Avoid fittings that distort or concentrate the flow

CDI METERS

Challenges

CDI METERS

Challenge: System Can't Be Shut Down

- Seasonal shutdowns only
- Scheduling constraints of auditors

The 5450 Hot Tap Meter

- Installs without system shutdown
- Same electronic and sensing technology as our standard meters
- Quick and easy to install

CDI METERS

Hot Tap Installation

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Hot Tap Installation

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Hot Tap Installation






CDI METERS

Challenge: Costly Wiring

- Wiring can be as costly as meter installation
- Requires an additional trade

CDI METERS

Wireless Data Collection

- Radio boards mounted inside meters
- Ethernet-connected gateways
- ZigBee® mesh networking extends range
- Host either
  - Factory automation system or
  - PC running MeterGrapher software provided by CDI

CDI METERS

Challenge:
Metering Compressor Output

- Verify compressor output
- Compare dryer input and output
- Thermal meters not suitable because of water droplets

CDI METERS

Coming: CDI Target Meter

- Senses force of moving air
- Suitable for moisture-laden air leaving a compressor
- Flow, pressure and temperature available through digital output
- Field trials under way

CDI METERS

CDI Meters, Inc.

CDI METERS

Thank You

CDI METERS

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Thank you for attending!

The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to Attendees within two days.

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Blower Demands with DO Control

Tom Jenkins, JenTech Inc.

Keynote Speaker

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