Compressed Air: Utility of VSDs

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Compressed Air is a Utility

- Unlike electricity or water: YOU
 - Generate it yourself
 - Control it yourself
 - Condition it yourself
 - Maximize efficiency internally

You have the opportunity to:

- Maintain the most efficient internal distribution system-
- minimize wasted energy
- Maintain air generation and treatment equipment to assure maximized performance.
- Create your own capacitance (storage)



Rotary Screw Air Compressors

- A popular choice for a variety of applications.
- Introduced in the 1960s are an alternative to reciprocating compressors.
- Are offered in a full range of capacities and pressures from 3-500 HP



Rotary Screw Positive Displacement

Single or two stage (mostly single)

Direct, gear or belt drive

Direct oil injection (on lubed units)

A variety of control systems

Modulation

On line/off line

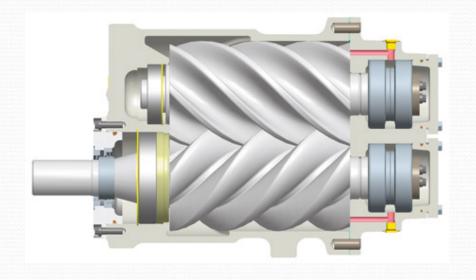
Variable displacement

Variable Speed

Air or Water cooled

Minimal vibration

100% duty cycle





Features of Rotary Screw

Lower initial cost
Lower installation cost
Reduced vibration
Small footprint
Continuous flow
No pulsations
Air or water cooled
Single or two stage





Rotary Screw Controls

Initially Rotary screw compressors were introduced with suction throttle controls or inlet modulation.

- Works by graduating the inlet valve open or closed in varying degrees to match demand
- Initially manufacturers suggested that air storage (tanks) were no longer required with suction throttled rotary screw compressors.



Suction Throttle

- Maintains steady discharge pressure
- Inexpensive and simple
- Oil carryover is minimized
- Very inefficient part load operation



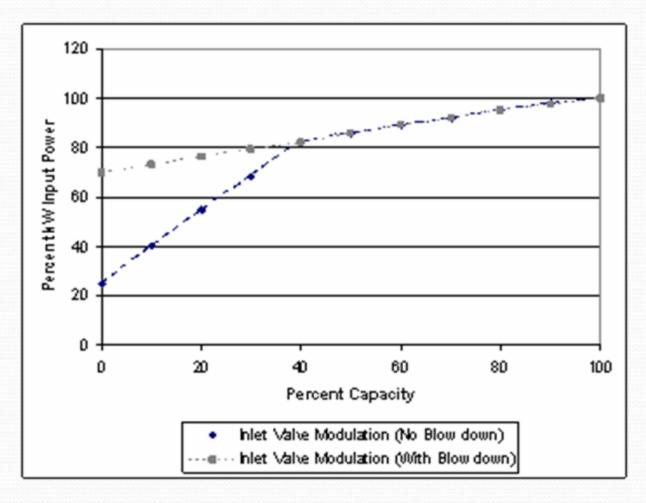
Suction Throttle

 Utilizes a subtractive pilot (regulator) to regulate a control device or air cylinder which will open and close the inlet valve based on rising and or falling pressure



Subtractive pilot

Common Suction Throttle Curve



Flat curve is typical for a suction throttled air compressor

At 40% load the power absorption is 80%

The point of blow down varies and will have more impact if there is greater storage (tanks)

Rotary Screw Control Systems

Variable Speed Drive

- Varies voltage (there are other types as well)
- Current varies with speed
- Speed varies with demand
- Advantageous when there is a lot of variation in load profile
- Can maintain stable discharge pressure
- Most efficient control system below 78% load



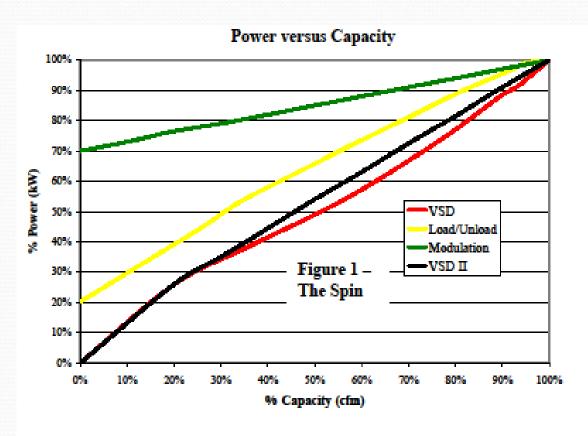
Rotary Screw Control Systems

Variable Speed Drive

- Reported performance curves are not always commensurate with actual field performance
- Can negatively impact Power Factor when in "turn down"
- Minimum effective speeds vary by manufacturer.
- Limited benefit on oil free systems
- Tendency to cause high oil carryover when operating at lower RPM for prolonged periods
- High initial cost.
- Expensive to replace components
- Tends to use smaller rotor diameters, higher RPM potential



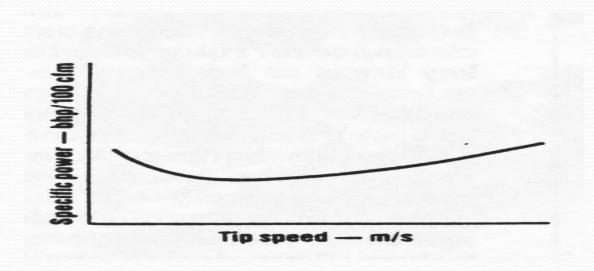
Comparative Power VSD vs other Control Systems



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Proceedings of the Twenty-Eighth Industrial Energy Technology Conference, New Orleans, LA, May 9-12, 2006

More tip speed discussion

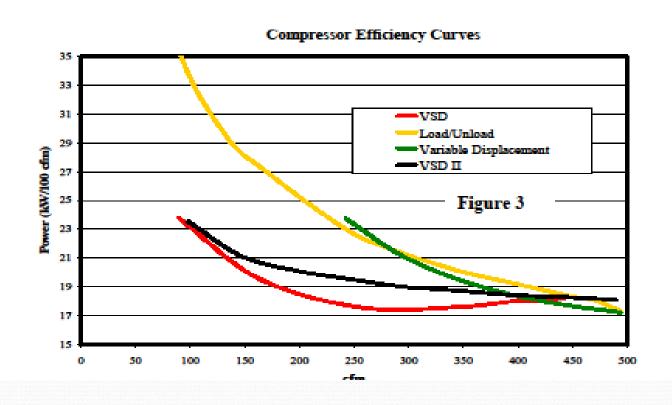
• Figure shows the effect of tip speed on volumetric efficiency (VE), VE is a measure of the effectiveness of filling the cavities between rotors during the inlet process. At low tip speeds, rotor sealing becomes less effective and high-pressure trapped air leaking back to inlet begins to reduce VE severely.





Impact of "turndown" on specific power

ESL-IE-06





Actual Case Study

Suction Throttled Air compressor

Very little variation in power demand

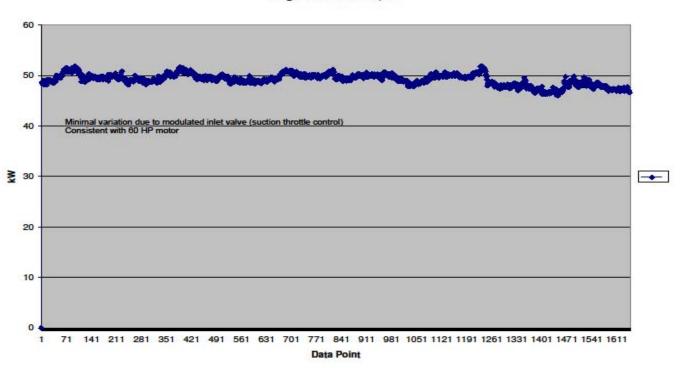
Power consistent with 60 hp

Air demand between 80-130 ACFM



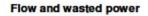
Actual Suction Throttle power curve

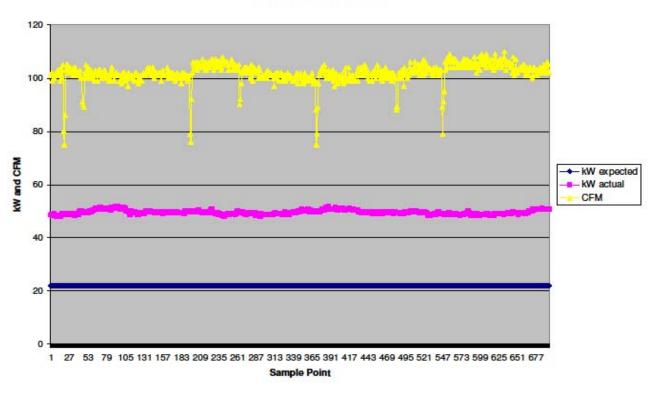
Avg kW entire sample





Monitored Demand vs power

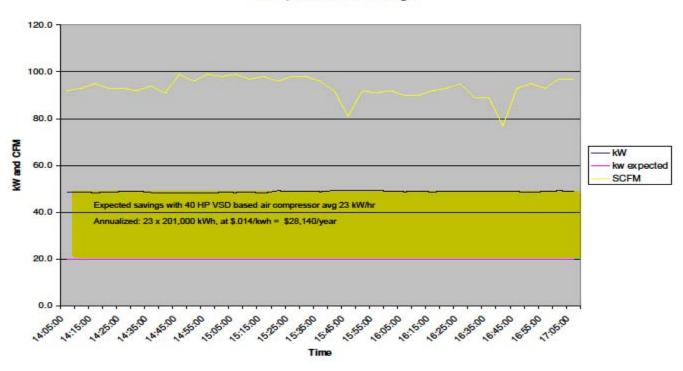






Profound Energy Savings with a 40 HP VSD

Sample Hour with Savings





Case Study Analysis

E:\NStar analysis sample.pdf

Which unit did this customer select?



Rule of thumb for air storage

- Load/no load controls
 - 4 gallons for each CFM of capacity
- Variable speed drive and var. displ.
 - 2 gallons for each CFM of capacity
 - This can be a sum total of wet and dry
 - The more storage the better



Save Energy!!!

Thank You

