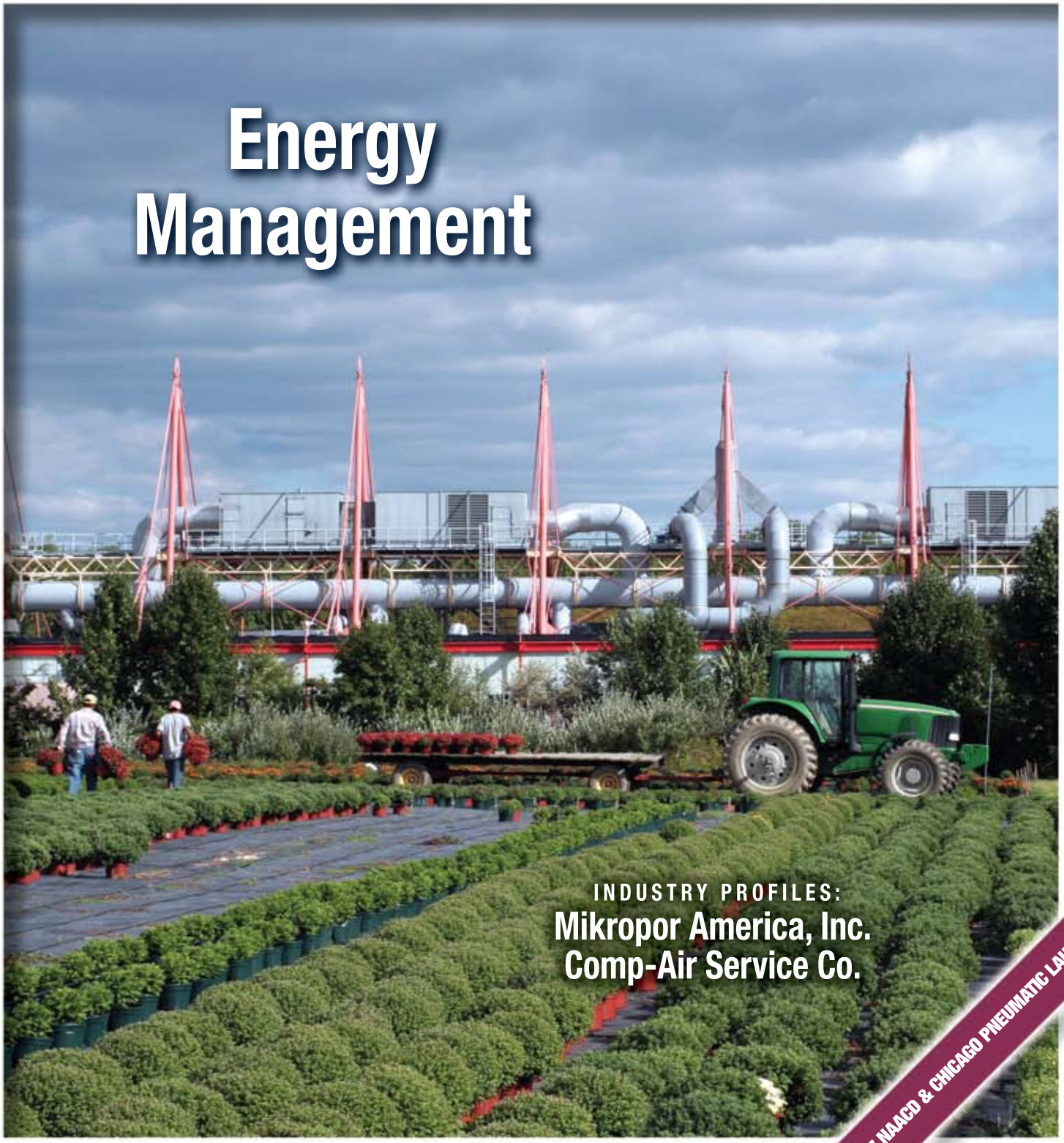
Smelter Audit Saves Energy | Selecting VSD Compressors | Pneumatics

January 2008

COMPRESSED AIR BEST PRACTICES



Energy Management

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* Reference: *Best Practices for Compressed Air Systems,* Compressed Air Challenge, 2nd Edition, 2007.

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FROM THE EDITOR

The Opportunity Provided by Energy Management

Industrial users have embraced the opportunity to reduce energy costs associated with their compressed air systems. Utility engineers recognize the rapid ROI's on the capital they deploy in these projects. Corporate management has recognized the opportunity to translate kW savings into the corresponding savings in carbon dioxide. The national average emissions factor for electricity is 1.37 pounds of CO_2 per kilowatt-hour.*

Industrial users are holding Kaizen events on their compressed air systems. When the audits are completed and executed, the results are translated into carbon dioxide savings. This is then equated to the equivalent number of trees one would have to plant to filter out the same amount of carbon dioxide. They also equate these savings to the number of cars we would have to take off the road. These corporations are making a huge difference to their bottom lines AND to the environment. The public relations departments of these companies will deservedly communicate to the public what they are doing.

We find it remarkable what an impact one-to-three people working at a large corporation can have on profits and the environment. The goal of this journal is to continue educating these "heavy-hitters" on the opportunities. We are introducing the logo seen on this page to call the readers' attention to BEST PRACTICES within an article. The symbol represents the benefits to both profits and to the environment that these compressed air system audits bring.

We are introducing a regular column called the "Audit of the Month" where we will let readers see edited-down versions of the audit work currently being done in compressed air systems. The "January Audit of the Month" is on a Copper Smelter in Peru. Mr. **David Smith**, a veteran compressed air auditor, shares with us how this facility spent $1.4 million per year on the electricity required for the compressed air system. They are now on track to spend $759,000 per year after a project that has a 9.5-month break-even point.

Utility companies can play a role in energizing (pardon the pun) a region to seek out opportunities to drive down energy costs. In this edition, we write about the incentive program offered by **National Grid**, which made it financially possible for a paper mill in Massachusetts to deploy wireless sensor technologies necessary to optimize a compressed air system.

Variable speed drive air compressors have made a tremendous impact in driving down energy costs. Like any technology, it is important to understand the application in which they will deliver the energy savings. In his "Real World Best Practices" column, Mr. **Hank Van Ormer** has provided us with a guideline for selecting VSD rotary compressors.

Finally, on behalf of the global compressed air industry, we extend our heart-felt condolences to the family and employees of BEKO, due to the passing of Mr. **Berthold Koch**. He will be greatly missed. His legacy is secure in that he personally changed the way compressed air condensate is managed around the world.

ROD SMITH

*Source: U.S. Energy Information Administration Electric Power Annual 2005, Table 5.1 (October 2006)

Real World Best Practices

by Hank Van Ormer

SELECTING A VSD ROTARY COMPRESSOR

VSD's save energy at < 80% demand

VSD's can be inefficient at >80% demand

Ascertain demand profiles

The variable speed drive, particularly in lubricant cooled rotary screws and metal vane compressors, is an excellent tool for optimizing the electrical energy cost to drive air compressors. However, it is only one of many available tools. Like other tools, it must be implemented correctly and at the right time to avoid misapplications and missed opportunities. Its capabilities and draw backs must be clearly understood.

The electric motor variable speed driven compressors are not new and have been employed many times over the last 30 to 40 years. These drivers were historically almost all VFD (Variable Frequency Drive) and the units were usually built as "specials" by the manufacture or packaged by specially trained and experienced organizations.

What Has Changed?

New types of variable speed drives have become available in addition to the variable frequency drive. Variable frequency drives have also become more efficient and responsive. Today, almost all manufacturers offer some form of variable speed drive as a "standard" product in their rotary screw and vane compressor packaged lineups. Air compressor manufacturers now offer excellent "factory packages" and VSD is "new" and very desirable. It is not a cure-all for every application and might use more electrical energy than other options, depending on the facility's unique requirements. Examine all the data carefully. There will always be an electrical energy loss going through the Variable Speed Drive equipment, which will show up dramatically at higher load conditions.

Does It Really Work?

Absolutely. **Variable speed drives in positive displacement compressors is by far the most overall power efficient type of part load capacity control when applied correctly.**

As the compressor slows down to reduce capacity to meet demand it is operating at or near full load efficiency from 40 to 50% flow up to 100% flow. What keeps it from maintaining the "perfect efficiency" under all conditions? The electric power has to go through some kind of variable speed controller and there will be some energy loss — probably in the range of 4 to 6% at full load compared to the same unit in constant speed. Therefore it is not designed to supply compressed air at full load on a continuing basis; it is designed as a very effective trim unit from 75 to 80% flow and lower with the capability of going to full load as required. It is a misapplication to spend the majority of the operating hours at a high load. However, the capability of reaching full load "once in a while" may actually keep the plant from turning on another air compressor, further increasing the savings under certain conditions. The performance curves in Figure 1 show the relative efficiency of various constant speed capacity controls and typical variable speed drive.

This flowmeter cost $495 and took 15 minutes to install.

It revealed leakage costing $3800 per year in a cluster of forming machines.

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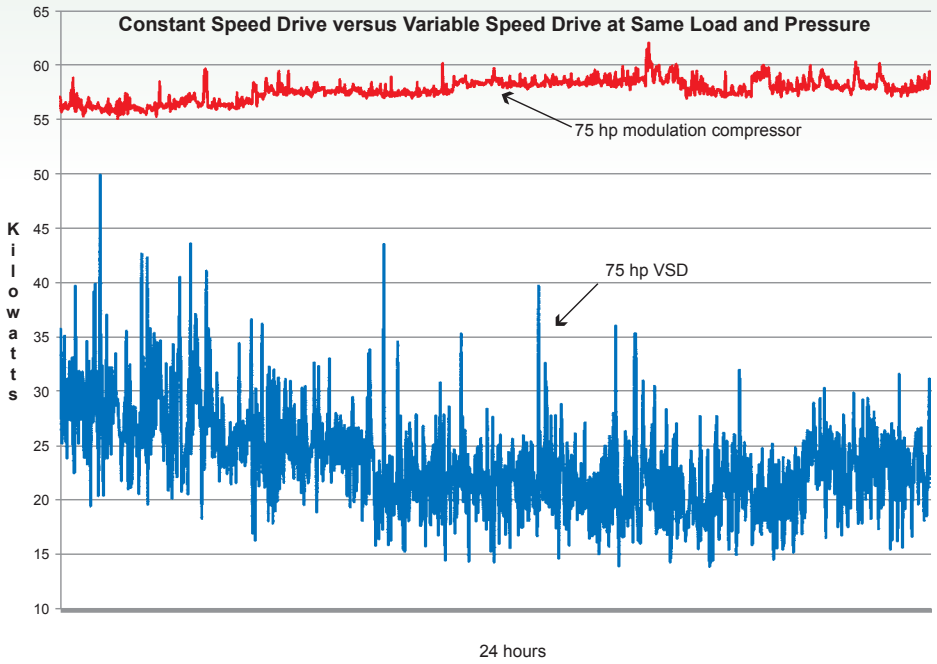
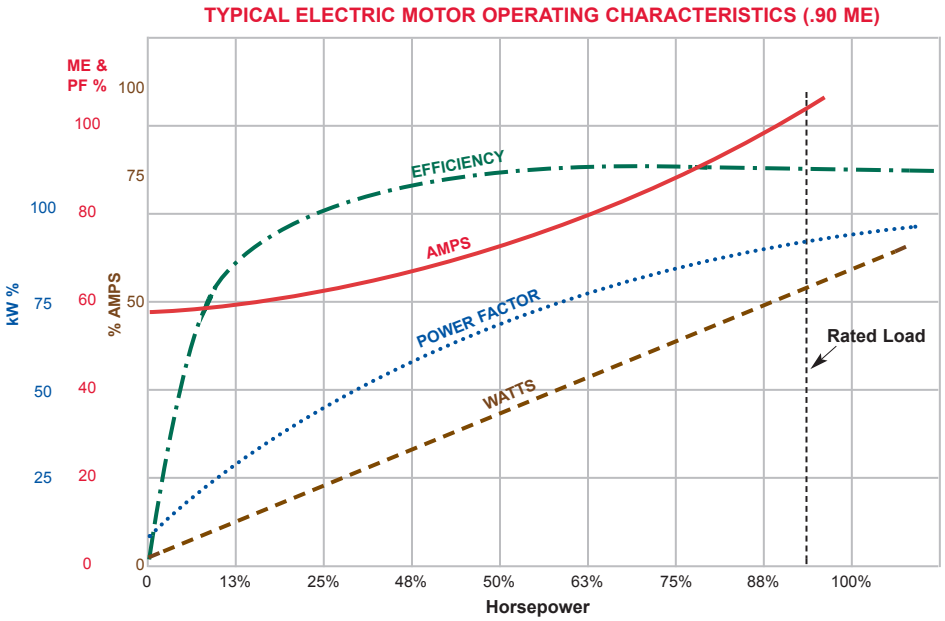
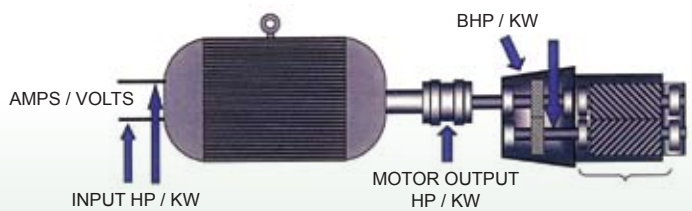
REAL WORLD BEST PRACTICES

Selecting a VSD Rotary Compressor





NOTE: 1. These operating characterisitics will vary with motor type, basic design, motor efficiency, constant or variable speed, etc..
2. Amperage will vary indirectly with changes in rated voltage.



When Do You Apply Variable Speed Drive?

Of all the capacity controls available on lubricant free and lubricant cooled rotary screw compressors, none are more power efficient in "their effective turn down range" than VSD's. VSD's can operate "in part load at or near full load efficiency." This effective turn down range will vary with different manufactures, different types of VSD drives and the performance profile of the rotary screw air end. For estimating purposes the most effective turn down range will usually run from 40% and up to 80% of full flow. Lubricant cooled rotary screws will usually have a wider effective turn down range than lubricant free models. Review the unit's specific performance data to establish this.

VSD's also offer the ability to pull down to very low loads (15–25%) with relative efficiency and then shut off and restart more times per hour than a similar constant speed induction motor. Certain types of drives have greater ability for unlimited starts and stops per hour than others. When reviewing various options for a specific load profile do not overlook this very important feature; it can and will save significant energy dollars under certain conditions. Almost all manufacturers offer unlimited starts and stops per hour. Review this performance with careful detail to your application. These statements make it clear that Variable Speed Drives with lubricant free or lubricant cooled rotary screw air ends are a very effective tool, when properly applied can offer great energy dollars savings.

They offer:

- Excellent trim capability when required.
- Deliver an effective steady pressure 1–2 psig operating band within their turn down range.
- Ability to effectively start and stop the motor more often when required.

Significant Savings Are Available when Applied Correctly

Below is a plant case study. The graph reflects two performance curves at a vinyl extrusion plant in Washington State. The upper curve reflects the kW power draw of a 75 HP class constaint-speed, inlet-valve modulation controlled single-stage, lubricant cooled rotary screw compressor (avg. 57.66 kW). The lower curve is the kW draw of a 75 HP class, variable-speed driven, single-stage, lubricant cooled rotary screw compressor (23.54 avg kW). Both units ran at the same demand profile. In this application there is a 40.8% reduction in power draw. The 34.12 kW reduction at $.07 per kWh generates $20,922 per year in electrical energy savings (these measurements were taken by plant personnel). The average flow is about 175 cfm at 100 psig with peaks to 210 cfm. The demand profile is about 50 to 60% load. The savings are significant.

Why Did This Application Work?

Referring back to the performance curves in Figure 1, when the VSD is compared to an inlet valve modulation constant-speed compressor, the VSD becomes more power efficient from 85 to 90% flow demand (varies with the actual slope of a specific compressors performance curve). We are in the "sweet spot" for the VSD which in this case can operate more and more efficiently right down to 10% flow demand at which point it can then shut off if desired. If the flow demand were from 300 to 350 cfm on a continuing basis these would be little or no savings. Variable speed drives should not run significant hours per year at higher loads. They are effective "trim" units, not base load. Most plants will only need one appropriately sized variable speed driven unit as a trim compressor.

REAL WORLD BEST PRACTICES

Selecting a VSD Rotary Compressor

Example: Lubricant Free Two Stage Rotary Screw (350 HP VSD and 200 HP Constant Speed Trim) Annual Electrical Energy Cost for Compressed Air Production

	Existing system: 1,526 cfm base load (350 hp) 1,026 cfm (200 hp) trim unit		**Proposed system:** Existing (350 hp) 1,526 cfm base load / new (350 hp) 1,520 cfm variable speed drive trim unit	
Measure	Three production shifts	Holidays and weekends	Three production shifts	Holidays and weekends
Average system flow	2300 cfm	900 cfm	2300 cfm	900 cfm
Average compressor discharge pressure	100 psig	100 psig	100 psig	100 psig
Input Electric Demand	393 kW	148.3 kW	405 kW	171 kW
Operating hour of air system	6,240	2,720	6,240	2,720
Specific power	5.85 cfm/kW	6.07 cfm/kW	5.68 cfm/kW	5.26 cfm/kW
Annual electric cost for compressed air	$122,616 / yr	$20,168 / yr	$126,360 / yr	$23,256 / yr
Total annual electric cost	**$142,784 / yr**		**$149,616 / yr**	

Existing Operating System Data Profile

Unit #	Compressor: Manufacturer/Model	Full Load		Actual Elec Demand		Actual Air Flow
		Demand kW	Air Flow (acfm)	% of Full kW	Actual kW	Actual acfm
Production Shift: Operating at 100 psig discharge pressure 2300 cfm						
1	1,526 / 350 hp constant-speed drive	100	100	254.7 x 1	254.7	1,526
2	1,026 / 200 hp two step full load / no load	78	87	157.8 x .874	138.3	800
				TOTAL (Actual):	**393 kW**	**2,300 acfm**
Limited Production Shift: (weekends, holidays) Operating at 100 psig discharge pressure and 900 cfm						
1	1,526 / 350 hp constant-speed drive	OFF				
2	1,026 / 200 hp two step full load / no load	88	94	157.8 x .94	148.3	900
				TOTAL (Actual):	**148.3 kW**	**900 acfm**

Proposed Operating System

Unit #	Compressor: Manufacturer/Model	Full Load		Actual Elec Demand		Actual Air Flow
		Demand kW	Air Flow (acfm)	% of Full kW	Actual kW	Actual acfm
Production Shift: Operating at 100 psig discharge pressure 2300 cfm						
1	1,526 / 350 hp constant-speed drive	100	100	254.7 x 1	254.7	1,526
2	1,520 / 350 hp variable-speed drive	50.7	53	288.9 x .52	150.3	774
				TOTAL (Actual):	**405 kW**	**2,300 acfm**
Limited Production Shift: (weekends, holidays) Operating at 100 psig discharge pressure and 900 cfm						
1	1,526 / 350 hp constant-speed drive	OFF				
2	1,520 / 350 hp variable-speed drive	59	59	288.9 x .59	171	900
				TOTAL (Actual):	**171 kW**	**900 acfm**

How Can I Tell What the Power Draw Is — Can I Use Amperage?

We do not use amperage to measure power; power is kW and kWh is energy power over time. Amperage can be very misleading with regard to power because it is not proportional to power throughout the motor operating cycle.

For example:

The example left shows typical HP data — BHP (at compressor shaft) output motor HP and input HP/kW. Basic specification:

	VSD	Constant Speed
CFM	490	490
PSIG	100	100
FL Amps	124	133
Power Factor	.944	.84

At first glance, the VSD at 124 amps would appear to be more efficient than the constant speed at 133 amps at the same flow and pressure. However, in this case, the power factor of the VSD driven motor is .944 and of the constant speed motor is .84.

When you put the data in the formulas shown to calculate kW you generate:

VSD drive	93.26 kW
Constant speed	89 kW

This particular VSD unit appears to be about 4 to 5% less power efficient than a comparable constant speed at full load — as one would expect.

Variable Speed Drive and Oil-Free Rotary Screw Compressors

Variable speed drives with lubricant free rotary screw air ends, when properly applied, can bring energy savings. In addition, they provide excellent trim capability when required. The lubricant free two-stage rotary screw has a much more narrow efficient operating speed range than the lubricant cooled models. The overall energy reduction will probably be of a lower magnitude than the lubricant cooled. The following case study is an example of misapplication of a VSD caused by attempting to select the proper unit on "rules of thumb" rather than "attention to details."

Plant Example — Lubricant-Free Rotary Screw

One processing plant has a 1,526 cfm, 300 hp compressor and a 1,026 cfm, 200 hp compressor. Both are fixed speed, lubricant free two-stage rotary screw compressors. The 1,526 cfm model runs base load and the 1,026 cfm, 200 hp model is used as the trim machine. A sales presentation on a 1,526 cfm class variable speed drive two-stage lubricant free rotary screw compressor pointed out that at 50% load (750 cfm), the compressor was at only 50% of full-load power. According to the sales presentation, a new variable speed drive 1,526 cfm trim unit in the system could slash electrical energy costs by as much as 40%. The data sheets supplied by the salesperson included BHP (shaft horsepower) ME and full-load amps but not PF or input kW. The manufacturer then supplied input kW data at various loads to allow an accurate comparison. The plant was able to fill out a load profile/operating cost estimate sheet. For this specific example, the total estimated annual electrical energy cost with the existing 1,526 cfm base load unit and the existing 1,026 cfm trim unit with two-step control is $142,784. The total estimated annual electrical energy cost with the existing 1,526 cfm base load unit and "new" 350 hp class variable speed drive unit is $149,616. In this particular case, the existing 200 hp two-step control unit acting as the trim unit has an estimated $6,832 lower electrical energy cost (at 0.05 kWh) than an alternate variable speed driven lubricant-free rotary screw compressor. However, in another profile with other equipment — or even the same equipment — the variable speed driven unit might offer significant savings.

Conclusion

It is critical to accurately ascertain the demand profile prior to considering the cost effectiveness of any new compressors. This axiom applies whether considering VSD or any other type of drive and capacity control. Only then can you accurately review the measured or projected input kW and the overall impact on your electric energy cost.

There are other articles and publications describing a complete review of your air system. You can do this yourself, ask the VSD equipment sales personnel or hire an independent consultant. Don't make unguided decisions because you could miss golden opportunities. The key point is that plants should NOT simply assume the variable speed drive will be the silver bullet that will reduce compressed air energy costs. It is important for plant operators to:

- Obtain all the important data, particularly input kW, for all units at critical percent-of-load points. Plants can and should evaluate existing equipment.
- Identify and optimize demand or load profile over all pertinent conditions — production, non-production, etc. Assign hours per year to each of these conditions to evaluate true operating cost. The plant example provided here is somewhat simplistic in that the production process does not vary much. However, the example is based on an actual processing plant's logged data.
- Identify blended electrical power costs in $0.0/kWh, but do not lose sight of the effect on demand charge if a smaller or variable speed drive can trim and shut off a larger unit.
- Prepare an operating cost comparison.
- Optimize the system. Is it necessary to have air on during weekends and holidays? How much air is essential? How much air is being lost to leaks?

REAL WORLD BEST PRACTICES

Selecting a VSD Rotary Compressor

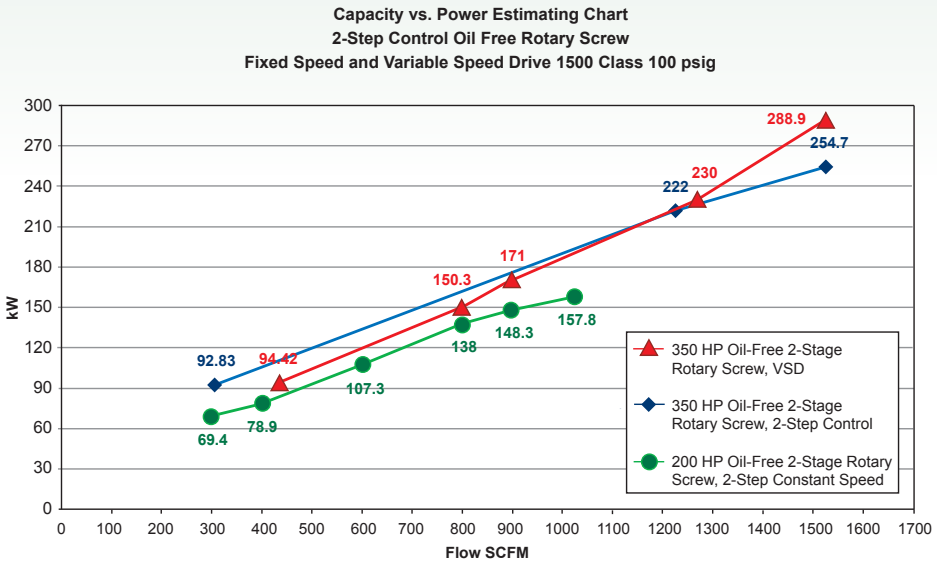
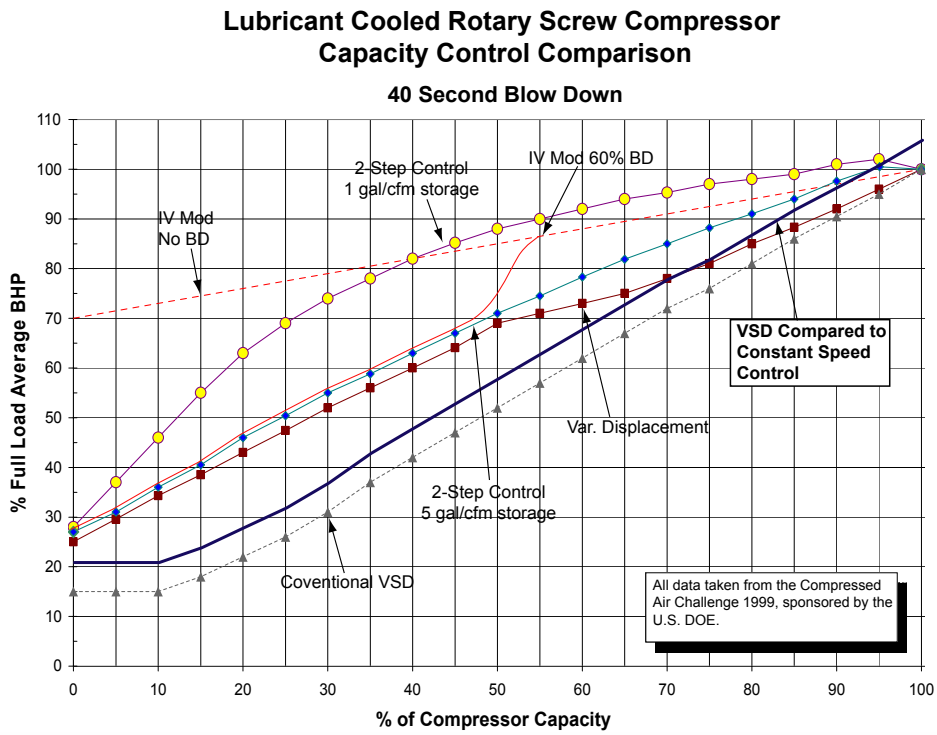


Figure 1. Typical performance curves of percentage of power to percentage of flow for lubricant cooled rotary screw compressors of various capacity controls. Based on 40-second blow down from no flow to full idle kW. Depending on the brand, size and age of the unit in question this time can vary from 10 seconds to 3 minutes or more.

Note that the variable displacement control is actually more efficient from about 75% to 99%.



Abbreviations:

IV	**Inlet Valve**
Mod	**Modulation**
BD	**Blow Down**
VSD	**Variable Speed Drive**

NOTE: All percentages are stated as a percent of full load horsepower at a specific discharge pressure (i.e., 100 psig) on a specific machine.

NOTE: Curves are based on a lubricant cooled screw with a 40 second blow down, other parameters see miscellaneous section.

Translate this into actual "input kW" throughout the "operating load profile." Apply it to the number of hours of operation to determine the "total kWh per year." In your calculations, compare some typical capacity controls at various loads. The manufacturer is capable of giving you actual input kW. The conventional method of using BHP x .746 or .7457 and dividing by the motor efficiency is misleading. It will miss the VSD equipment loss and/or belt losses in belt driven equipment.

Keep in mind the VSD starts at a higher full load kW than a comparable constant speed model. Accurate performance charts will show you where the "break even" point is and where you start saving energy in your operation. Properly selected and applied the VSD controls on positive displacement rotary compressors are a great help to improve your overall compressed air system efficiency and to help maintain it. Utilizing all its strengths in the operation plan can:

- Lower overall average and peak kW — lowering the base electric cost and reducing the effect of demand changes.
- Increase savings with its capability of almost unlimited starts and stops per hour — "nothing is less costly to run than a stopped electric motor."

Spend the time and effort to do it right — if improperly selected and applied it not only may achieve no savings, you could spend more dollars to actually increase the operating cost.

Estimated and Measured Performance Curves from Lubricant-Free Examples

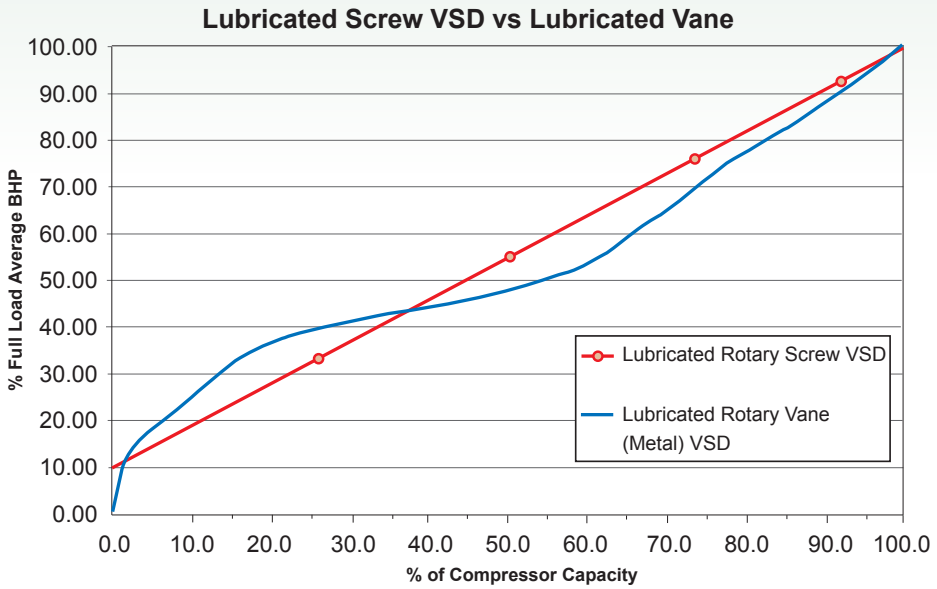
Actual input kW of the 3 units described, oil-free two-stage rotary screws, 350 hp 2-step constant speed, 350 hp variable speed (the two 350 hp units are equal at about 80% flow, from 80 to 100% the 2-step becomes more efficient, from 80% down the VSD is more efficient).

Lubricant Cooled Rotary Metal Vane Compressors

Lubricant Cooled Sliding Vanes: The lubricant cooled sliding metal vane compressor is another very reliable product from 5 to 125 hp and its basic operating characteristics create a very favorable VSD performance curve.

The following graph shows the typical efficiency relationship between the lubricant cooled rotary screw VSD and lubricant cooled metal sliding metal, single-stage vane VSD.

From 100% to 35/40% load the vane unit is more power efficient because the peripheral pressure of the vane to the cylinder walls falls as the rpm slows reducing the friction load. This creates about 10% difference around 50–60% flow. The relative performance deterioration of the vane graph below 35% flow is the effect of the capacity control and becomes a combination of inlet valve modulation and VSD. This lower-end difference is also about a maximum of 10% over a little shorter range. Remember this is a percent (%) of full load kW and is an estimate — "attention to detail" is still needed to make the proper selection and realize the optimum benefits. BP



Compressed Air Audit of the Month

Energy Savings in Peru

By David Smith

January Audit of the Month

Where:	**Peru**
Industry:	**Copper Smelter**
Audit Type:	**Compressed Air System Supply-Side**
Current yearly kW costs:	**$1,359,117**
Proposed yearly kW costs:	**$758,832**
Current yearly costs for Rental Instrument Air:	**$60,000**
Current yearly maintenance cost on Air Dryers:	**$29,880**
Proposed Project Capital Requirements:	**$384,083**
ROI Break-Even:	**9.5 months**
5-Year Savings Projection:	**$2,925,975**

Overview

A major mining corporation in Peru operates one of the world's largest copper smelter and refinery facilities in the world. Located at sea level on the Pacific Ocean, the facility is located well south of Lima, Peru. The smelter facility melts down raw ore and forms it into copper ingots, which are 4' by 4' in size with a thickness of 12 inches. The copper ingots are sent by railcar to the neighboring refinery where they are further refined and shaped into 4' x 4' plates ¼'' inch thick. They are then shipped to customers all over the world.

The smelter facility has had ongoing problems with their compressed air system. The problems are unacceptably high (and increasing) energy costs, poor air quality and unstable operating pressures. The energy costs of the compressed air system have risen 62% since 2003. Energy costs now totaled $1,359,000 per year. The facility is looking for ways to reverse this trend and drive down energy costs.

The smelter operation also has continual problems with the presence of moisture and solid particulates in the compressed air system. They are unable to achieve their objective to have ISO Grade 1.4.1 Air Quality for the facility. The facility has many sophisticated pneumatic logic circuits, which malfunction when air quality deteriorates. To address this problem, the facility has contracted to purchase clean compressed air from their local utility to supply the most sensitive pneumatic circuits. The yearly cost is $60,000 for this clean, compressed air. The air pressure is also very unstable. The facility requires a constant 100 psig pressure but continually faces daily pressure variations between 77 psig and 100 psig. There are significant losses in air pressure after the compressor discharge and solutions are required.

The air compressors and air purification equipment installed are in various stages of disarray. Two of the five air compressors are inoperable. The facility is frustrated because five new desiccant air dryers, purchased just last year, are overloaded and require overhauls. The facility is faced with the decision to repair or install new equipment. The question is what will the ROI be on the project.

Complicating matters further is the fact that there are four different departments simultaneously trying to fix the compressed air system: Maintenance, Operations, Projects and Controls. The other departments do not believe that Maintenance can provide a steady, clean and reliable supply of Instrument Quality compressed air.

The turn-down controls made this centrifugal oil-free compressor consume 70% of full-load electrical capacity while operating at 40% load — 24 hours per day.

Operations has been adding pipe headers to protect themselves, Controls has been adding out-of-date compressor control interface schemes and Projects has been throwing money at the problem, only to make the system worse. Maintenance has been in a purely static mode just trying to keep the facility running every day.

The Air Compressors

The system consists of two separate compressor powerhouses. The North compressor room had three 300 horsepower lubricated rotary screw compressors and one 800 horsepower oil-free centrifugal air compressor. Total installed horsepower is 1700 hp. The South compressor room has two 300 horsepower lubricated rotary screw compressors for a total of 600 hp. The total installed horsepower, therefore, at the smelter is 2,300 hp. It should be noted that two of the 300 hp rotaries were not in operating condition.

The average cost per horsepower of the air compressors had risen from $460.00 in 2003 to $744.00 in 2007. Their energy costs were at $.105 per kWH in comparison to a rate of $.065 per kWH in 2003. The difference is staggering. In 2003 each hp cost **$460.44** and in 2007 the very same hp costs **$744.00** This is a **$283.35** increase between 2003 and 2007, or a 61% increase in the cost of electricity between 2003 and 2007. After data logging the installation, we determined that the facility is using **1440 hp** in installed air compressor capacity. The electrical energy costs associated with running the plant air compressors totals **$1,062,518 per year**.

The existing centrifugal compressor is using a control scheme known as turn-down. After 30% turn-down, the compressor provides no further electrical down-turn under partial load conditions. The centrifugal air compressor can never consume less than 450 hp even though it remains at roughly 40% of full-load most of a 24-hour day.

The lubricated rotaries are worse in that they are set to a control scheme know as Modulation. This means that after you throttle back only 10% you cannot reduce electrical energy any further. This means at 50% of the unit's output, the compressor is still consuming 90% of its rated energy. Keeping in mind that the 300 hp rotaries consume 330 BHP (Brake Horse Power) you never get below 90% or 300 actual hp consumed.

Finally, we take note that the corporation has decided that all primary air compressors must be oil-free machines. This is due to years of having no air treatment equipment and then, when air dryers were installed, they were undersized, so problems with moisture and oil carry-over continued. The corporation has the

COMPRESSED AIR AUDIT OF THE MONTH

Energy Savings in Peru

The new centrifugal oil-free compressor with extended turn-down capabilities

perception that oil lubricated compressors, even when installed with the appropriate air treatment, will not do the job. We are on record disagreeing with this position but are guiding our recommendations according to this mandate.

Lubricated rotary screw compressors currently on-site will be used as back-up machines. We are recommending a new oil-free centrifugal three-stage air compressor. This unit has turn-down capabilities to match reduced air loads. The existing oil-free centrifugal will be used as the base-load machine. The overall horsepower requirement will be reduced to **961 hp**. The new reduced electrical operating costs of the air compressors will be an annual **$699,578.00**.

The Air Storage

The facility has three 1,000-gallon tanks for air storage. Proper air storage provides actual control of the Demand Side (Plant Requirement) compressed air need while optimizing the specific electrical input required of the air compressors. The 25-year old and out-of-date rule of thumb was 1 gallon of storage for every 1 scfm available. The industry has accepted for some time that this was, in fact, undersized.

Poor maintenance led to blocked air filters and dryers creating a pressure drop of 35 psig

The new or up-to-date rule of thumb is that for every 1 scfm available you must have between 2 and 10 gallons of air receiver. In this case, the North Compressor Room currently has 6511 scfm available. Using only the short 2 gallon per scfm rule, the facility needs 13,000 gallons of available storage.

Air receivers can completely correct this condition by accomplishing the following: a proper combination of Air Receivers and Steady Pressure Controller will allow controllers and, in particular, Automation Control Panels to completely control the compressors to the extent it will keep off what is not needed and bring on only what is needed. An Automation Panel will select the specific compressor it needs while monitoring the downstream (Demand Side) pressure to within 1% of set point. It allows for compressor controls to be set on Full Load/No Load control when a Steady Pressure Controller is added after the Air Receivers. This Control Scheme will allow the compressors to operate at 100% output or no output, but the plant will never see this up/down pressure swing as the Steady Pressure Controller is set below the set points of the Compressor Packages, say 90 psig. Currently the installation is getting 77 psig by our logger readings. This will drop the current electrical costs by an additional 33% and completely stabilize the unstable current pressure readings we are getting down stream in the actual Demand Side.

Compressed Air Dryers, Filters and Condensate Drains

This facility has operated for many years with no air treatment products. This led to so many problems that critical use areas of the facility signed an Air-over-the-Fence contract with the on-site utility company for clean, dry compressed air. The annual cost of this auxiliary supply is $60,000 per year.

A year ago, the engineering firm contracted to install air treatment equipment provided a specification of ISO Grade 1.2.1. This specification requires desiccant air dryers capable of producing a -40 ºF dew point. This dew point specification is common in the mountainous regions in the Andes of Peru, due to the low ambient temperatures. Since the smelter facility is at sea level and never sees ambient temperatures below freezing, we believe this specification to be unnecessary and recommend an ISO Grade 1.4.1 for air treatment. This allows a lower-energy cost refrigerated air dryer which produces a +38 ºF dew point.

The dryers installed were five twin-tower, heat-reactivated, desiccant air dryers. These dryers are 1225 scfm dryers installed on 1363 scfm

COMPRESSED AIR AUDIT OF THE MONTH

Energy Savings in Peru

Air Compressor Packages. Therefore these dryers are already undersized by 138 scfm or 11% undersized. This means several things. The natural design point pressure differential, across the dryer automatically increases artificially, plus the dryer cannot produce the specified pressure dew points to remove water from the system, even as a brand new, out of the box dryer package.

This new and increased artificial pressure rise is never good. It restricts airflow. It either artificially lowers the natural plant pressure, or causes additional H.P. to be added to overcome the natural resistance of under sizing, which increases the electrical bill unnecessarily. It also assists in premature blockage, causing short life, of all assigned filtration such as Coalescent Filters and Particle Filters to prevent dusting. The poor maintenance practices at the facility, have also caused contamination of the entire desiccant bed causing a complete collapse of any Dew Point (Moisture Removal) you are trying to achieve and make an entire desiccant change out mandatory.

The cost for the facility to operate these heated desiccant air dryers under normal conditions will be **25.40 kW** each dryer, which includes the 36 scfm needed for each piece, to correctly dry each desiccant bed. This amounts to an operating cost of **$25, 324.90** per unit, or **x 4 = $101,299.96** total to run all 4 dryers under normal operating conditions in the North Compressor Room. We are recommending a refrigerated air dryer system, which will **cut kW costs to $43,072** annually under normal operating conditions.

Last but not least, the air compressors have to overcome an unusually high pressure-drop of **35 psig** caused by the obstructed filter elements and desiccant tower bed, which causes a radically increased electrical bill. Current and modern air treatment system designs demand that pressure drops never exceed 5 psig. This makes any type of pressure control at the plant level virtually impossible. The extreme pressure drop of 35 psig is causing the facility to waste an additional 17.5% electrical energy on a system that costs **$744.00** per hp. The hp this

A damaged filter element

is stealing is **262.5 x $ 744.00= $ 195,300** in waste energy. Add that to the **$60,000.00** annual expense for the Over The Fence Compressed Air and the total unacceptable cost penalty on this system is **$255,000** in actual waste energy attributed directly to the Air Compressor Clean Up Equipment (Dryers & Filtration) and does not include the annual maintenance or needed overhaul listed below.

To overhaul all five dryers the facility will require **8,000 lbs**. of desiccant at a cost of **$12,480**, plus 10 new filters at a cost of **$5,800**, plus 2 men 2 days each dryer for 10 days total [2] men. Plus all switching valves shall require cleaning and replacement where necessary. The total overall, not counting labor or unforeseen issues, will be $18,280.00 plus taxes, freight, etc. Routine maintenance on these dryers under the conditions that they are expected to operate will be three filter changes per year x 10 = 30 filters for a total of **$17,400** annual plus one desiccant change of **$12,480** annual not including labor. The total to maintain these dryers will be **$29,880** annual. The total annual operating cost of this air treatment system (which does not provide quality air) is **$386,479**. This represents a tremendous opportunity for energy savings.

There are no auto drains of any kind visible except for the four antiquated float type drains installed under the centrifugal compressor. Most drain points are 100% manual, so if maintenance doesn't open the drain two or three times per day it's all headed for the desiccant or downstream. We will recommend 22 zero-loss smart drains. The drains will include a sensor to allow for complete PLC monitoring and triggering if necessary.

Conclusion

The new compressed air system will have an oil-free air compressor which can turn down to match partial air loads. The air purification system will provide reliable ISO Grade 1.4.1 quality air. The pressure losses will be greatly reduced and air storage tanks along with flow controllers will allow pressure to be closely managed at 100 psig. The Over-the-Fence contract can be cancelled for the resulting savings. Finally, control over-the-air system will be placed in the hands of a competent outside service organization, which will be the only authorized party to perform maintenance and make changes to the system.

Financially the project requires $384,000 in capital to implement. The first year savings are $305,000 with a project payback of 9.5 months. It is projected that the smelter facility will save almost $3 million dollars over the first five years. These financials do not add into the equation the larger benefits of reliable pressure and contaminant-free compressed air. BP

For more information, please contact David Smith, Senior Compressed Air Auditor, Comp-Air Service Company, tel: 305-687-8787, email: dsmith@comp-air.com

Properly sized and maintained air treatment products save $255,000 per year

"Energy costs now totaled $1,359,000 per year. The facility is looking for ways to reverse this trend and drive down energy costs."

The Low-Hanging Fruit

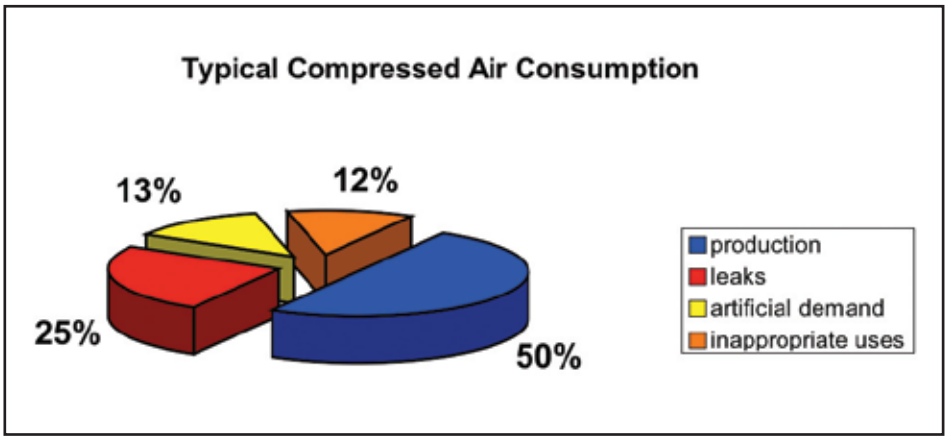
BY RANDY GREENWOOD

Compressed air has been used in industry and manufacturing processes for well over a hundred years. Virtually every plant has a compressor and uses compressed air in the manufacturing process. The supply of the raw material (the air in the atmosphere) is abundant, and compressed air is easily transported from the compressor to the point of use at the machine. It is easily understood by most people who use it and it is safe around most processes because air is generally considered to be benign in nature. It can be easily adjusted to vary the manufacturing process. So, it is easy to understand why its use in industrial manufacturing is so pervasive.

Unfortunately, it is one of the most neglected systems in any plant, and as a result can easily be the most costly energy transmission source. While many people understand how to make something work using compressed air, relatively few people have a good understanding of the problems inherent in the system, and even fewer have an understanding of what to do to improve the system.

A COSTLY UTILITY

According to the Department of Energy studies, in an average manufacturing plant, **only about 50% of the compressed air generated is actually consumed by normal production processes**. As much as 25–30% is wasted in leaks, another 15–20% is consumed in inappropriate uses of compressed air, such as personnel cooling and handheld blowguns for cleaning and the remaining air goes to what is termed "artificial demand," caused by operating the system at excessively high pressure. For every dollar spent on electricity to generate compressed air, only about 12–17¢ is actually used productively. These figures only take into account direct energy costs, and do not reflect the cost of capital equipment investment and maintenance.



Examine the Demand Side

The demand side of the system is any area or device that consumes air, regardless of whether it is performing useful work or not. This includes, but is not limited to:

- Valves
- Cylinders
- Air Motors
- Actuators like grippers or rotary actuators
- Condensate drains
- Filters, regulators and lubricators (point of use)
- Painting and finishing equipment
- Diaphragm Pumps
- Blow guns
- Piping
- Air knives, air curtains
- Parts cooling
- Material conveying
- Venturi-type vacuum generators
- Air tools (impact wrenches, screw-drivers, nut runners, grinders, etc.)
- Quick couplings and fittings, including hose and tubing
- Leaks

IN PNEUMATIC SYSTEMS

AN ANALYTICAL LOOK

People tend to look at air systems in relation to the direction the air flows, i.e., from the compressor out to the end use. From an analytical standpoint, however, it is important to understand that the **Demand Side** (where air is consumed) of the system determines what happens or needs to happen on the **Supply Side** (where air is generated). Let's take a look at some of the issues specific to the demand side of the air system.

Since demand determines what is required on the supply side of the system, it is imperative that one start with the end points of the system and work backward (counter to air flow) in analyzing where the air is being consumed. An obvious first step in improving air system efficiency and reducing energy demand is to stop the leaks in the system. In an average compressed air system, **20–30%** of the air is lost to **leaks**. An aggressive leak identification and correction program needs to be an integral part of any compressed air energy management program. Unfortunately, many compressed air audit programs only take a cursory look beyond leaks, when looking for opportunities to reduce energy consumption in compressed air systems.

Second to leaks, the biggest potential improvement areas in the system are reducing or eliminating inappropriate uses of compressed air, and identifying and eliminating the artificial demand caused by operating the system at excessive pressure. Remember, every 2 psi change in operating pressure is equal to 1% of the input horsepower for the application. It is important to recognize what are appropriate uses of compressed air, and what are considered inappropriate uses of compressed air.

THE FIVE "LOW-HANGING FRUIT OPPORTUNITIES" TO SAVE ENERGY

When looking for opportunities to reduce energy consumption or improve efficiencies in compressed air systems, an often-overlooked area is the opportunity that exists in reverse-engineering existing equipment. There are five "low hanging fruit opportunities" that most people fail to consider when looking at ways to reduce consumption and increase efficiency:

1. Proper sizing of supply lines and connections from the main header to the inlet of the equipment to minimize pressure drop. Best design practices reduce the number of angle fittings and connections, reducing leaks and minimizing pressure drop.

2. Proper sizing of point-of-use air treatment components, such as filters, regulators and lubricators at the machine inlet, also minimizing the pressure drop. Reducing the cost of ownership over the life of the equipment far outweighs the acquisition cost of properly sized equipment.

3. Proper use of reverse flow regulators and dual pressure circuits in automation applications using valves, cylinders and actuators can reduce air consumption while increasing efficiency. Most actuators such as cylinders perform work in one direction only, and the return stroke is merely repositioning for the next cycle. Performing work extending a cylinder or proper operation, and then retracting the cylinder at a reduced pressure can result in significant energy savings and reduced cost of operation.

THE LOW-HANGING FRUIT IN PNEUMATIC SYSTEMS

Let's take a look at a specific example:

Consider the case of a machine with a 4 inch bore cylinder and a 6 inch stroke, with a 1" diameter rod, performing work as the rod extends. Initially, system operating pressure extends and retracts the cylinder at 100 psig. The cylinder cycles 10 times per minute, operating 6 days/week, 24 hours/day. The cost of electricity to generate compressed air is $0.07 per kWh (Kilowatt hour).

In case two, the first improvement we make will be to install a regulator in the inlet supply line and reduce the operating pressure to the application to 80 psig, both extend and retract. In case three, we install reverse flow regulators in the lines between the directional valve and the cylinder, and we reduce the retract pressure from 80 psig to 60 psig. In case four, we further reduce the retract pressure from 60 to 40 psig. In case five, using simple trial and error, we determine that

COST SAVINGS DUE TO USING PARKER'S REVERSE FLOW REGULATORS *(ASSUMING POWER STROKE ON EXTEND)*						
Insert your values in the yellow boxes to get the annual cost						
Cylinder Bore	4	Inches	12.57	=	Cylinder Area	$In.^2$
Cylinder Stroke	6	Inches				
Cylinder Rod Diameter	1	Inches	11.78	=	Eff. Area	$In.^2$
Cycles per minute (extend and retract)	10					
Number of Actuators in the Plant	1					
Extend Pressure	80	PSI	6.44	=	Compression Factor	
Retract Pressure	40	PSI (for spring retract cylinders use 0)	3.72	=	Compression Factor	
Number of Shifts in a Day (assuming 8 hour shifts)	3					
Number of Operating Days in a Week	6					
Full Cost of Electricity	$0.07	$/kWh *(Approximately $0.05 per U.S. Department of Energy 2004, please note that this is only the cost of providing electricity to the plant and it does not take maintenance into account, in order to compensate for maintenance you can estimate around 0.09 kWh)*				
Annual Cost of Electricity with Normal Regulators	**$743.12**					
Annual Cost of Electricity with Reverse Flow Regulators	**$487.39**					
Annual Savings	**$255.73**					

COST SAVINGS DUE TO USING PARKER'S REVERSE FLOW REGULATORS *(ASSUMING POWER STROKE ON EXTEND)*						
Insert your values in the yellow boxes to get the annual cost						
Cylinder Bore	4	Inches	12.57	=	Cylinder Area	$In.^2$
Cylinder Stroke	6	Inches				
Cylinder Rod Diameter	1	Inches	11.78	=	Eff. Area	$In.^2$
Cycles per minute (extend and retract)	10					
Number of Actuators in the Plant	1					
Extend Pressure	60	PSI	5.08	=	Compression Factor	
Retract Pressure	40	PSI (for spring retract cylinders use 0)	3.72	=	Compression Factor	
Number of Shifts in a Day (assuming 8 hour shifts)	3					
Number of Operating Days in a Week	6					
Full Cost of Electricity	$0.07	$/kWh *(Approximately $0.05 per U.S. Department of Energy 2004, please note that this is only the cost of providing electricity to the plant and it does not take maintenance into account, in order to compensate for maintenance you can estimate around 0.09 kWh)*				
Annual Cost of Electricity with Normal Regulators	**$439.63**					
Annual Cost of Electricity with Reverse Flow Regulators	**$330.75**					
Annual Savings	**$108.88**					

the extend pressure can be reduced from 80 to 60 psig, and the retract pressure set at 40 psig. The resulting savings from case one to case five over a five-year operating period is an impressive $7,400.00! In addition to the significant energy savings, the total cost of ownership is further reduced because the system components last longer operating at a lower operating pressure. Additionally, any potential leaks will leak less at a lower pressure.

4. Proper control and regulation of air consumption devices such as air knives, diaphragm pumps and compressed air venturi-type vacuum generators. When operated in an unregulated or uncontrolled manner, these devices can be significant consumers of high-pressure compressed air. This is not only wasteful, but places unnecessary stress on the compressed air system. Simple sensing circuits that turn the air off when the machine is idle or parts are not present can represent significant savings opportunities.

5. Proper design and application of directional control valves, utilizing resilient seals (Wear Compensated Seal technology) on the spools and solenoid-controlled pilot-operated technology, instead of lapped-spool and sleeve design using direct-solenoid operators can reduce energy consumption and increase reliability. In a large manufacturing plant utilizing thousands of directional valves, the energy savings can be significant.

Once demand side opportunities have been identified and acted upon, then you can take an analytical look at the supply side to optimize or maximize the potential savings opportunity.

Conclusion

As energy costs continue to rise, the "low-hanging fruit opportunities" will become even more important as companies continue to look for ways to reduce energy costs and improve profitability. These opportunities represent the hidden part of the energy iceberg, but are easily captured and acted upon by companies who are committed and willing to change the way they look at their compressed air system. A commitment to an ongoing program of monitoring (auditing) and performing corrective action on identified opportunities will pay off in reduced energy costs and lower total cost of ownership. And it doesn't hurt to take the message to your stakeholders and shareholders that you've become a "greener" company by taking advantage of these "low-hanging fruit opportunities." BP

For more information, please contact Randy Greenwood, PASS-Parker Air Systems Solutions, tel: 720-530-4640, email: randy.greenwood@parker.com

Mikropor America, Inc.

Compressed Air Best Practices interviewed Mr. Mark McCullagh — President & General Manager of Mikropor America, Inc.

Mark McCullagh, Mikropor America

Good morning. What is the history of Mikropor?

Mikropor was established in 1987 in Ankara, Turkey to meet the need for higher performing coalescing filter products in the compressed air market. Today, we are a leading worldwide provider of quality filtration and purification products in many markets.

Please describe Mikropor operations.

We are privately-held and headquartered in Ankara, Turkey with offices in Istanbul, Milan, Brussels and Michigan. Currently, all manufacturing is based in our three Ankara facilities totaling over 650,000 square feet.

We are vertically integrated and ISO Certified. The facilities include engineering, complete metal fabrication, media processing, injection molding, automated assembly and world-class testing capabilities.

Importantly, Mikropor manages all processes in-house. This includes design, engineering and all aspects of manufacturing. This in-house control translates to world-class quality products and real value for our customers.

What markets does Mikropor serve?

Mikropor designs and manufactures filtration and purification products for air, gas and liquid applications in markets which include Compressed Air & Gas, Utilities, Gas Turbines, Dust Collection, CleanRooms, Transportation and HVAC. Mikropor also excels at supporting, designing and manufacturing custom filter products for Equipment Manufacturers around the world.

What advantages does manufacturing in Turkey offer to customers?

Quality and value. Turkey is an incredibly dynamic country. It is the sixth largest economy in the European Union and the 17th largest economy in the world. Its strategic geographic location provides access to the EU, Central Asia and Middle East markets. Exports are up 240% over the past four years and Turkey has had average annual GDP growth of 7.4% per year since 2002.

With 400,000 university graduates per year, working professionals are young, motivated and well educated. Foreign direct investment is skyrocketing because of these favorable business conditions. Taken together, Turkey offers great value, quality and expertise.

What does Mikropor do differently than other filtration companies?

Innovate. Fast. We have the ability to develop solutions to very technical challenges efficiently and economically. This is a real benefit to our customers who must compete in today's faster and more demanding world.

Mikropor Compressed Air Filters

We are very proud of how our team has delivered a steady stream of new products, services, proprietary processes and new technologies. This is evident with our new Mikropor NanoFiber air filters, compressed air filters and MB refrigerated dryers. Each product delivers value, unique features and distinct advantages.

What can you tell us about Mikropor engineering and testing capabilities?

Mikropor is very focused on developing new products and solving problems for our customers. Our engineers work closely with media manufacturers, other suppliers and customers to test and develop new technologies. This constant research and development provides great insight and innovation for all of our products — and that, in the end, delivers value for users.

Our labs and testing capability support all of our engineering efforts. For example, separator testing uses an in-house mass spectrometer to measure oil carryover rates. With this device, accurate coalescing performance is available after a few operating hours and this translates to better response times, faster designs and greater throughput. For ambient filtration products, Mikropor has a very accurate and automated testing system to classify filtration efficiency for HEPA products. Our testing capabilities go hand-in-hand with our engineering team.

MIKROPOR AMERICA, INC.

Air Inlet Filters are the first line of defense for compressors

Briefly describe your product range.

For the compressed air market, Mikropor manufactures air/oil separators for compressor manufacturers, refrigerated dryers, compressed air filters, inlet filters and a host of related components including float drains and differential pressure gauges.

In addition to our compressed air products, Mikropor is also meeting today's demand for high quality ambient air which is driven by increased regulation of indoor air quality and the widespread use of sensitive electronics and microprocessors in equipment. We are now a leading filtration supplier to the global HVAC market, utilities, cleanrooms and many other markets that demand high-levels of purity in ambient air. For example, we have been producing HEPA filters for cleanrooms, hospitals, labs and specialized breathing equipment for many years.

This wide market exposure gives us great visibility into new developments and this is integrated into our all of our products.

What are some recent innovations from Mikropor for the compressed air market?

MB Dryers feature Low Pressure Drop

We have recently launched three products in the North American market — our new line of compressed air filters, Nano-Fiber air inlet filters and our line of Mono-Bloc MB Refrigerated Air Dryers.

Our new compressed air filters feature an easy-maintenance design, no porosity in the filter body, better drainage, four grades of elements and a very reliable Auto Drain that is internal to the filter to prevent damage in handling and installation.

We are also introducing our new line of Intake Filters for compressors, blowers and engines. The new filters feature High-Efficiency NanoFiber media and deliver better protection and longer service life for the air/oil separator, lubricant and oil filter. Our 99.99% initial efficiency provides increased protection over traditional cellulose filters by allowing fewer contaminants to pass through the media over the full life of the filter. In addition, our media is moisture resistant so it lasts longer and holds up to five times more contaminants than cellulose, making Mikropor filters ideal for extended maintenance intervals.

Lastly, our line of very durable MB Refrigerated Dryers feature a very distinct heat exchanger design, consistent dewpoint and a very low pressure drop. Today, pressure drop is a very important consideration as the cost of producing compressed air continues to rise.

What are the key features, advantages and flow ranges of the MB dryer?

Mikropor dryers are based on thirty years of experience in dryer manufacturing. They are designed with simple and proven components from global refrigeration suppliers and are very easy to maintain. Many thousands of users worldwide can testify to the efficiency and performance of Mikropor dryers.

Our standard MB Dryers are non-cycling and models range from 10–3500 scfm. All MB dryers feature our very unique MonoBloc heat exchanger that delivers real performance and value.

What energy-saving features do the refrigerated dryers have?

Virtually all dryers and air system components contribute to pressure loss. However, there is no question that dryers with the lowest pressure drop deliver real savings for users. Our MB Dryer saves energy by delivering one of the lowest pressure drops in the market.

Also, thanks to the large surface area of the heat exchanger and the direct heat transfer design, Mikropor dryers use virtually all of the cold energy produced by the refrigerant unit. This not only delivers a good dewpoint, it also lowers energy consumption. In addition to that, standard MB dryers are non-cycling and run in continuous mode, eliminating costly starts and stops.

The 3 in 1 Monobloc Heat Exchanger delivers a low pressure-drop and that translates to very real energy savings. The 3 in 1 refers to three key zones of the heat exchanger:

- The 1st is the Air/Air entry where the exiting air pre-cools the incoming air
- The 2nd is the Refrigerant zone where our unique copper fins guarantee a near perfect heat transfer between refrigerant and compressed air
- The 3rd is the integrated Moisture Separator where both mechanical direction change and gravity work to remove liquid from the air so the no-loss float drain can automatically remove it

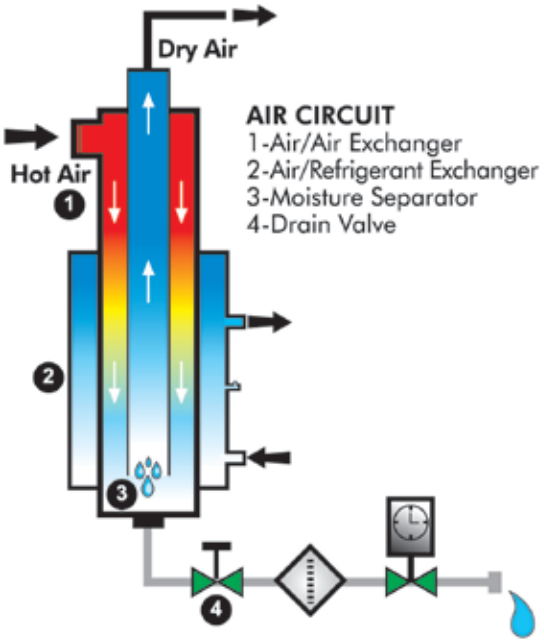


Plate Heat Exchanger Design

Please describe the refrigeration circuit in the refrigerated dryers

The refrigerant unit is a direct expansion type. The dryer circuit is regulated by two valves — a Thermostatic Expansion Valve and a Hot Gas Bypass Valve. This high efficiency regulation system guarantees that the heat exchanger is used at 100% of capacity. The refrigerant liquid level is adjusted to the optimal level with the thermostatic expansion valve and the hot gas bypass valve maintains the refrigerant low pressure and the optimal heat exchanger temperature.

The large surface area of the heat exchanger and the direct heat transfer of the copper fin design allows the MB Dryer to use all of the cold energy produced by the system. This ensures the guarantee of a good dewpoint and low energy consumption.

MIKROPOR AMERICA, INC.

How does the MB dryer ensure a stable dewpoint under varying load conditions?

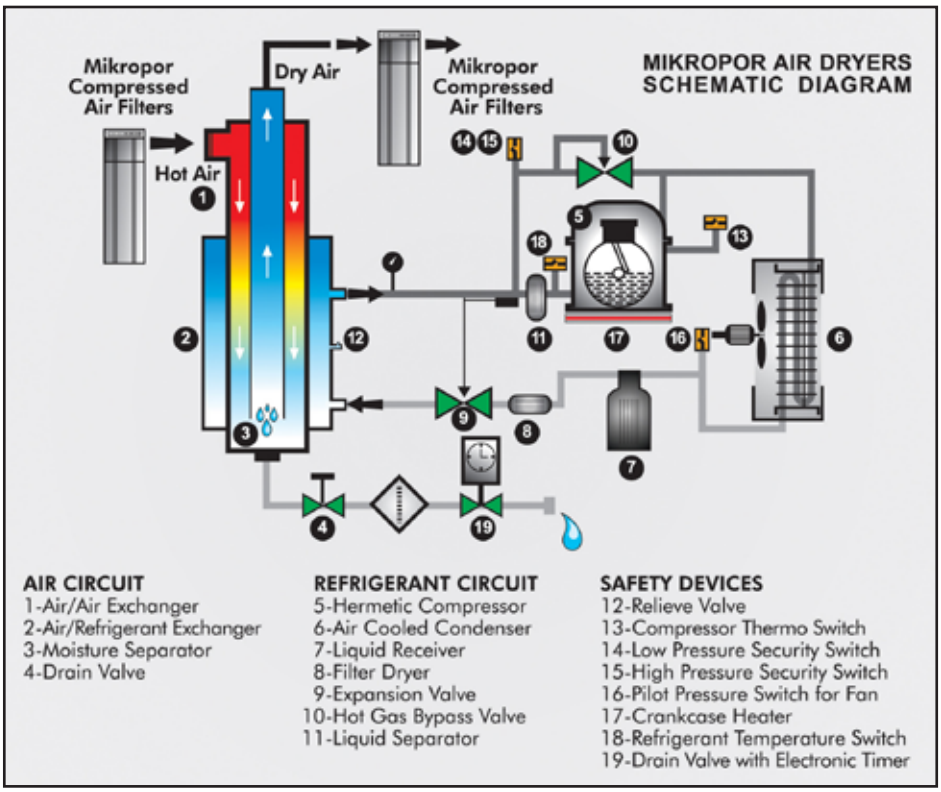
The two-valve regulation system, the Thermostatic Expansion Valve and the Hot Gas Bypass Valve is the guarantee of a stable dewpoint at varying loads. The two valves are working together and have a quick response time. The heat exchanger is a crucial part of the MB Dryer performance and the heat transfer efficiency has a major impact on dewpoint and on energy consumption.

What type of warranty and quality guarantee does the MB Dryer carry?

Delivery of a quality product is critical for success in this market. The MB dryer carries a full two-year warranty and the heat exchanger is guaranteed for five years. Every dryer is thoroughly tested before leaving the factory. In-process checks include helium leak tests, multiple quality control inspections and final assembly tests. We are very confident that Mikropor is delivering one of the finest refrigerated dryers in the market.

What is Mikropor focusing on for product development and investments for the future?

We pay very close attention to what our OEM customers and markets need so our product development efforts generally follow their need for better efficiency, smaller designs or lower costs. They have a vision for their market and we try to help them achieve that vision. At the same time, we anticipate where the market is going and work on developing proprietary products and capabilities to share with our customers. To get there, we are continually investing in new processes and equipment so we can deliver consistent value, world-class quality and top performance for our customers.



MB Dryer Refrigerant Circuit

What investments has Mikropor made in the U.S.?

While we have had a presence in the US market for many years, our recent expansion into having a full-time presence in North and South America is an important step for us. Over time, our US operations will include more distribution locations to serve our different markets and will, very likely, include manufacturing. We are looking forward to meeting the needs of this market for many years to come and will continue to invest in our presence here so we can deliver the highest quality products and provide exceptional levels of service to our customers.

Thank you Mikropor for sharing your insights.

For more information please contact Mark McCullagh, Mikropor America, tel: 877-645-7676, email:mmccullagh@mikroporamerica.com, or visit the website www.mikroporamerica.com

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WIRELESS SENSOR NETWORKS

IMPROVE EFFICIENCY IN COMPRESSED AIR SYSTEMS

BY PATRICK RAFTER

THE PLAYERS

The Facility: Hollingsworth & Vose (www.hollingsworth-vose.com)

Established in 1843, Hollingsworth & Vose Company has manufactured and supplied specialty, industrial and technical papers and non-wovens for more than 150 years. Through its advanced R&D and manufacturing facilities, Hollingsworth & Vose drives value in its customers' products by inventing next-generation materials with superior performance. H&V's products are found in applications such as engine filtration, high-efficiency air and liquid filtration, battery separators, gasket materials and specialty and industrial non-wovens.

The Utility: National Grid (www.nationalgridus.com)

An international energy delivery company, National Grid delivers electricity to approximately 3.3 million customers in the northeastern United States. National Grid's core business is the delivery of electricity and natural gas. In addition, its subsidiary, National Grid Wireless*, provides telecommunications infrastructure and services.

The Solution: Sensicast Systems (www.sensicast.com)

Sensicast's SensiNet® Wireless Sensor Networks were deployed at an H&V facility to wirelessly monitor compressed air and electrical usage. The results of the deployment (in the way of energy and cost savings) were rapid and significant.

BACKGROUND

The Hollingsworth & Vose paper mill in Ayer, Massachusetts uses compressed air to power equipment in its manufacturing facility.

According to the Department of Energy, over $1.5 billion per year is spent by US industries on electricity used to compress air. The average compressed air system runs at 30 to 50% inefficiency resulting in higher than needed operating costs.

National Grid services the Hollingsworth & Vose facility in Ayer, and is proactive in implementing programs to contain and lower electric usage in this service area through joint initiatives with its customers in order to conserve electricity.

Problem to Solve

Improve the efficiency of the paper mill's compressed air system, lower the electricity expense component of manufacturing cost in this commodity industry and conserve energy leading to lowered greenhouse gas emissions.

As the H&V legacy system initially operated with virtually no monitoring, it was impossible to tell where air was being lost to leaks, inefficient application and distribution system degradation.

Compressed air systems degrade over time and become leaky and inefficient.

To compensate, the system operator increases the line pressure delivered by the air compressor. This results in the air compressor running more often in order to compensate for the degradation of the distribution lines. Inspections were performed infrequently — usually once a year — and as a result, systems operated inefficiently and used excessive electricity for long periods of time.

Hollingsworth and Vose wanted to increase the frequency of system inspections but wanted to avoid the high cost of employing manual labor to do this. Proposals for traditional wired networking were too expensive and also fell outside the eligibility range for reimbursement from National Grid.

The SensiNet® Solution

A SensiNet® system was deployed to monitor the compressed air system in the plant. SensiNet is a turnkey wireless sensor network platform that enables operators of industrial and commercial facility to monitor operational levels and environmental conditions for newfound efficiencies and cost savings.

The SensiNet system was configured to monitor key operating parameters of the compressed air system including temperature, line pressure, airflow and energy usage of the compressor. SensiNet software was employed to display the data and the graphical user interface and data display made it easy to spot trends leading to system degradation.

The monitoring and reporting interval was set at one minute. A complete system profile was then measured every minute, and small changes in system performance became visible immediately. This enabled the facility's personnel to take corrective action immediately to restore the system to full efficiency and avoid increased costs due to unnecessary air compressor activity.

SensiNet's wireless architecture made the system very easy to install and operate in this crowded paper mill manufacturing line.

SensiNet — Wireless Sensor Networks for Industrial Monitoring

SensiNet is a turnkey wireless network solution for industrial and commercial facilities where highly reliable wireless monitoring of operational or environmental data is required. SensiNet comprises three principal components:

1) SensiNet® Smart Sensors

Long-lived, battery-operated radios with pre-integrated sensor probes to measure data types including electricity (either voltage, power in Kilowatt hours or current), pressure, temperature, humidity, flow and other essential operational data.

2) SensiNet® Mesh Routers

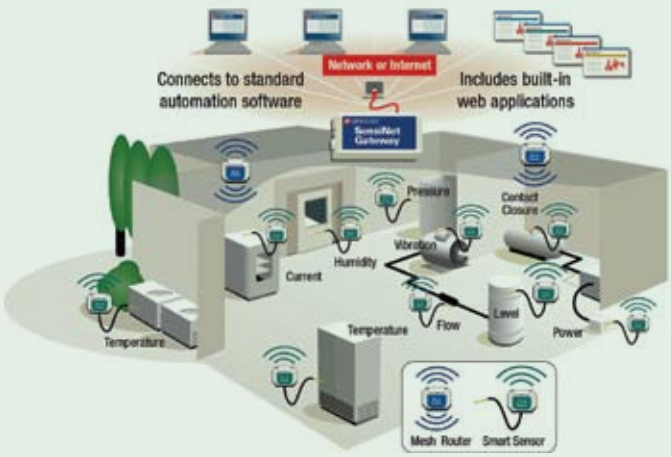
Wireless mesh network repeaters that extend the range and coverage area of SensiNet. These routers collect data via wireless connection from Smart Sensors in the plant and relay it to the SensiNet Services Gateway.

3) The SensiNet® Services Gateway

The Gateway provides data access and communications capabilities to bridge the data collected by SensiNet to software applications and third-party hosted services. The gateway stores and forwards data and also provides data access and graphing tools to help operators interpret and act upon information.

SensiNet's components are mutually "self-aware" to create a self-managing system that can scale from small trial deployments to massive networks spanning multiple buildings over a coverage area of multiple miles.

Figure 1: SensiNet Wireless Sensor Network



WIRELESS SENSOR NETWORKS IMPROVE EFFICIENCY IN COMPRESSED AIR SYSTEMS

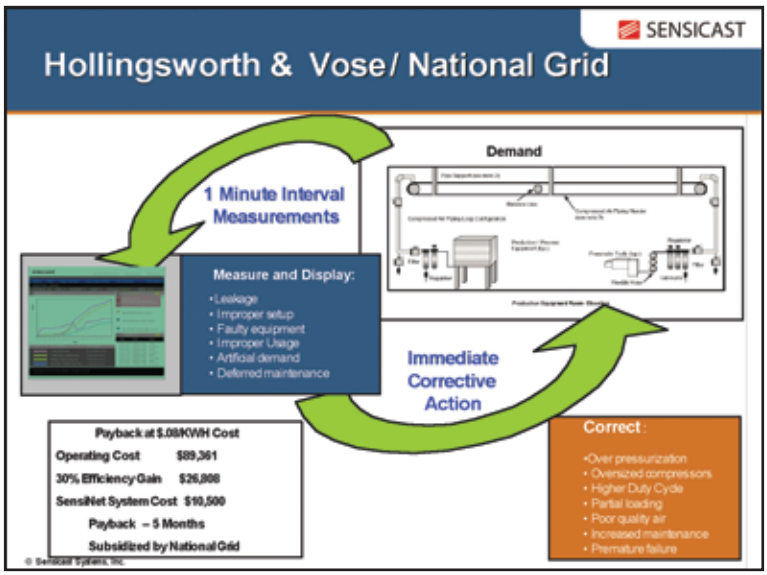
Results

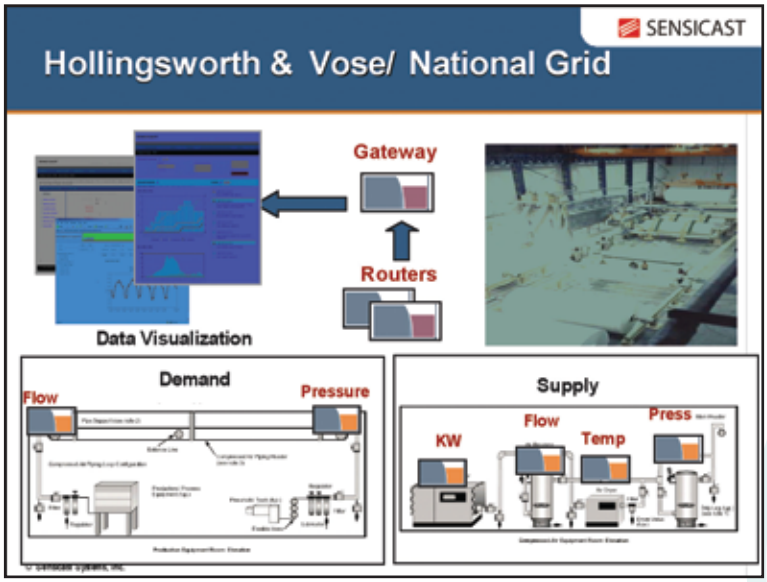
A 50% efficiency gain on the compressed air system which reduced annual operating costs by $26,000 for a five-year projected savings of $130,000.

With a system cost for the SensiNet system of $10,500, payback was 5 months and will lead to a projected 5-year ROI of 13X.

The $10,500 to deploy the SensiNet wireless system, proved very cost effective compared to the projected cost of $75,000 for a wired system. This cost effectiveness qualified the system for subsidization by National Grid.

National Grid reimbursed Hollingsworth & Vose for the full price of the SensiNet system.





CONCLUSION

Wireless Sensors are a Good Solution for Monitoring Compressed Air

Compressed air is an essential but often costly and inefficiently deployed utility. Air pressure and the energy required to produce it (in kW) are not measured and monitored at most facilities. For these environments, SensiNet provides a convenient and easy method, using wireless sensors and software, to monitor and manage air pressure and the energy to produce it on an ongoing basis. Managers of facilities (like the H&V plant) find it a powerful tool for energy audits. Furthermore, utilities (like National Grid) have even given industrial plants that've deployed Sensicast rebates and credits in response to the reductions in energy usage precipitated by their use.

Beyond monitoring compressed air systems, wireless energy management can dramatically reduce energy usage in other problem areas identified by the US Department of Energy (DOE) including motors and motor systems and HVAC processes. Manufacturing, oil and gas and power plants consume 34% of all energy according to ON World. Appealing to industrial users, Sensicast's energy solutions enhance the accuracy of energy audits by serving as a building diagnostic tool leading to reduce operating costs, improved productivity and facilitate regulatory compliance. BP

For more information please contact Patrick Rafter, Sensicast Systems, email: prafter@sensicast.com, tel: 781-453-2555, www.sensicast.com

Special Report:

Chicago Pneumatic

THE CHICAGO PNEUMATIC COMPRESSOR LAUNCH IN NORTH AMERICA

BY ROD SMITH

A CP Portable Compressor from 1925

Mike Tucker, Charlie Townsend and Edna Rodriguez (D&D Compressor) with a 7.5 hp tank-mounted rotary screw with air dryer package

Founded in 1894, Chicago Pneumatic (CP) was a pioneer and a market leader in the pneumatic tool and air compressor industry. CP was there, assisting U.S. industry during the industrial build-up for World War II. Rosie the Riveter's famous posters even show her holding a Chicago Pneumatic pneumatic riveter. CP was also a market shareholder in the air compressor business in the 1920–1960s until it decided to focus more on the pneumatic tool side of the business.

In late October, I was invited to CP's U.S. Headquarters in Rock Hill, South Carolina to witness CP's air compressor business launch ceremonies. Now a member of the Atlas Copco Group, it was announced that the strategic decision has been made to leverage the strong CP brand in North America, and build a large industrial CP Compressor business.

Air compressor distributors from across North America came to view the complete product range that was on display. It was pretty incredible that a comprehensive range of air compressor and air treatment products was presented with world-class designs and technology all at one time for the launch of the business.

CP's Vehicular Services Division has already had quite a lot of success selling 5–30 horsepower air compressors to the light industrial and automotive markets. The product line-up included a full piston compressor product line and rotary screw product line with all kinds of different tank-mounting and air treatment options. The rotary screw compressor product line-up included 5–30 hp rotaries. **Charlie Townsend**, who led the very successful effort in CP's Vehicular Services Division, is now the National Sales Manager for the Industrial Compressor Business. An important announcement made was that responsibility for technical service for all installed air compressors will be turned over to the industrial compressor distributors who partner with CP.

SPECIAL REPORT: THE CHICAGO PNEUMATIC COMPRESSOR LAUNCH IN NORTH AMERICA

Charlie Townsend and Joel Stevens with a 50 hp belt-drive rotary

Distributors were able to view a 75 hp gear-drive rotary screw up close

The new line-up of portable compressors

The industrial range of air compressors on display included belt-drive rotary screws from 40–100 horsepower, gear-drive rotary screws from 75–200 horsepower and Variable Speed Drive rotary screws from 20–250 horsepower. A portable line of air compressors was also on display. CP's Compressor Product Manager, **Joel Stevens**, provided a half-day technical overview of all the products to an amphitheatre full of compressor distributors.

CP's technical service capabilities and aftermarket fulfillment strategy was outlined by the National Service Manager for Rotary Screw Compressors, **Mike Tucker**. All products and spare parts will be kept in inventory in Rock Hill with next-day delivery guarantees. A schedule of sales and service schools was presented as well.

The designs of the CP rotary screw product lines are unique to the CP brand. This was a commonly asked question. The CP management detailed how each CP brand machine will be the only one of its' kind in the North American market. The technology has been proven already in other global markets as it has been sold under other brand names, which do not exist here. The product line has been "Americanized" and now the mutual opportunity exists to build alliances with sales and service organizations in North America.

The compressor distributors I spoke to had come to see the technologies being offered and wanted to understand CP's strategy for North America. The companies there came from distributors who sell every brand of air compressor. It was interesting to see Gardner Denver, IR, Quincy, Atlas, Sullair, Curtis and Kaeser distributors all in the same room. The feedback I received was that they were very impressed by all that they had seen.

It's always a rare opportunity to be there when a significant business is launched. It will be interesting to watch CP's growth over the coming years in the industrial compressor market of North America. BP

For more information on Chicago Pneumatic Compressors, please contact Mr. Charlie Townsend, tel: 803-817-7149, email: Charlie.townsend@cp.com, www.cp.com

For Canada, please contact Mr. Robert Barker, tel: 905-816-9923, email: robert.barker@cp.com

MEASURING VACUUM

BY DOCTOR VACUUM

It seems that there is a new rule of thumb in the vacuum industry: the less money you spend on a vacuum gauge, the more likely it is that you will attain perfect vacuum.

When I get phone calls or emails about vacuum systems, my first question is always the same, "what is the level of vacuum in the system or **at the process**?" In other words, what amount of vacuum is doing the work for you? The answers I get are varied but can be placed into three general camps. The first and most common answer is that the level of vacuum is "unknown" and they really do not know exactly what they have or what they need. The second most common answer is an "around" number. For example, someone will say they have around 26" HgV to 28" HgV based on a gauge somewhere in the system. The gauge may not have been calibrated since the late 1970's but at least it is there. The third answer category, which is very rare, is they know exactly what they have and exactly what they need.

Measurement of Vacuum is Critical

Install Gauges at the Process

Install Gauges at Pump Inlet

Your process is critical to your success as a manufacturer and knowing the benchmarks for vacuum supply at the process is essential. Saying your supply is around 26" HgV to 28" HgV is an equivalent magnitude to stating that your compressed air supply is 100 to 200 psig — a very large range. This is where the compressor workers have an easier time because compressed air systems can easily have a 20 psig swing and production can still function normally. Vacuum systems only have the equivalent of about 15 psig **total** to work with, so accuracy in vacuum processes has to be that much greater.

It is prudent to place a couple of high-quality gauges at your process so that accurate metrics can be established. This way, trouble-shooting is streamlined when there are hiccups and improvements can be implemented with complete and accurate information. Attaining the "perfect" vacuum for your production systems then becomes much easier. My second recommended location for high-quality gauges is directly at the inlet to the supply vacuum pump or at the manifold in multiple pump systems. With accurate gauges in two locations, you are provided with a simple yet effective diagnostic tool. Lastly, when new piping systems are put in place or modifications are made to existing systems, I recommend installing threaded gauge ports in other strategic locations where gauges can be installed for system analysis and monitoring when necessary.

The most severe example of a lack of measurement that I have seen was in a production system that was generating vacuum at 26" HgV and using vacuum at 4" HgV. That particular system was using over three times the horsepower that it needed to do the work. Accurate demand information also allows you to make the necessary changes in production machinery for increased throughput or scrap reduction. Knowing exactly what levels of vacuum are typical in your production systems allows you to fine tune your supply and distribution systems to optimize your ratio of energy input to work output. BP

For more information contact Dan Bott, Dan Bott Consulting LLC, tel: 251-609-1429, email: dan@dbott.com, www.danbottconsulting.com

Compressed Air Best Practices Magazine has introduced the AIR BEST PRACTICES symbol (at left) to represent the tremendous opportunity for dollars to be saved in electrical costs of compressed air systems. These projects have very attractive ROI profiles for corporations. The reductions in kW consumption by industry will have correspondingly positive benefits to the ambient air in the form of reduced carbon dioxide emissions and greenhouse gases.

ROD SMITH

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The Comp-Air Service Co.

CABP interviewed Larry Olesky (President) and David Smith (Auditing Director) of Comp-Air Service Co.

How did Comp-Air Service get started in Florida?

Comp-Air Service Company was founded in 1957 by two former air force pilots. They were the first air compressor assemblers in Florida. They packaged Kellogg and Quincy, and supplied Sherwin Williams paint stores and car dealerships with air compressors. On the service side, the company focused exclusively on repairing Quincy and Kellogg units. Over the years, the firm established a reputation as a strong service company who took care of their customers. They built a tremendous amount of goodwill from their customers who appreciated the quality of service.

Comp-Air Service Company Headquarters in Miami, Florida

A partner and I (Olesky) purchased the company in 1975. After college, I was looking for an opportunity to own or manage a compressor service and sales company. I had grown up working as an installer and service technician in Detroit for my father's company. During high school and college I was the head installer and whenever I had a day off from the classroom, my father had a job scheduled for me! We worked on all kinds of air compressors including Schramm, diesel engine blocks, Quincy and Kellogg-American units.

So, on a Thursday afternoon, a couple years after college, the Kellogg-American rep called to tell me of a good company for sale in Florida. I flew out that Saturday and bought the firm on Monday! The rest is history.

What is the size today of Comp-Air Service?

We have grown into an international company that operates five self-sufficient service and sales branches. We employ approximately sixty employees in six branch locations located in Miami, Orlando, Tampa, Fort Myers, Peru and Honduras.

What geographies do you serve?

Our geographic strategy has been to expand so that we can provide superior local service across the state of Florida. This is why we have invested in the branches over the years. We have also capitalized on Florida's proximity and high levels of business with Latin and South America. This business grew to such a point that we now operate branches in Peru and Honduras. Our branch in southern Peru is located in the middle of the Andes at an elevation of 15,000 feet. Although it only takes one and a half hours to fly there from Lima, a car ride takes 15 hours!

COMP-AIR SERVICE CO.

What industries do you serve?

We often say that in Florida, we will visit the office of a dentist in the morning and a NASA space shuttle launch pad in the afternoon! The diversity of our customer base is amazing. Florida has farming/agricultural, amusement parks, resorts, textile, Tier 3 automotive, printing, electronics, food packaging, climate control, laundry and many more industries.

Growth industries in Florida have been the pharmaceutical industry and Tier 3 automotive (equipment going into new vehicles, like key safety devices). A mainstay in Florida has been building component manufacturers (window and door manufacturers). This is always a cyclical business with years of overbuilding and then downturns. This past year was the first year in twenty years that more people left the state than entered it. Currently the real estate bubble has burst and some of these construction-related companies are closing. The big homebuilder, Lanier, has just declared bankruptcy for example. Construction and real estate in Florida is a cyclical market and just a part of our business.

In Honduras, the primary market is the textile industry and Dole Foods. In Peru, we focus primarily on copper mines. We are located in the heart of the Andes, where over 800 mines are in operation, and have developed an expertise in designing compressed air systems for mines.

Service was first and foremost, good products are important, having capable and competent people on the road (even if I had to do the job myself). No magic formula to finding good service techs. We were a pioneer in Florida in doing the entire installation.

What product lines do the firm represent?

We represent compressed air system and vacuum products. Air compressors range from fractional horsepower units to 20,000 horsepower reciprocating, rotary and centrifugal technologies. We offer low, medium and high-pressure compressors ranging from blowers at 15 psig to higher pressures at 700 psig for PET bottle blowing. We also offer a full range of air purification products for every ISO grade of air quality. The vacuum systems cover applications between 29.99 inches of mercury to a couple of Tor.

An international business with branches in Miami, Orlando, Tampa, Fort Myers, Peru and Honduras.

We are now adding demand-side system components to modify existing production machines. We are now working with air curtains, cylinders and pneumatic circuits to improve the speed and efficiency of production machines.

Please describe your auditing services.

We have evolved to the point that we are no longer a sales and service company, but a solutions company. We are comparing our equipment to others with less frequency. Our focus has always been to make our customers problems our problem. We need to know more about their air system and usage needs then they do and solving their problems is our main focus.

Before auditing became popular, Comp-Air Service Co. had this focus. We have been in this mode for many years. We always had a systems approach and provided systems solution. In the past, Larry would do the walk-through and now, with air audits, we provide better documentation of what we've been doing for all these years.

How do you measure flow, kW and leaks?

We use amp loggers and pressure loggers extended all the way out in the plant and internally on production equipment. They are independent and self-contained with an e-prom memory. On amp draw we work on mean averages. Flow meters are normally intrusive, forcing you to slice into a header or a pipe. For flow measurement, we prefer to amp log a machine and determine what percentage load it is running at. We then back into the flow number by comparing load to full-load capacity data published by the compressor manufacturer.

We do remote monitoring with some clients like Tropicana and Southern Peru Copper. We find customers with remote locations and with strong technical departments have a preference for remote monitoring.

How significant are the air leaks you encounter in your audits?

We just finished auditing four factories of a major multinational corporation. They were all at over 50% leak rates of installed horsepower. This corporation has taken a very aggressive Kaizen approach to driving down energy costs globally. They shut down the entire factory on Sunday and allow auditing teams to analyze various systems in the facility in a "at rest" condition with no production load on the equipment. We could load up the machines and run them and find out how much was required to simply supply the air leaks.

We would then see the system ramping up on Monday, running full bore on Tuesday, and we would turn in our Kaizen results on the compressed air system on Wednesday. This company is auditing every plant they have globally in this manner. Being able to audit a facility in a "at rest" condition and then compare it to full production conditions absolutely provides us with the best possible situation to provide a perfect audit.

COMP-AIR SERVICE CO.

This company takes the results of the Kaizen audits, which show the dollar savings from the audits, and then further interpret these into the equivalent carbon footprint of so many acres of trees, CO_2 reductions, removing cars from the road. This company has a global mandate of an equivalent reduction of 12% in greenhouse gases (GHG) by 2009.

Do you review pneumatic systems?

Absolutely. Historically, the two industries (pneumatics and air compressors) have run in parallel. It's not that hard to train pneumatics people on air compressors, but it is harder to teach pneumatics to air compressor specialists. Our auditors, like Dave Smith, began their careers working with pneumatics at a fluid power house. Long term, distribution may have to think out of the box to create more linkage between these two industries. If you want to truly understand demand, you have to understand pneumatics.

Where are the biggest opportunities for savings?

The biggest opportunity lies in turning off air compressors. Audits identify ways to reduce air demand while freeing up more useful air for production. Almost every plant we visit for the first time has over-purchased air compressors. A facility with multiple 300 horsepower machines continually throws horsepower at problems wishing they will go away. At today's high electric energy costs in Florida, running between $790 to $1,500 per horsepower, this is unacceptable. Some of our customers in the Caribbean Islands see even higher energy costs because they use diesel generators to produce electricity.

Do the Florida power companies offer incentives to reduce energy consumption?

There are limited rebates from Florida power companies. They have very strong generating capacities. The University of Miami was financed to do industrial audits on behalf of FP&L and they audit plants and the air compressors. We have found, however, that most of their customers are not adopting the actions recommended because the audits are supply-side oriented and quite generic. BP

Thank you Comp-Air Service for your insights.

For more information please contact Mr. Larry Olesky, Comp-Air Service Co., tel: 305-687-8787, email: info-request@comp-air.com, www.comp-air.com

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Special Report: THE 2007 NAACD

BY ROD SMITH

Mr. Sid Van der Meer, NAACD President

The North American Association of Compressor Distributors (NAACD) annual meeting was held at the Renaissance Vinoy Resort in St. Petersburg, Florida on October 21–24, 2007. My task was to enjoy three days of southern Florida weather, a round of golf and meet with air compressor distributors and compressed air equipment vendors from all over the USA and Canada.

One thing that strikes you at this meeting is what a good mood every one is in. The NAACD's motto, "Progress through Communication," certainly seems to be more than a slogan. The President of the NAACD, Mr. Sid Van der Meer of Northwest Equipment in Alberta commented, "It is invaluable to be able to gather together once a year and view the latest compressed air technologies, and discuss strategies which help us run our businesses." All members of the association are independent CompAir USA distributors.

Bill Steele (left) and Tom Pischl of CompAir USA

The primary sponsor of the event, CompAir USA, is a strong supporter of the NAACD. The company manufactures a broad range of rotary screw, rotary vane and high-pressure air compressors. The flagship brands are CompAir and Hydrovane. Mr. Bill Steele, CompAir's Vice President of Sales & Marketing said, "This is our annual national sales meeting. We embrace the opportunity to provide training, discuss strategies, share market intelligence and introduce new technologies." CompAir had a huge stand full of all kinds of equipment, but nothing took a back seat to the "American Tour" truck which was pulled up right next to the exhibit hall.

CompAir's introduction of their new DH Series oil-less rotary screw air compressor (20 hp to 150 hp) has been supported by the "American Tour" truck, which allows end users to see this new technology operate in person. Inside the truck, I was given an introduction to the 20 horsepower, water-injected, oil-less, variable speed drive unit installed in the truck by Mr. Tom Pischl P.E., a District Sales Manager for CompAir USA. "All models have VSD capabilities, the 20–30 hp models use an inverter while the 50–150 hp units have switch reluctance drives." All models use a single-stage rotor with carbon-ceramic sleeve bearings. He went on to describe the reverse osmosis semi-permeable membrane and storeage tank system, which ensures the supply of pure water to lubricate the compressor. "Customers greatly appreciate the reduced maintenance benefits of not having to replace oil in these air compressors," said Mr. Pischl. He went on to describe how he had visited a major consumer goods factory, with Mr. Kurt Barhurst of Air Handling Equipment, and shown them the DH Series in their American Tour truck. "This factory has always used oil-free compressors of a different brand. They were so impressed by the quiet operation and reduced number of spare parts of the DH Series that they purchased a 150-horsepower unit!"

A CompAir Hydrovane Rotary Vane Air Compressor

Pam and Bill Thomas from Belair Technologies

Katie Garber, Danny Thompson, and Eric White from JORC Industrial

SPECIAL REPORT: THE 2007 NCAAD

Kelly Ingoldsby (center) from SMC Corporation

Mark Lauterwasser (left) and Tony Hergert from Parker domnick hunter

Volkan Ayhan and Mark McCullagh from Mikropor America

The NAACD invites many other equipment vendors to attend the conference. Products on display ranged from air dryers, air filters, chillers, condensate drains, oil-water separators, wireless service products and intake filters.

Belair Technologies exhibited high-temperature refrigerated dryers that can accept inlet temperatures to 180 °F, and their new FT Series filters and AMD Series refrigerated air dryers. JORC Industrial displayed their new Air-Saver programmable valve, which isolates air leaks downstream to prevent compressors from turning on when the plant is not in production. They also displayed their new PODS pneumatically-operated, no-air-loss condensate drain along with their Puro-Dri oil-water separators.

Mikropor America exhibited for the first time at the NAACD. The firm exhibited their range of gas turbine inlet filtration, ambient air filtration and compressed air dryer and filter product lines. Parker domnick hunter displayed their newly launched range of refrigerated air dryers for flow from 10–6,000 scfm, the Artic Star Plus. They also displayed their new line of chillers.

SMC had a booth where they displayed both pneumatic products and their line of air dryers and filters. SMC has launched a strong compressed air auditing initiative, which identifies energy-saving opportunities in pneumatic circuits and components. They are working with compressor distributors to deliver this value to end users.

The conference ended with a round of golf (my partner Mark Lauterwasser called me "Aqua Man") and a very pleasant banquet where we were entertained by a combination magician/mind reader. That was scary. I don't know if the mind reader will be there in 2008, but I highly recommend attendance at the 2008 NAACD (www.naacd.org) if you have the opportunity to go. BP

Wall Street Watch

BY COMPRESSED AIR BEST PRACTICES

The intent of this column is to provide industry watchers with publicly-held information, on publicly-held companies, involved with the sub-industry of compressed air. It is not the intent of the column to provide any opinions or recommendations related to stock valuations. All information gathered, in this column, was on December 4, 2007.

Gardner Denver, Inc. (NYSE: GDI) announced that revenues and net income for the three months ended September 30, 2007 were $457.2 million and $53.7 million, respectively. For the nine-month period of 2007, revenues and net income were $1.4 billion and $141.2 million, respectively. Diluted earnings per share ("DEPS") for the three months ended September 30, 2007 were $0.99, 65 percent higher than the comparable period of 2006. For the nine-month period of 2007, DEPS were $2.62, 46 percent higher than the comparable period of the previous year. Other than the reduction in the tax provision, the Company's DEPS improvement for the three months ended September 30, 2007 was primarily attributable to the incremental flow-through profitability of organic revenue growth and operational improvements, including the benefits from acquisition integration.

"I am very pleased with our results for the third quarter, which reflects the diligent efforts of Gardner Denver's employees throughout the world," said Ross J. Centanni, Chairman, President and CEO of Gardner Denver. "Demand continued to be strong in end market segments in Europe and Asia, while growth slowed in North America. The year-over-year flow-through profitability in both of our reportable segments was excellent in the third quarter, as we continue to realize the benefit of some of our integration activities. As a result, the company's total segment operating earnings (1) grew 21 percent when compared to the same quarter of the previous year, which was twice the rate of revenue growth for the same period. The strong flow-through profitability was achieved despite the unfavorable effect of selling fewer drilling pumps in the three-month period of 2007, than in the same period of the previous year. The solid operating performance in the third quarter and the first nine months of 2007 has resulted in more than $127 million in cash provided by operating activities.

"Our Compressor and Vacuum Products segment revenues grew by 10 percent in the third quarter of 2007, when compared to the same period of 2006, due to strong demand in Europe and Asia and favorable changes in currency exchange rates. Orders increased 11 percent in the three months ended September 30, 2007, when compared with the same period of 2006, reflecting good demand for engineered products and OEM applications on a global basis, and low-pressure and vacuum applications in Europe. Order growth for this segment accelerated in the third quarter of 2007, compared to the second quarter of the current year, reflecting strong growth in end market segments, the benefit of reducing manufacturing lead-times as we integrate acquired operations, and favorable changes in currency exchange rates.

"Compressor and Vacuum Products segment operating earnings as a percentage of revenues (segment operating margin) expanded to 11.8 percent in the third quarter, the highest level achieved since 2001," said Mr. Centanni. "The improvement is the result of the segment's strong flow-through profitability on organic revenue growth, cost reductions and the benefits of acquisition integration activities. Further improvement is expected to be realized as the manufacturing integration of the Schopfheim, Germany facilities is completed at the end of this year. In 2008, these process improvements are expected to increase productivity, while reducing lead-times and inventory, generating incremental operating earnings of approximately $6 million annually."

CLEVELAND, Nov. 1, 2007 — Parker Hannifin Corporation (NYSE: PH), announced that it has acquired Kay Pneumatics Ltd., a manufacturer of pneumatic valves, cylinders and precision electro-pneumatic control systems for transportation, semi-conductor, medical and general industrial markets. Known as KV Automation, the company is headquartered in Milton Keynes, UK, and has operations in the United States, Spain, France, Netherlands, Thailand, China and United Arab Emirates and reported sales of approximately $43 million for the fiscal year ending April 30, 2007.

KV Automation will operate within Parker's Automation Group. Sales will be reported largely within Parker's Industrial International segment. KV will continue to leverage its unique rapid prototyping capability to design and manufacture fully integrated electro-pneumatic and electro-fluidic system solutions for customer specific applications. Some typical applications include bus door actuation, anesthesia and mobile emergency ventilator modules for medical use and pressure regulation systems used in the ultra pure semiconductor production environment.

WALL STREET WATCH

"We are very excited to welcome the KV team to Parker's Automation Group," said Roger Sherrard, Group President-Automation. "Their innovative, systems driven culture of more than 40 years complements our own and strengthens our industry expertise in key markets. These extensive capabilities, already well aligned with our global target markets, will allow us to bring even more value to our customers."

"We have been aware of Parker as the motion and control leader for quite some time," said Tony Cersell, Managing Director, KV Ltd. "Our internal discussions determined that a candidate to acquire KV must be an industry leader of high reputation, able to leverage our pneumatic technology integration strengths, embrace our culture and work ethic and demonstrate a human resources ability to provide career development opportunities to KV employees. We are pleased that Parker meets all of those expectations."

Hamilton, Bermuda, October 26, 2007 — Ingersoll-Rand Company Limited (NYSE:IR) announced earnings and revenues for the third quarter of 2007.

The company reported net earnings of $266.6 million, or diluted earnings per share (EPS) of $0.92, for the third quarter of 2007.

"Third-quarter 2007 performance continued to demonstrate the benefits of our transformed business portfolio, expanded market and geographic diversity and our investments to fuel innovation," said Herbert L. Henkel, chairman, president and chief executive officer of Ingersoll-Rand. "We again offset several soft domestic markets with strong revenue growth from international operations, new product offerings and recurring revenues."

The company now classifies its businesses into three reportable segments based on industry and market focus: Climate Control Technologies, Industrial Technologies and Security Technologies. The results of Club Car® are now reported as part of the Industrial Technologies segment.

Industrial Technologies is focused on providing solutions to enhance customers' industrial and energy efficiency and provides equipment and services for compressed air systems, tools, fluid power production and energy generation systems. Total revenues in the third quarter increased by approximately 13% to $702 million.

Air Solutions revenues increased by 19% with improved activity in industrial and process markets for complete air compressor units in all geographic regions and increased revenues from the aftermarket business.

Productivity Solutions revenues increased by 4%, as expanding activity in fluid handling, material handling and industrial markets outside of North America offset sluggish domestic markets, particularly for tools.

Club Car revenues increased by 3% compared with the third quarter of 2006, primarily reflecting increased parts and rental revenues, higher sales of utility and off-road vehicles and market share gains in a soft golf market.

Third-quarter operating margins for Industrial Technologies of 13.3% increased compared with 12.8% last year, resulting from higher volumes, improved pricing and productivity savings, partially offset by higher material costs and unfavorable product mix.

Hartford, Conn., October 17, 2007 — United Technologies Corp. (NYSE:UTX) reported third quarter 2007 earnings per share of $1.21 and net income of $1.20 billion, up 22 percent and 20 percent, respectively, over the year ago quarter. Revenues for the quarter increased 14 percent to $13.9 billion and included 9 percent organic growth. Foreign currency translation and acquisitions accounted for the remainder of the revenue growth. Cash flow from operations was $1.38 billion and capital expenditures were $238 million.

"This was another solid quarter for UTC. Notably, organic revenue growth came in at 9 percent, following 10 percent growth in each of the first two quarters of 2007. In addition, five of our six business segments grew profits at double-digit rates as markets in general remain healthy and cost reductions continue. While market conditions in Carrier's North American residential business are clearly challenging, its other three global businesses delivered double-digit earnings growth," said UTC Chairman and Chief Executive Officer George David.

CHARLOTTE, N.C., Nov. 1, 2007 — EnPro Industries (NYSE: NPO) reported higher sales, increased segment profits and higher segment profit margins in the third quarter of 2007, and an improvement to net income in the quarter compared to a net loss in the third quarter of 2006.

"Our third quarter results demonstrate the effectiveness of our strategies and the commitment of our employees and managers to carrying them out," said Ernie Schaub, president and chief executive officer. "Sales, segment profits and segment profit margins were the best we've ever reported in a third quarter and were in line with the record performances we reported in the first two quarters of the year. Acquisitions, improved efficiencies, foreign exchange and continued strength in our markets all played a part in our ability to maintain a high level of performance."

Net income in the third quarter was $12.3 million, or $0.54 a share, compared to a net loss of $4.3 million or $0.20 a share in the third quarter of 2006. Before asbestos-related expenses and other selected items, income in the third quarter of 2007 improved to $19.5 million, or $0.86 a share, a 34% improvement over the third quarter of 2006, when income was $13.8 million, or $0.64 a share.

Sales in the third quarter were $252.7 million, an improvement of 11% over the third quarter of 2006 when sales were $228.6 million. Sales improved in all of the company's segments, reflecting continued strength in North American and European industrial markets, high levels of activity in oil and gas markets worldwide, the benefits of acquisitions and favorable foreign exchange. Acquisitions and foreign exchange accounted for about six percentage points of the improvement in sales.

Segment profits improved by 30% in the third quarter to $40.4 million compared to $31.1 million a year ago, and segment profit margins reached 16.0% compared to 13.6% a year ago. Lower pension expense, improved pricing, acquisitions and foreign exchange each benefited the comparison to segment profits in the third quarter of 2006, as did the absence of a contract loss provision recorded last year at Fairbanks Morse Engine.

Sales in the Engineered Products segment increased 15% over the third quarter of 2006. Acquisitions and foreign exchange contributed 11 percentage points of the improvement. Sales at GGB Bearing Technology benefited from increased demand in Europe, improved pricing and the benefits of foreign exchange. Acquisitions completed in June and July of 2007 combined with strong organic growth to help sales at Compressor Products International (previously known as France Compressor Products) nearly double over the third quarter of 2006. At Quincy Compressor, sales decreased as activity in construction markets declined from the record levels of a year ago.

The segment's profits in the third quarter of 2007 grew by 15% compared to the same period in 2006, and profit margins increased slightly to 15.5%. GGB's profits improved and profit margins increased as the business benefited from stronger European markets, greater efficiencies, better pricing and foreign exchange. Profits at Compressor Products International (CPI) increased reflecting stronger market conditions and the contribution of acquisitions. Profits at Quincy Compressor were about the same as last year, although margins improved as Quincy benefited from increased efficiency. BP

DECEMBER 4, 2007 PRICE PERFORMANCE	SYMBOL	LAST PRICE	1 MONTH	6 MONTHS	12 MONTHS
Parker-Hannifin	PH	$79.57	-0.3%	15.2%	44.1%
Ingersoll Rand	IR	$51.48	0.9%	-1.3%	33.2%
Gardner Denver	GDI	$33.00	-4.8%	-19.7%	-10.8%
United Technologies	UTX	$74.75	-1.0%	5.9%	17.3%
Donaldson	DCI	$46.00	10.3%	26.9%	32.1%
EnPro Industries	NPO	$30.35	-12.8%	-26.9%	-11.7%
SPX Corp	SPW	$102.95	-3.9%	17.4%	67.5%

JOB MARKET

Job Openings in the Compressed Air Industry

SERVICE SALES MANAGER

Houston, Texas

Excellent opportunity to join a growing, World-class turbo air compressor Manufacturer that offers a competitive salary and premier benefits including medical, vision, dental, life short and long-term disability, long-term care insurance and 401(k) with matching company contribution.

Position base within the company's sales office located in the Southwest area of Houston, this position is dedicated to the aftermarket parts and service sales for equipment installed throughout the U.S. Industries include petrochemical, refinery, chemical, electronic, automotive and general manufacturing firms.

Requirements:

- Minimum 5 years related sales experience with engineering degree.
- Understanding service sales, selling thru distribution as well as to direct end-user type companies.
- The ability to travel throughout the US on a regular basis.
- Previous experience to understand turbo machinery; particularly turbo air compressors and related accessories.
- Proficient computer skills for reporting, excel spread sheets, word and the like.

For consideration, submit resume including salary history to:
Email: info@dareent.com
Fax: 412-231-6101

SERVICE TECHNICIAN

Blake & Pendleton, Inc.

Blake & Pendleton, Inc. currently has an immediate need for technicians in Augusta/Aiken, Atlanta, and Savannah, Georgia. Must be able to work independently and as a team player.

Requirements:

- 3–5 years experience.
- Proficient in electrical/electronic troubleshooting.
- PLC and computer literate.
- Refrigerant and EPA certified.
- Clean MVR

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All interested persons please send resumes in Microsoft Word format only to:
Email: jobs@blakeandpendleton.com
Fax: 866-907-6395.

SALES ENGINEER

Nashville, TN

AIM Power & Fluids, a Sullair Industrial Compressor Distributor, located in the booming economy of middle Tennessee has an immediate need for an experienced outside sales engineer.

Nashville is a great place to work and live, and AIM offers an EXCELLENT compensation and benefits package.

Interested candidates should please send resume to John Elias at:
jpelias@aimcompanies.com

TERRITORY SALES MANAGER

Comp-Air Ohio

Comp-Air Ohio is seeking qualified Professional salesmen to sell industrial air compressors and related products, service, parts and lubricants in Northern Ohio

Excellent benefits, 401K, background check and pre-employment drug screen. Salary commensurate with experience.

Apply in Microsoft Word to:
Email: compairohio@aol.com
440-237-6700

SERVICE MANAGER

Comp-Air Ohio

Seeking a qualified person to take over as service manager effective August 2008 when job becomes open due to retirement.

Accepting applications through June 2008

Excellent benefits, 401K, background check and pre-employment drug screen. Salary commensurate with experience.

Apply in Microsoft Word to:
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