What do you mean Compressed Air Isn't Free? We Use It Everyday!

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It is amazing that while there is so much discussion in various media about energy and carbon reduction, most plant personnel fail to realize that there are incredible opportunities for cutting energy waste and carbon gases right under their proverbial noses. These are opportunities that could dramatically improve their company's competitiveness.

In fact, many management personnel fail to realize that it isn't always necessary to commit to major capital-intensive programs that produce long term returns on investment. The often are either not aware of or just overlook inexpensive projects with short-term, almost immediate returns that will improve energy efficiencies in their plants.

One answer is looking for and repairing leaks in utilities such as compressed air and steam. These programs often provide a very fast and dramatic return on investment. In some cases this has translated to hundreds of thousands and as high as millions of dollars per year without major capital investment.

Compressed air is one utility that offers tremendous savings potential. The problem is that there are many plant personnel who don't quite understand that compressed air isn't free. There is the attitude that since it's just air and it's used every day, it's free and doesn't require much attention, even if there are obvious leaks. Unfortunately this is far from the truth. Compressed air is an extremely expensive utility.

In fact back in 1995 the US Department of Energy instituted a Compressed Air Challenge to help industry reduce the use of compressed air by 10% by 2010. They had stated that compressed air is one of the most costly utilities in plants and of all the compressed air produced in the USA, 30% was lost to leaks. They estimated the annual cost to be around $3.2 billion!

Why is compressed air so costly? It is extremely expensive to produce and it is very inefficient to use. Of the energy required to produce compressed air, less than 20% of input energy is left for use. That means 80% of what is paid for is used up before compressed air is put in the distribution system. Here's an example of how inefficient compressed air is. If we compare the cost of running a one horsepower electric motor to a one horsepower compressed air motor, the former might cost $200 per year while the latter $1500 per year.

One simple approach for those facilities that use compressed air is to schedule routine compressed air audits and leak surveys. Compressed air leak surveys often disclose the cost of wasted air impacting the electric bill ranging form tens of thousands to hundreds of thousands of annualized dollars.

The chart below is an example of how costly compressed air leaks can be. While the numbers relate to one leak, imagine the cost of hundreds of leaks with sizes ranging from 1/16 up to ¾ of an inch!

Air Leak Cost

LEAK DIA	AIR-LOSS CFM/DAY	CFM LOSS/DAY	LOSS /DAY $	LOSS/YEAR $
1/64	.45	576	0.13	48.00
1/32	1.60	2,304	0.51	186.00
3/64	3.66	5,270	1.16	424.00
1/16	6.45	9,288	2.04	744.00
3/32	14.50	20,880	4.59	1,674.00
1/8	25.80	37,152	8.17	2,981.00
3/16	58.30	83,952	18.47	6738.00
1/4	103.00	148,320	32.63	11,904.00
5/16	162.00	233,280	51.32	18,721.00
3/8	234.00	336,960	74.13	27,036.00

NOTE: Based on 100 PSI, $0.22/MCF, 8760 hours/year

While design and compressor efficiency are important factors to consider regarding system efficiencies, there are two other contributing factors to excessive energy consumption in a compressed air system: leaks and misuse.

On the plant level, there are many workers who are under the assumption that "air is free" and for this reason air is often misused and wasted. Air leaks are ignored. It is not uncommon to walk through a plant where the tell-tale loud hissing sounds associated with gross leaks are heard and taken for granted as background noise. If leaks are too loud to be tolerated, we have seen rags or duct tape wrapped around them to reduce the sound level and make it more acoustically comfortable for the personnel in the area. Abuses have also been observed. At times personnel have placed air hoses in a position to continually cool their working space. In one instance an enclosed metal box was set up in a plant with an air hose run through the top, positioned to continually blow air on soda pop cans to keep them cool!

Engineers have also misunderstood the inefficiency and cost associated with compressed air. Some common wasteful and costly practices in many plants are using compressed air to blow on and cool bearings or to continuously blow on conveyors to clean them. We have seen drain valves left open with big warnings placed on the tanks above stating: "do not close this valve, keep it open".

One simple, inexpensive approach to reducing compressed air waste in facilities is to embark on an educational campaign. Meetings are often a good start where the cost of energy waste and its impact on operating costs in particular can be discussed. Personnel can be asked to help identify misuse and be encouraged to inform their co-workers. Motivational signs can be placed around the plant to illustrate wasteful behavior and suggest changes. Newsletters can be used to promote a campaign. A suggestion box can be set up and rewards or awards given to the most effective suggestion. In some cases monetary rewards based on the value of the suggestion have been given to personnel.

As part of the misuse or misapplication of compressed air, a survey can be undertaken to look at alternatives to compressed air. For example, instead of blowing compressed air on a bearing, try a fan. Instead of mixing or agitating with air, try an electric mixer. Keeping in front of the issue and looking around for alternative resources can help reduce the electric bill noticeably.

Since about 30% of all the compressed air produced is lost to leaks, it is imperative for a facility to incorporate a compressed air leak survey program. Not only is this a "non-capital intensive", relatively inexpensive approach, the results can be gained as quickly as the leaks are repaired. Energy consumption, specifically the reduction of electricity usage also will have an impact on a plant's carbon footprint.

Compressed air leak detection surveys require planning, personnel, training, equipment, identification, reporting and follow-up.

Without planning the program can be lost and ineffective. Planning includes consultation with plant management and plant personnel, observation and review of the compressed air system. A "walk-through" for any survey is recommended. This is performed to help set up the survey, breaking it down to small workable units. Safety issues can be observed, route logistics can be planned which can include where to begin and where to end in a particular section. A walk through can also help plan what equipment will be needed. Are there keys needed to open cabinets, flashlights for dimly lit areas, ladders or lifts or special modules for piping in ceilings?

Personnel should understand the goals of the program and should understand how to conduct a leak survey.

Training provides personnel with the knowledge and methods needed to effectively perform a survey. Properly trained inspectors learn how to plan for and conduct a compressed air leak survey using inspection techniques that avoid problems such as misidentification or improper labeling, which might lead to costly mistakes and unreliable results. They also learn how to use reporting tools to calculate and demonstrate survey savings.

Using the right equipment for the job will add to the effectiveness of the survey. The most common tool for compressed air leak surveys is an ultrasonic detector. These instruments sense high frequency components of turbulence produced by air leaks.

Directional in nature, ultrasound is a localized signal which makes it relatively easy to locate the source of the leak. If the instrument is not sensitive enough, some mid-sized leaks might be missed. If there are accessibility issues such as leaks in ceilings or in layers of pipes or behind walls or underground, special modules that adapt to these situations should be considered.

Identification of leaks is very important. The leak should be tagged and if possible photographed to assist those who are responsible for the repair locate and perform the repair. A big, brightly colored tag can help. If possible a tagging system can be used to correlate with location, component, pressure, CFM or even the cost of the leak.

Any survey needs reporting. A report can be a form of "leak management". A leak report should be useful on many levels. The report helps identify the specific leak, the number of leaks, an identifying number which can correlate to a work order and the location of the leaks. Some reports will also include a summary of identified and "actualized" cost avoidance along with identified and "actualized" carbon footprint reduction. The actualized is the leaks that have been repaired, which represents the real savings of a survey. Unfortunately there have been instances where good intentions resulted in costly mistakes simply because surveys were performed with no allowance for planning of leak repair.

Some software allows for the summation of surveys over time demonstrating the cumulative annualized cost savings. Other reporting features can include demonstration of reduction of the carbon footprint gases that are associated with the energy cost of leaks. Below are examples of this type of reporting.

2	Year to Date	$56,227.99			Air Leaks Repaired	
3						
4	Month	Identified leaks Cost Avoidance	Repaired Leaks Cost Avoidance	% Complete	CFM	Cost
5						
6	Aug-08	$26,743.99	$5,146.91	19%	29.8	$5,146.91
7	Jul-08	$19,853.88	$1,895.60	10%	11.0	$1,895.60
8	Jun-08	$9,630.12				

Note the columns stating "Identified leaks Cost Avoidance" and "Repaired Leaks Cost Avoidance". It is only when a leak is *repaired* that the savings are realized.

Carbon Dioxide CO_2 (lbs)		Nitrogen Oxide NO (lbs)		Sulphur Dioxide SO_2 (lbs)	
Identified Avoidance	Realized Avoidance	Identified Avoidance	Realized Avoidance	Identified Avoidance	Realized Avoidance
211199	40645	265	51	506	97
156787	14970	197	19	375	36
76050		96		182	

It is necessary that all parties responsible for the leak survey be on the same page. Communication is essential. Maintenance managers and planners must understand the necessity of leak repair and a workable schedule set. For example if 200 leaks are found in a survey and the report left is left with those responsible for the repairs without an explanation, there is the possibility that these leaks might be looked on as an additional 200 work orders and left unattended. If discussions of repair included the participation of the repair team, a method could be established to break the repairs down into small workable chunks starting with the most costly leaks first or pairing leaks that are close together, making leak repair more efficient. Inclusion and communication will lead to cost savings and a successful program.

Follow up of listed repairs will help assure leaks have in fact been repaired and no new leaks developed due to the repair. It will also include a review of system pressures to be restored to original settings. Finally the review of the entire survey will help set up the logistics for all subsequent surveys.

CONCLUSION

Energy savings can be realized without major capital expenditures. Compressed air is a costly utility that is often taken for granted. It is not free. In fact it is one of the most costly utilities in plants today. A comprehensive program of leak repair that includes education of plant personnel, planning, training, methods of identifying and repairing leaks and a system of reporting survey results can lead to reduction of energy use, increased profitability and an improved carbon foot print. A compressed air leak survey is a truly “green” way to improve profitability.