Understanding the Impact of Air Technology on Energy Efficiency and Product Quality in the Beverage Industry

Summary

The efficient and effective use of air during production and packaging is the secret ingredient helping successful beverage manufacturers gain an edge over the competition, in better product quality, reduced energy and production costs, and improved sustainability. Air technology has been used throughout the development and growth of the beverage industry; and now the latest evolutions in air technology offer tools which help cut production costs and give companies the edge they need to maintain and build market share.

The Evolution of the Beverage Industry

The first beverages to be put in containers and sold were beers or ales of some sort. In fact, many historians connect the invention of beer to the first beginnings of both technology and civilization. These beverages were so highly esteemed that early pagan cultures often had gods and goddesses of brewing. The connection of brewed beverages and religion continued into the early Christian era with many monasteries earning renown for the quality of their brews. Until the dawn of the Industrial Age, however, the sale of beers, and later wines and distilled spirits as well, remained on a local scale.

In the 1800s, the soft drink industry first emerged. In a vast contrast from today when many soft drink brands have global sales and recognition, in those early days most soft drink businesses were not only local but seasonal with most plants closing down for after Labor Day.

It wasn't until the second half of the 20th century that the beverage industry expanded with national distribution of soft drinks. The burgeoning of the industry brought higher standards for labeling and sanitation while products were being shipped over longer distances. The need to ensure package dryness before labeling and shipping become a major consideration. In order to achieve the next level of growth, beverage corporations utilized the nascent new technology of air manufacturing tools.

The beverage industry's need for air tools coincided with the early phases of air technology. In the 1950s and 1960s, early pioneers were just beginning to explore the use of air in manufacturing environments. The primitive era of air technology for manufacturing environments involved two primary tools: blowers and compressed air.

BLOWERS

Many bottling and canning facilities invested in large, powerful blowers. These first generation blowers delivered a tremendous volume of air at low velocity. They accomplished some drying, but their air delivery was too diffuse. As energy prices rose, so did the operational cost of electricity-consuming blowers.

Regenerative blowers or ring blowers remain widely used today. They are inexpensive to purchase and easy to operate. However, they are very inefficient, operating at only 20 – 40% efficiency due to the large amount of waste heat that they generate. A better choice is the use of high efficiency centrifugal blowers. While more expensive to purchase, centrifugal blowers, like the Paxton AT- and XT-series blowers, have efficiencies of 55 – 70%, and system efficiencies to over 90%, so operating costs are reduced substantially.

COMPRESSED AIR

For more targeted drying, many facilities used compressed air. While this solution permits a more specific direction for air flow, compressed air comes with a luxury price tag, using funds most manufacturers would rather focus on areas such as innovation, growth and customer relationships.

Compressed air is often referred to as the fifth utility. Just as in the past when plant personnel may not have focused on water, steam or electricity usage, the same was true for compressed air. Now, however, all utilities, including compressed air, are managed and optimized. It is estimated that poorly designed and maintained compressed air account for up to $3.2 billion in waste utility dollars. And in a recent analysis of compressed air systems, it was found that on average, as much as 55% of compressed air usage is mis-applied – i.e. that compressed air is being used where other air technologies are better suited.

How Air Affects Product Quality

Since the turn of the century, air technology has become increasingly specialized with the development of new tools specifically tailored to the needs of different manufacturing environments. Both blowers and air compressors have become more efficient, and air delivery better engineered. An ideal air delivery system will produce the most fluid power using the least energy, and then deliver it to the target with minimal losses.

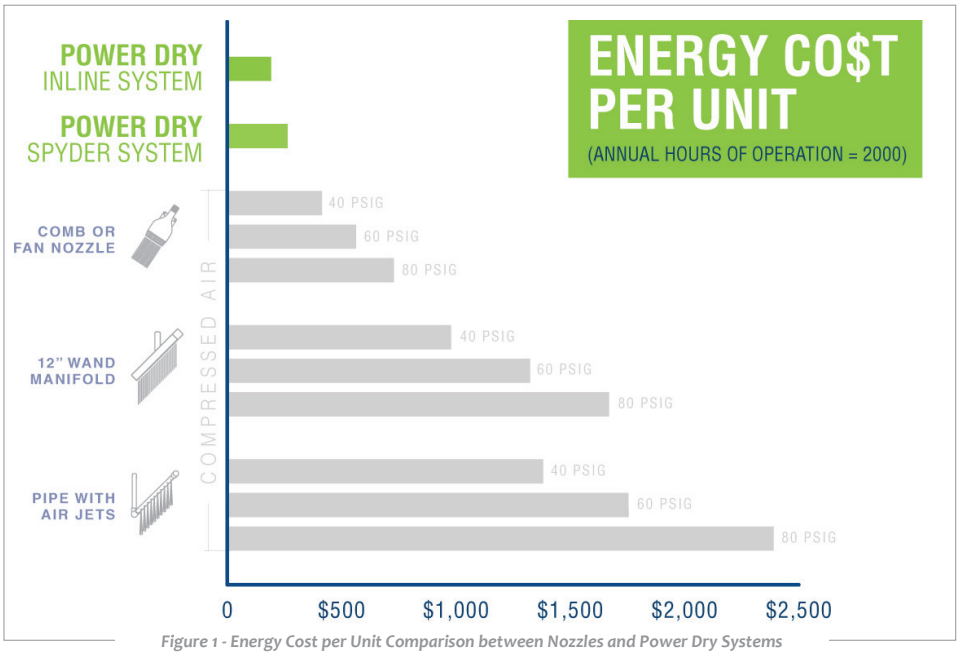


Figure 1 - Energy Cost per Unit Comparison between Nozzles and Power Dry Systems

Drying continues to be one of the major challenges facing beverage and food manufacturers in this decade. Without targeted and effective drying, bottled and canned products can be rejected by distributors, retailers and consumers. However the effective use of air in manufacturing environments requires attention, expertise and engineering. Too much air too forcefully applied can spell disaster. Too little air can leave bottles and cans too damp, promoting the conditions that cause bacterial growth, reducing the quality of labeling and date coding, and affecting the overall aesthetics of the packaging. The use of compressed air or inefficient blowers or fans adds significantly to energy costs, and yet product quality issues may remain due to improperly engineered systems.

Beverage manufacturers cannot afford to lose consumer share due to obsolete production technology. Manufacturing technology must be innovative and effective yet highly durable to withstand the rigors of industrial environments. Technology must offer ease of use and installation and come backed by solid equipment warranties, engineering and design support, as well as strong customer service.

When selecting an air technology vendor, choose a company with the most in-depth understanding of the unique needs of the beverage industry. Ask questions on related to all decision-making points: cost-effectiveness and ROI; design engineering capabilities; service and warranty. Learn the history of the company, what clients it has served and what those clients have to say about the company. Air technology in particular is a highly specialized field requiring specific engineering expertise.

Fluid Power

When evaluating air technologies for drying and blow off applications, the most critical criteria is not pressure to even flow rate, but rather fluid power. The higher the fluid power, the better the drying or blow off. Fluid power is defined as the pressure of the air times the air flow rate:

Power = Pressure x Flow

So low volumes of high pressure air often offer lower fluid power and thus less effective drying and blow off than a lower pressure, high volume air stream.

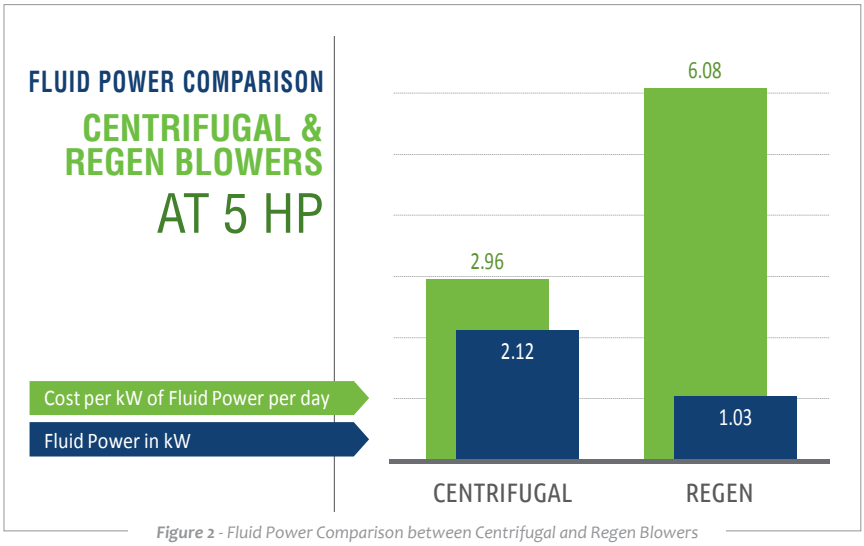


Figure 2 - Fluid Power Comparison between Centrifugal and Regen Blowers

In comparing options for drying and blow off, it is necessary to evaluate the fluid power as well as the energy required to generate fluid power. Let's compare three types of systems commonly used today for blow off and drying:

The regenerative blower, also known as a ring blower or side channel blower, is a direct drive blower. The motor spins the impeller directly, drawing air into an annular-shaped housing. Here the regenerative principle takes effect as the air is spun back towards the base, then thrust outward again. Each regeneration cycle imparts more pressure to the air, until the now high pressure air reaches the outlet and is discharged.

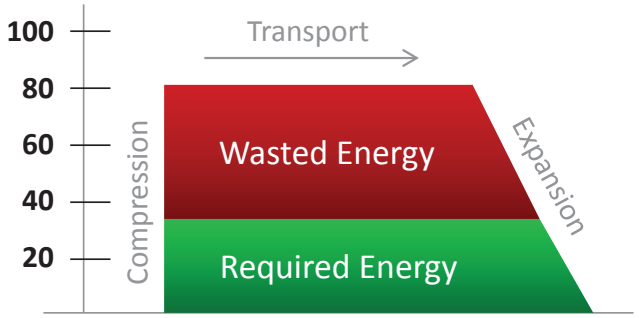
Regen blowers are inexpensive to purchase, but are only 20 – 40% efficient – in other words, a 10 hp regen system will generate only 2 – 4 hp of fluid power, with the balance of the energy used generating waste heat.

Compressed air nozzles, manifolds and pipes: As discussed, the fifth utility in most manufacturing plants, compressed air, is readily available and very effective in drying or blow off. But while it is effective, compressed air is highly inefficient when it comes to energy usage. The majority of energy used is wasted in the transport and expansion of the compressed air from the compressor to the target drying area, as shown in Figure 3, using 5 times the energy to generate the same fluid power as centrifugal blowers.

High efficiency centrifugal blowers were first commercialized for industrial applications in the 1950s, drawing on technology developed for the automotive supercharger. These belt-driven systems amplify the power from a 3600 rpm motor, spinning the blower at up to 18,000 rpm to generate low pressure, high velocity air. These centrifugal blowers are usually 50 – 70% efficient, generating very little waste heat and imparting high fluid power to shear water and debris from the target, effectively and efficiently drying and blowing off.

COMPRESSED AIR

Air reduced in volume and held under pressure. Compressed air systems are typically 10 to 20 percent efficient (80% to 90% of the energy it takes to compress the air and deliver it through a device is lost).



BLOWER DRIVEN AIR

Air which is created by a motor and pulley driven impeller system. Paxton systems are up to 70 percent efficient (Resulting in 5X more output at 1/5 the energy required).

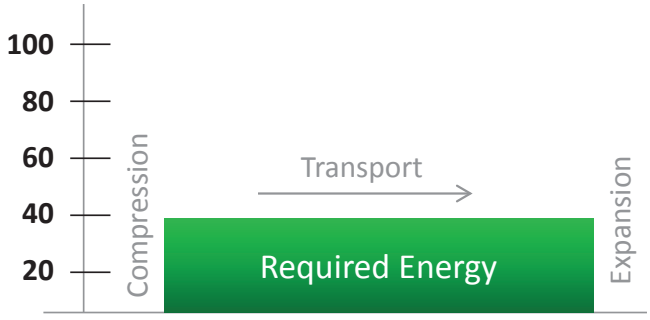
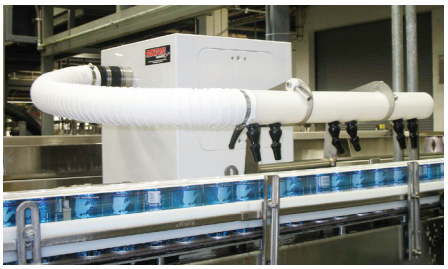


Figure 3 - Compressed Air vs. Blower Driven Air

The Problem: Compressed Air Drives Up Costs at Cola Canning Facility



A leading U.S. carbonated soda facility located in Indianapolis was using compressed air to dry the cans on its production line prior to date coding. On the line at this cola canning plant, 12-ounce, two- piece aluminum cans were filled and sealed on equipment originally installed in 1986. Since filling occurs at 45°F, a hot water spray bath warms cans above the dew point to prevent them from sweating which, inside the multi-packaging, could cause mold growth or score leakers. (Score leakers occur in the gaps in the varnish coating that allow the aluminum in the tab area to corrode.)

Since cans emerge from the warmer dripping wet, they require drying prior to date coding. Until recently, a home-grown compressed air system with three banks of nozzles dried the base of the cans where the code is applied. A trio of disc-style compressed air nozzles was positioned near the exit of the warmer before the 1600 can per minute line splits into two lanes to move cans past inkjet coders. The second and third two banks of compressed air nozzles are positioned to cover both lanes.

"Code quality is one of our big quality focuses," the Manager at the cola canning facility notes. "We have multiple checks and balances to ensure that the correct code is applied. In addition, both lab personnel and operators pull samples every 30 minutes to make sure codes are readable. Our goal is to make the coding process as fail-safe as possible because there is no economical, automated way to verify a code is good. Affordable machine vision systems can verify the presence of a code, but not the quality of the print," he explains, adding, "The first part of obtaining a good code is getting the can dry. "If there is one drop of water, a character or half a character could be missing from the code," explains the maintenance manager, "and that's unacceptable."

"I am almost embarrassed to say how much compressed air we were using to dry cans," recalls the Manager. "It was really high. But we are graded on 'Is the code on the can right?' Compressed air is easy to use, and it works, so we tended to use it even though it's expensive." The company wanted to reduce expenses but was unsure how to cut down on its compressed air usage without sacrificing coding quality.

The Solution

The Indianapolis facility Manager researched newer air technology solutions online and talked with representatives of various companies. He learned that the most effective solution on the market went beyond merely drying the cans. "With the PowerDry system, air velocity physically shears off water rather than evaporating it," Rick Immell, International Sales Manager at Paxton Products explains. "At today's high line speeds, physically blowing the water off the can rather than evaporating it is usually required."

The plug-and-play PowerDry System in Indianapolis consists of a three horsepower centrifugal blower housed in a washdown-compatible polypropylene cabinet, an air tube manifold with six position-able nozzles, and air tubing to connect the manifolds to the blower. Not only do individual nozzles adjust, but the nozzle manifold moves up and down and in and out on a stainless steel arm, to give maximum flexibility for varying line configurations and can sizes. Designed for quick installation, the stainless steel arm can be bolted to the conveyor, and the blower cabinet positioned above or under the conveyor, or as far away as 25 feet. The unit in Indianapolis was fully installed in about 2 hours, start to finish.

The Benefits

"The Paxton unit is what we always thought we needed," says the Manager. "The velocity of the air is the key. Other systems try to evaporate the water; this one blasts if off. It's like washing a car. If you rinse it off and drive at a slow speed, the water just sits. If you drive faster, the water blows off." Despite the velocity of the air passing through the nozzles, the PowerDry System is very quiet. "The only time you hear it is when everything else is turned off," the site Manager reports.

The PowerDry System is also being used at filling plants throughout the world. The maintenance Manager comments, "With the kind of energy savings we experienced, the PowerDry unit paid for itself in less than a year. We're working with Paxton now on replacing compressed air drying in other areas of the plant."

The PowerDry System is also being successfully used on lines running PET bottles for soft drinks and water. And although coding applications were the impetus for the design of the PowerDry System, "The unit has much broader applications like prior to labeling or to blow off debris," says Immell. "Basically," he concludes, "it can replace compressed air for any kind of spot drying or blow-off cleaning application."

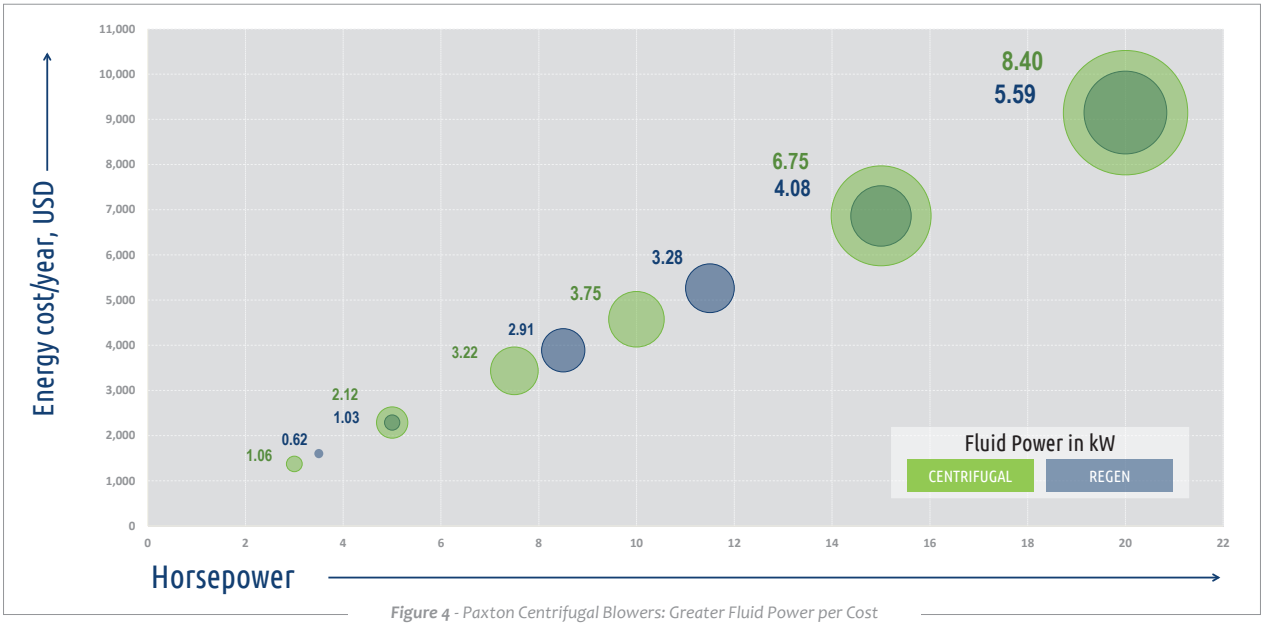


Figure 4 - Paxton Centrifugal Blowers: Greater Fluid Power per Cost

The Problem: Label Slippage Resulting From Lack of Air Tools at a Brewery

Graduating from successful local microbrewery to becoming a major regional brewery was an important turning point for Yards Brewing in Philadelphia, PA. However, the expansion brought new challenges as well as increased opportunities.

At the same time that demand for Yards' products grew, so did the company's need for better bottling technology. Bottles were moving through the bottling line without being dried first, and the resulting wet bottles meant a high rejection rate due to the labels not sticking to the bottle, and/or not getting them on straight. The rejection rate varied with humidity: as high as 25% during the summer but significantly lower during winter months.

When rejected bottles were re-circulated through the labeler, extra time and labor were required as brewery employees had to peel off the partially applied labels before putting the bottles through the line a second time.

The Solution

Yards Plant Engineer Daniel Dolan contacted his equipment supplier, Evco Industries, for advice on dealing with the problem. After determining that the issue was not poor quality adhesives but insufficient drying of bottles, Evco recommended the best drying solution on the market: Paxton's PowerDry.

Evco's problem-solving experts designed a customized PowerDry solution which fit the brewery's needs and the size of their operations. Evco project managers suggested a Spyder version of Paxton's PowerDry system. This ensures that the 110 bottles which move through the production line per minute are thoroughly dry so that Yards' two bottle labels, one on the neck and the other on the body, adhere properly to the glass.

The Benefits

Yards Plant Engineer Daniel Dolan was impressed with the ease of installation of the Paxton system as well as the results it delivers. Dolan states, "We installed the blower and enclosure underneath the accumulation table, with a top outlet. The spyder manifold we positioned above the single line conveyor, just before the bottles enter the labeling machine. It takes up almost no space at all—which is pretty impressive considering how effective it is. We used to deal with a lot of wasted time and aggravation from the wet bottle problem. I wasn't sure if that problem could be solved without an enormous and expensive piece of equipment but this dries them comprehensively."

Dolan was also impressed at the PowerDry system's low maintenance demands: "A lot of times, when you get more technology in a plant, you have to pay for it with more work keeping the system running. But the PowerDry doesn't create any extra hassles like that. This system is great, even better than we expected."

The Bottom Line: ROI

Thanks to more sophisticated engineering, the newest generation of air systems targets the product with high velocity air, shearing water from the surface. The emphasis on custom engineering for efficiency, means manufacturing plants using these new air products utilize anywhere from 60% to 80% less energy. This energy savings means return on investment typically takes place within 6-18 months.

Conclusion

For more than 50 years, air products have played an important role in facilitating the growth of the beverage industry. The newest generation of air products enables beverage companies to gain a technology advantage which delivers faster and more efficient production lines as well as reduced energy costs at manufacturing sites. By eliminating unnecessary production costs as well as lag time on the line, beverage companies are better positioned to win a larger share of consumers in an increasingly competitive beverage marketplace.

Who We Are

Paxton Products has been the industry leader in air delivery solutions, services and products for more than half a century. Paxton Products is part of the globally recognized Illinois Tool Works (ITW), a Fortune 200 company located in Chicago, Illinois. For over 50 years, Paxton Products has provided superior products, unmatched engineering expertise and an industry-best 3-year blower warranty with a 100% performance guarantee.

Paxton Products is proud to have worked closely over the decades with its beverage clients, which include soft drink manufacturers; breweries; and producers of fruit juices, soy-based drinks, teas and other beverages. Our air technology engineers have made intensive on-site studies at beverage plants to analyze the realistic day-to-day concerns of facilities managers and create realistic, workable solutions to these challenges. We understand the needs of both large and small beverage bottling and canning facilities, having worked with clients of all sizes from multinational corporations whose products are household names to small, growing companies just establishing themselves as a regional presence.

A pioneer in the development of air-knives and widely regarded as an expert in air flow systems and solutions, Paxton has refined today's air-knife designs for "precision-drying," coating control, removal of dust and other unwanted materials, as well as air curtains and other drying applications. And for applications where an air curtain may not reach nooks and crannies in the product which can retain water, Paxton has designed a full line of custom manifold systems to dry all shapes, and sizes, including kegs, crates and other irregularly shaped materials. Paxton Products' technical application engineers have decades of experience and will design and engineer the system for optimal performance, balancing the blower system with the best combination of air knives and nozzle manifolds.

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