

## FUJIFILM Hunt Chemicals U.S.A. Achieves Compressed Air System Energy-Reduction Goals with a Three-Phased Strategy

In an attempt to eliminate equipment failures and downtime issues associated with the plant’s compressed air system, FUJIFILM Hunt Chemicals U.S.A.’s in-house maintenance team worked with a team of faculty and students from the Tennessee Technology University Industrial Assessment Center (IAC) to conduct an assessment at its Dayton, Tennessee, facility to identify opportunities for improvement. Following the assessment, the team formulated an implementation plan that would increase the system’s reliability, reduce system maintenance costs, reduce the facility’s overall energy use, and eliminate the use of nitrogen when compressed air systems are down.

### The Dayton, Tennessee, Facility

FUJIFILM Hunt Chemicals U.S.A. (FUJIFILM) is a wholly-owned subsidiary of FUJIFILM Corporation. The company’s Dayton, Tennessee, manufacturing facility produces fine and specialty chemicals, with products ranging from high-performance antioxidants and ultra-violet stabilizers for plastics, to battery sealers, to etching acid blends. Employment at the 120,000-square-foot site ranges from 70 to 85 workers, including highly experienced engineers, production operators schooled in International Organization for Standardization (ISO) 9001 and 14001 requirements, and a fully staffed analytical lab for in-process testing and technical support. Energy use at the Dayton plant costs the company approximately \$897,000 a year (electric and natural gas).

The manufacturing facility consists of two independent production plants and three main production lines. Each plant has individual meters for utilities and support facilities. Manufacturing operations are conducted 24 hours a day (operating two 12-hour shifts)—the only time the facility ceases its operations are during scheduled maintenance shutdowns. These operations are supported by the facility’s maintenance department, which operates one shift, five days per week.

### The Energy Situation

The Dayton facility was experiencing excessive downtime due to chronic air compressor failures and significant inefficiencies throughout its compressed air system. In 2007 alone, system operating costs totaled over \$45,000,



with maintenance and repair costs exceeding \$17,000. The problems FUJIFILM was experiencing were also causing frequent interruptions in the facility’s production operations.

Due to the nature of these operations, the facility could not afford to experience the downtime required to complete compressed air system maintenance. The facility was depending on a backup operating system that relied on the utilization of onsite nitrogen, which is normally reserved for processing flammable materials. While maintenance staff were certified in both quality- and environmental-management systems—ISO 9001 and 14001 standards, respectively—they lacked the parts and system expertise needed to effectively support the compressed air generating equipment.

Exhibit 1

Additional Costs Incurred with Old Compressed Air Scheme	
<i>Maintenance</i>	<i>\$1,296</i>
<i>Nitrogen Backup</i>	<i>\$7,921</i>
<i>Repair</i>	<i>\$7,877</i>
<b>TOTAL</b>	<b>\$17,094</b>

Furthermore, the frequency of equipment failures indicated inherent and systemic inefficiencies, including unutilized capacity generation and overstated requirements. These issues led the facility Maintenance Manager, Manuel Calero, and his team to partner with the Tennessee Technology University IAC, sponsored by the U.S. Department of Energy’s Industrial Technologies Program (ITP), to conduct an overarching assessment of the Dayton facility’s compressed air system. ITP’s IAC program provides eligible small- and mid-sized manufacturing plants with no-cost energy assessments. In 2008, a team of engineering and technology students and faculty from Tennessee Technology University visited the Dayton plant to conduct the compressed air system assessment to identify potential savings opportunities.

## Developing a Baseline

The IAC and in-house maintenance team's first step was to baseline the system's demand-side air requirements to determine the system's actual efficiency. The site's original compressed air system scheme consisted of two Ingersoll Rand air compressors, located in Buildings 1 and 6.<sup>1</sup> Compressed air in these buildings was used in a variety of processing operations that facilitated material delivery through a system of pipelines. Major uses of the air included the operation of pneumatic control devices, such as actuator valves and cylinders, and liquid transfers via air diaphragm pumps to appropriate storage tanks. These transfer rates were critical to maintaining quality in both the process and product.

To establish the baseline, the IAC team calculated the cost of air production; gathered initial measurements of energy, flow, pressure, and leak load; and estimated energy consumption, which was then correlated to the appropriate production levels. The team also conducted energy surveys with the assistance of Ingersoll Rand. This effort required connecting amp and flow meters to each compressor for five days. This allowed the facility to accurately assess energy versus standard cubic feet per minute generated and used.

Results of the assessment showed that both facility compressors were set to run at 120 pounds per square inch (PSIG), but were only delivering between 90 to 95 PSIG at point of use (POU), and were, at times, dropping as low as 80 PSIG. Additional findings demonstrated that higher air use was occurring during transfers—as opposed to reactions—and that the system's air use was cyclical, depending on production. It was also confirmed that Production Line 1 had excess capacity.

The compressed air distribution system also contained significant leaks. A concurrent review of existing system dryers indicated subpar performance and explained undue levels of moisture in the system. Most importantly, though, the data indicated that the Dayton facility could be operated using only one compressor.

## Compressed Air Energy-Reduction Strategy

### Project Goals and Implementation

Following the IAC assessment, FUJIFILM's maintenance team formulated project goals and an implementation plan that centered on the utilization of existing facility infrastructure and equipment. The team's implementation strategy was divided into three phases and focused on increasing the system's storage capacity to handle production peaks and valleys; lowering air compressor operating pressure; repairing

system leaks; and ultimately, operating the facility with one compressor. The team's strategy was also aided by the company's closure of its Orange Park, Florida, operations. This facility housed a 75 horsepower (HP) air compressor, a dryer, and a receiver, which the Dayton facility incorporated into its efforts.

Project success, then, depended on the accomplishment of four specific goals:

- To increase system redundancy, therefore increasing system reliability
- To reduce system maintenance costs
- To reduce overall facility energy use
- To eliminate the use of nitrogen when compressed air systems are down.

### Phase I

Phase I was justified using maintenance-cost-reduction estimates. Labor was billed as a maintenance expense to the existing budget. During this phase, the facility installed Orange Park's 75 HP air compressor in Building 5, a receiver in Building 6, and a 2-inch airline from Building 5 to Building 6. The 60 HP air compressor in Building 6 was then shutdown for repair and established as a backup unit. The building's piping was also combined with its heat installation. Phase I was completed in May 2008.

### Phase II

The Dayton facility justified Phase II to FUJIFILM Corporate by utilizing total project energy-saving estimates. During this phase, piping was installed from Building 5 to Buildings 1 and 6, and an additional receiver was installed in Building 1. The existing 50 HP air compressor and dryer in Building 1 were shutdown for maintenance and repair and established as a backup unit. This established the 75 HP air compressor in Building 5 as the facility's central unit. Phase II was completed in March 2009.

### Phase III

During Phase III, the maintenance team developed and implemented a Leak Detection and Repair (LDAR) program (completed in the fall of 2009), and developed a quarterly preventative maintenance program to repair system leaks and reduce the amount of compressed air losses.

Additionally, the facility gathered data that indicated a 2 PSIG drop in pressure resulted in a 1% reduction in cost. The team reduced compressor set pressure to 105 PSIG, which resulted in POU delivery of 98 PSIG.

<sup>1</sup> TBuilding 1 houses a 50 HP Ingersoll Rand air compressor. It is 8,250 square feet and was built in 1984. Building 6 houses a 60 HP Ingersoll Rand air compressor. It is 21,000 square feet and was built in 1999. Both buildings are used for the production of chemicals and Building 6 (where the majority of facility production is processed) has mezzanines for reactors that use flammable and combustible liquids.

## Exhibit 2

Estimated Savings of Energy Efficiency Improvements				
<i>Recommendation</i>	<i>Conservation (-/yr)</i>	<i>Savings (\$/yr)</i>	<i>Implemented Cost (\$)</i>	<i>Simple Payback (months)</i>
<i>Establish LDAR program</i>	<i>120,832 kWh</i>	<i>\$9,100</i>	<i>\$2,500</i>	<i>3</i>
<i>Eliminate Use of Nitrogen in Compressed Air</i>	<i>-</i>	<i>\$8,200</i>	<i>-</i>	<i>-</i>
<i>Install More Efficient Compressed Air System</i>	<i>292,283 kWh</i>	<i>\$21,980</i>	<i>\$27,800</i>	<i>15</i>

## Conclusion

The decision to implement a comprehensive, compressed air system energy-reduction strategy at the FUJIFILM Dayton, Tennessee, manufacturing facility has saved the company nearly 1,240,976 kilowatt hours since the project's initiation in 2008.

Since implementation, the facility has not only reduced energy use and operating costs, but has also eliminated most of the downtime associated with its compressed air system. Mr. Calero states that, "We have been able to improve the preventative maintenance of our equipment. The equipment operates more efficiently because it is properly maintained... We have been able to lower operating pressures without affecting any part of the operations." The Dayton facility achieved its project goals and continues to operate using only one air compressor. In May 2010, ITP formally recognized the

plant's efficiency achievements with an Energy Champion Award. The Dayton facility was one of 56 awardees, having realized more than 250,000 million British thermal units in energy savings or more than 15% total energy savings.

Further, Dayton is sharing its best practices with other FUJIFILM plants, as well as other industrial stakeholders in its region. Results of the facility's efficiency efforts were presented to the company's North America Energy Managers and highlighted in the company's worldwide publication, "FUJIWorld." Additionally, project information was shared with other manufacturers in the region at the Southeast Energy Efficiency Alliance (SEEA) Industrial Coalition session held in Chattanooga, Tennessee, in May 2010. SEEA is an Atlanta-based, nonprofit organization that promotes energy efficiency in the southeast region of the United States through networking, program activities, and education.