3M COMPANY



CODY HUEDEPOHL

MECHANICAL ENGINEERING, IOWA STATE UNIVERSITY



COMPANY BACKGROUND

3M Company is a global technology company delivering innovative solutions to life's everyday needs. 3M Knoxville serves customers through six business segments with operations in more than 65 countries. Production began in 1975 at the Knoxville, Iowa facility, which currently employs approximately 550 people. Various types of tapes and adhesives used in commercial, industrial and consumer applications are manufactured at the 600,000-square-foot facility. Products include acrylic foam tapes, transfer tapes, window films for commercial, home and auto uses, diaper fastening systems and laminating adhesives.

PROJECT BACKGROUND

Air conditioning is vital to product quality assurance. Air handlers are utilized throughout the plant to maintain constant temperature and humidity levels. Most of the 74 air handlers are original to the plant. Currently, no inspection plan is in place to monitor performance or track maintenance. Optimizing the operating efficiency of the air handling units could significantly reduce energy usage and the associated utility costs.

3M is committed to actively contributing to sustainable development through environmental protection, social responsibility and economic progress. High standards in safety, health and the environment are top priorities in this facility. Over the years they have implemented 80 improvement projects that have prevented 30,000 tons of air pollution and 18,000 tons of solid waste.

INCENTIVES TO CHANGE

The air handlers are one of the largest energy consumers in the plant. There have been significant improvements in HVAC controls since the units were installed in 1973. New controls would ensure operational efficiency and could track the performance of each air handler. Increasing the air handlers' efficiency would reduce the demand on the boilers and chillers, extending the lifetime of this equipment.

RESULTS

The intern inspected all of the air handlers and recommended the following four strategies to increase the efficiency of each unit.

Reduce Wasted Heat: Each air handler was inspected during the summer, so they were in cooling mode. It was discovered that preheat coils were still heating the air in some units. This significantly reduces efficiency because it requires energy to heat the air, which must then be cooled back down. Currently, the chillers reach capacity on very hot summer days. Eliminating this additional cooling demand would significantly reduce the load on the chillers. These units also utilize a large amount of reheat to maintain a constant zone temperature and humidity level. Controls could be redesigned to improve the efficiency of this process.

Implement Scheduling: A majority of the plant requires conditioned air 24 hours per day, seven days per week to maintain the product quality. Some areas of the plant and offices are unoccupied during the nights and weekends. Integrating zone schedules into the system controls could considerably reduce equipment run times.

Utilize Free Cooling: Many of the plant's air handlers use both outside air and return air from the zone. An actuator controls a damper on each duct to adjust the amount of



PROJECT	ANNUAL COST SAVINGS	ENVIRONMENTAL RESULTS	STATUS
REDUCE WASTED HEAT	\$130,000	1,600,000 KWH 108,000 THERMS	IN PROGRESS
IMPLEMENT SCHEDULING	\$21,000	430,000 KWH 5,700 THERMS	RECOMMENDED
UTILIZE FREE COOLING	\$17,700	444,000 KWH	RECOMMENDED
INSTALL VFDS ON FAN MOTORS	\$32,750	818,500 KWH	RECOMMENDED

each type of air supplied to the air handler. Few of the air handlers adjust the amount of outside air supplied. An economizer control would measure the enthalpy (energy) of each air stream and determine which one is easiest to cool. As the temperature outside decreases, cooling becomes easier and eventually the outside air cools enough to supply the plant with free cooling. If this control were implemented, the plant could utilize free cooling during most of the spring and fall, which would significantly reduce the load on the chillers.

Install VFDs on Fan Motors: A variable frequency drive (VFD) adjusts the speed of a motor by reducing the power supplied. As the speed of the motor is reduced, the power consumed is reduced to the third power. VFDs installed on most of the air handlers could significantly reduce electrical usage.

CONVENTIONAL AIR POLLUTANTS AND GREENHOUSE GASES DIVERTED IN STANDARD TONS

Total for all sectors							
CO ₂	SO ₂	CH ₄	N ₂ 0	CFC	PM-10		
1700.69	8.01	161.65	0.35	18.61	0.19		

