Advanced Extrusion

Tiger Rost
Aerospace Engineering,
University of Minnesota Twin Cities

Company Background

Advanced Extrusion is a business to business supplier of rolls of polyester for the thermoforming and laminating industries. Material such as polyethylene terephthalate (PET) is extruded into sheets that are used to produce food packaging. The company out grew a plant in Becker, MN and moved to a 190,000 square foot facility in Rogers, MN. Sixty-eight employees manufacture over 30 million pounds of polyester sheet annually.

"Addressing energy usage helps not only our clients save money, but helps keep the energy use in our state sustainable. Looking through the opportunities, I believe not only the intern, but people at the company walk away with a new perspective on how important it is to save energy. What is really exciting is that often people will start coming up with their own ideas and suggesting improvements long outside the scope of the internship, and that's the kind of thinking needed to be good stewards of our environment." ~ TR

Project Background

Plastic extrusion is an energy intensive process. Advanced Extrusion receives pelletized material which often requires crystallization and drying for several hours at temperatures from 200° F to 350° F. A vacuum system conveys material to blenders before being sent to one of seven extruders. Extruders use heat and pressure to force the material through a screw, a die and on to rollers to form a sheet. This sheet is then quickly cooled and wound up into rolls. Electricity and natural gas are used through these steps. Opportunities to use energy more efficiently were a focus of this project.

Incentives to Change

The plant spent over $1,000,000 on electricity in 2016. The company anticipates increasing production needs and is looking to continually improve the manufacturing processes. Increased efficiencies can allow them to remain competitive in the market and increased throughput will allow them to meet the future demands of their customers.

"Advanced Extrusion has many motivations to change our current energy demands. The first is to reduce our energy footprint and become more responsible consumers. As the company has grown, our electricity usage has increased two-fold. We also want to reduce our monthly energy bills and use the savings for process improvements, and capital expenses, in order to maximize profit."
~ Brandon Eid, Process Engineer, Advanced Extrusion

Solutions

Update Lighting

The existing 32W fluorescent lamps are planned to be converted to 15W LEDs. Motion sensors could be added to further reduce lighting hours and lower the baseload energy use. Battery packs are being added to selected fixtures to act as emergency lighting during power outages. These opportunities are being implemented which will reduce 362,7,00 kWh of electricity, saving $29,000 with a 1.8 year payback.

Fixing Heat Losses and Leaks

Compressed air leaks, material conveying systems gaps and drying/crystallization equipment heat losses lead to increase electric load. Addressing these specific issues in the systems will save 1,153,000 kWh of electricity, saving $92,400 with a payback under 5 months.

Switch to Efficient Motors and Drives

A detailed motor inventory was documented for the plant. A plan was developed to replace some motors with more efficient motors, convert extruder motors from DC to AC, and add variable frequency drives to certain motors. Adding controls and sensors to the grinding operation could reduce the electric use in that department. Motor system improvements would improve the power factor for the facility, save 2,086,000 kWh of electricity, save $178,000 and have a 6 month payback.

Change Production Settings

Making adjustments to its dryer cycle times and crystallization temperature settings to reduce the energy use per pound of material was suggested. There is some concern that product throughput may be reduced. Lengthening the regeneration cycle of the dryer beds and lowering the crystallization temperatures could save 487,000 kWh and $39,000. Gradually changing the settings over time will allow for monitoring of product quality and throughput.

Miscellaneous Upgrades

- Improvements to the dust collection system would result in increased safety, improved housekeeping, and a lower defect risk. By improving dust control, worker conditions improve and the frequency of extruder screen changes will likely be reduced.
- Electric curtailment does not change energy consumption, but results in an estimated $62,600 annual cost savings by agreeing with the utility to reduce electric use during peak demand periods.
- Alternative fuel modifications could reduce electric usage and costs while facilitating curtailment options.

Equipment Upgrades Needing Further Evaluation

Two large capital suggestions were also studied. Purchase of high vacuum twin screw extrusion equipment would eliminate the need for drying and crystallization. This equipment would improve throughput and reduce the relative production energy use. Adding PET compounding at the facility instead of buying processed materials could improve the overall process efficiency and save money despite using more energy. Compounding in-house could save $9,000,000 and extrusion equipment purchases could save 5,000,000 kWh of electricity and $400,000 annually.

Recommendation	Annual Reduction	Annual Savings	Status
Lighting	362,700 kWh	$29,000	In progress
Heat losses and leaks	1,153,000 kWh	$92,400	In progress
Efficient motors and drives	2,086,000 kWh	$178,000	In progress
Changing production settings	487,000 kWh	$39,000	Recommended
Miscellaneous upgrades	0 kWh	$256,000	Recommended

MnTAP Advisor: Paul Pagel, Senior Engineer