Improving Productivity Without Talking to Your Banker

Keeping your banker happy is unusually difficult when credit is tight, sales are slow and foreign competition is growing. Your factory is the engine that generates cash for your business. When business is good, we focus on increasing production rates. When business is slow, we need to focus on improving production efficiency. The most expensive component in film and sheet manufacturing is the raw material. The second most expensive cost component is energy.

There are two common sources of inefficient raw material usage in factories. Scrap is product that cannot be sold. Excessive gauge or layflat variation results in lower yields. The following list is some strategies to improve raw material usage.

Reduce Product Changeovers

When a factory is not working at maximum production capacity, you have more options when scheduling production. It takes a long time to change products, particularly when it involves changing colors. Make sure you know how long it takes to change colors on a line. It may be better to dedicate certain lines to specific colors, even if it means running slower than normal. Keep in mind that running slower often improves gauge variation, bubble and web stability as well.

Maintain Your Instruments

A common problem as lines get older is that instruments break and are not replaced. For example, magnehelic pressure gauges on air rings and internal bubble cooling systems (IBC's), temperature gauges for air rings, melt temperature and air cooling coils, extruder motor amperage, haul-off nip pressure etc. These instruments allow operators to fine tune production conditions so that consistent quality product is made each time.

One diagnostic tool that is frequently ignored is a traversing melt temperature probe. The probe is usually installed in the melt pipe between the screen changer and the die block. The correct procedure when using this instrument is to push the probe across the channel until it touches the opposite wall of the internal flow channel. Readings are taken at equal distances (usually each rotation of the thumbwheel) until the probe is in the full out position. This procedure lessens the risk of bending the probe if it is left in the melt stream for too long.

Focus on Housekeeping

Dirt inside dies causes Transverse Direction (TD) gauge variation. A common mistake is to strip the plastic off the die lips when the line is shut down. The plastic inside the die lips is then exposed to heat and oxygen during the start-up procedure. This plastic degrades into hard carbon that is difficult to remove. The resulting die lines can often take 30 minutes to wear off. Leaving some plastic on the die lips during shutdown will minimize the formation of die lines. The plastic that is exposed to air will burn (carbonize) during start-up, but little oxygen will get into the hard to reach die gap.

A gradual build-up of dirt inside air rings and IBC stacks can also affect TD gauge variation. One common mistake is to spray silicon oil onto the air ring lip set. Some of this oil can drip into the air ring gaps and freeze, resulting in uneven cooling around the bubble.

Surfaces that contact the film must be kept clean of sticky residue. Bubble sizing cages will destabilize the bubble and force the operator to move the cage away from the bubble. Idler rollers in collapsing frames, towers and winders will cause transient web tension pulsations that will create wrinkles in the web.

Dirt will gradually build up inside blower, cooling coil and motor cooling fan filters. Build-up of oily residue inside IBC exhaust ducts will gradually reduce the air exchange rate and cooling capacity of the IBC system. In extreme cases, it will be difficult to control bubble stability. Output capacity of

most blown film lines is limited by the bubble cooling capacity, so these blockages will reduce output capacity over time. Clean air ducts at least once every 6 months.

Heat exchange coils become encrusted with mineral deposits that reduce heat exchange efficiency. The most common problems occur in extruder throats, water cooled barrel heaters and air cooling coils. Monitor the outlet temperature and clean the circuit when required.

Monitor Energy Consumption

Energy is expensive, so use it efficiently. Insulate long melt adaptor pipes and air exchange pipes. Not only will this save energy, but it will reduce gauge variation. Uninsulated melt adaptor pipes may create melt temperature variation that the die must randomize. Uninsulated air ring hoses heat up the air before it reaches the air ring, even if unchilled air is used. Air ring hoses should all be the same length and insulated. Make sure none are too close to hot metal such as screen changers. If you can feel differences in the temperature around the air ring chamber, then the frost line will be uneven around the bubble. This will result in gradual changes in TD gauge. Check and seal air ring, air ring and IBC hoses. These leaks will reduce cooling effectiveness.

Screen changers are designed to reduce downtime. Pre-heat the breaker plate and screen before placing them into the slide plate. Cold breaker plates chill the melted polymer, producing unmelted gels that must be purged from the die before starting a new production roll. This can take 15 minutes. One popular technique is to expose the breaker plate and screens, replace only the screens, and slide both the new screens and old breaker plate back into position. This technique also reduces the risk of scoring the screen changer flanges if the breaker plate is not seated correctly. It is advisable to change the breaker plate when changing colors because some pigment may get hung up in the breaker plate and take a long time to purge.

Moisture in resin can result in hollow gels, even with non hydroscopic resins such as polyethylene and polypropylene. A common problem in winter is condensation when resin from unheated silos arrives at the feed throat. Let the resin warm up in a gaylord next to the extruder instead of using a dryer.

Extruder motors consume the most amount of energy in an extrusion line. Make sure DC motors have brushes that are not worn out. Watch the motor amperage and make sure the motors are not overheating, especially at slow speeds. Although some new lines have AC motors connected directly to the screw, most still use gearboxes to maximize the rotation speed range. Other motors that turn chill rolls, nip rolls or winder components also use gearboxes and belt or chains. Make sure these connections are not loose or worn out. This will increase energy consumption and cause subtle variations in speed that will affect the Machine Direction (MD) gauge variation. Remember to maintain gearboxes at the temperature recommended by the supplier. Gearboxes that are too hot will accelerate gear wear. Too cool will force the motor to expend more energy than necessary to maintain the correct speed.

Speed and temperature are typically maintained using PID (proportional-integral-derivative) controllers. These controllers must be tuned whenever a component is replaced, such as a thermocouple or heater band. Improperly tuned controllers will destabilize the process, and usually increases MD gauge variation.

Take Advantage of Slow Time

Extruder screws and barrels wear over time. The symptoms of screw wear are well documented. Consider rebuilding a screw when you lose 15% of your pumping capacity or mixing is insufficient. Repairs could take 2 to 3 weeks to complete, so schedule it when you have spare capacity if possible.

Shifting from a gradual increasing to humped or reverse temperature profile may compensate for small amounts of screw wear.

Idler rollers are a common source of web tension fluctuations that can magnify small gauge variation into large wrinkles, edge wander and deformed rolls. Start at the winder and follow the film back to the die. Look for positions where wrinkles appear and fix bent or misaligned rollers.

Plan Ahead

As a general rule, it makes economic sense to replace an air ring lip set every 5 to 7 years, even if it is undamaged. Compare the performance guarantee of a new lip set from the same manufacturer to your old one. Look at other suppliers as well before you decide to update or completely replace the air ring. Consider buying an air ring that can be upgraded to automatic gauge control if you plan to replace it. Automatic gauge control will reduce TD gauge variation by about 50%. You may not be able to justify it right now, but it may change in the future.

The addition of a second air ring above the first one can increase bubble cooling capacity by 30%. It can also improve film properties if you choose the right extrusion conditions. In blown film extrusion, external haze tends to be reduced when the frost line is high. MD tear strength and dart impact can improve as well.

Gear pumps are becoming popular in film lines because they allow the extruder conditions to be optimized to melt and homogenize the formulation. A gear pump allows colder melt to be pushed through the die at competitive output rates. A more homogenous melt at the die lips results in better quality film and more output capacity.

Many options that was very expensive only decade ago are now much more affordable. Three of the most popular upgrades are oscillating haul-off nip assemblies, composite carbon fiber roller collapsing frames and internal bubble cooling systems. There is a lot of used equipment that may be available. Remember that maintenance is one of the first budgets to be cut back when cash flow is tight, so be prepared to spend time and money repairing used equipment if you buy it. Air rings and IBCs that are more than 10 years old are usually not competitive with new systems.

Do Not Hesitate to Ask for Help

Where do you begin? If you are not sure, consider an independent audit of your factory. Your equipment and raw material suppliers can often recommend someone who can help. Remember that equipment is only one part of the equation. If you do not have a formal in-house training program, consider looking to outside sources. The cost is usually not expensive and well worth the effort.