

MODERN EXTRUSION COATING EQUIPMENT FOR EFFECTIVE COST REDUCTION

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ABSTRACT

Cost is on everyone's mind because it can mean the difference between a successful business and one that fails. Virtually every plant keeps track of cost in one form or another. This effort is often part of an overall quality program to ensure the product is being produced as planned. In most cases, these programs result in continuous improvements of the existing process, but they seldom look beyond the inherent limitations of the process. This paper addresses some of those accepted limitations by pointing out the costs associated with them and how new technology can be a cost effective method of increasing your productivity. The basic extrusion coating line will be broken up into specific sections and examined. Not only will the most cost-effective solutions be presented; possible negatives for each will be mentioned such that each individual can evaluate the feasibility of these solutions.

INTRODUCTION

What Contributes to Unnecessary Cost of Extrusion Coated Products?

The most visible type of waste is the unusable product roll that comes off a winder. There are many different reasons for this. For example, gauge bands that create high spots and an uneven finish on the roll. Web handling problems that can create many different types of wrinkles in the final product. Poor web tension control or lack of guiding that can result in starring or ends that are not square. Problems of roll formation are fundamental to the successful operation of any extrusion coating line and as such will not be discussed in this paper. What needs to be examined are other types of waste that contribute to the cost of the product. Some of these are edge bead, edge trim, splice tail waste and scrap at finished roll transfer. These types of material waste are commonly accepted as a part of an extrusion coating process.

Other types of waste in this process are known as hidden waste. Downtime, set-up time and handling are examples of hidden waste.

Downtime is a result of something in the machinery or process that causes the machine to be stopped until the problem is fixed. There are some key questions that can be asked to easily pinpoint problem areas. Is there one particular part that always seems to break, wear out or need maintenance? Are there any parts that need to be cleaned more than others are? In other words, can a common or frequent cause of downtime be identified? If the answer is yes to any of these questions, here is an area where new parts or techniques could help reduce costs.

Set up time is the time needed to get the machine running good quality product. This could be thread up time, die bolt adjustment time, slitter adjustment or edge guiding adjustment. It also includes tension and draw adjustments as well as nip loading adjustments. Even preparing for different QC checks can take time. Many necessary activities reduce the available productive time of the machine, creating hidden waste.

Handling time for a product is the number of times that the product has to be processed. For example, a product may need to be run through an extrusion coating line twice to coat each side. After this, it may be taken to a slitter winder to be slit into final widths. If the final product includes printed materials, this is done on yet another line. These types of handling may be greatly reduced by combining processes. This could include in line printing, in line slitting or tandem coating. However, one should keep in mind that

increasing the functionality of a line can result in more downtime and longer set-ups. Care must be taken not to overly complicate the process. Equipment reliability and computability must be considered.

Economics of Producing Extrusion Coating/Laminating Products

Examining a typical extrusion coating product, the product cost can be divided into three separate areas. The first is material cost. The easiest measurement of material cost is cost per unit weight. The resin portion of this cost is the ratio of the saleable resin produced divided by the resin used multiplied by the resin cost. This ratio accounts for all losses including off line drool.

This formula is:

$$\text{Resin cost} = \text{Resin Price} \times (\text{Amt. of Resin Produced} / \text{Amt. of Resin Used})$$

For example, a resin costs \$1/lb. If 50,000 lbs are used and 45,000 lbs are the resulting usable amount of resin, the actual resin cost is $(\$1/\text{lb} \times 50,000 \text{ lb} / 45,000 \text{ lb}) = \$1.11/\text{lb}$. The cost of the resin can be added to the cost/ weight of any other materials used in the structure to obtain the total material cost/ weight.

The next step is to compute the machine cost. Since the material cost is measured in cost per unit weight, the machine cost should use similar units of measure. This value should consist of the cost of labor and benefits for the operators, the amount of set up time for the product being calculated, the total number of run hours for the product and the throughput in kg/hr.

The last cost for an extrusion coating product would be termed allocated costs. These costs are for utilities, maintenance, operating supplies and other miscellaneous costs associated with production. Dividing these costs by the number or hours of operation over which they were incurred will result in a cost/hr. value. This value is then divided by the throughput in kg/hr to yields the cost per unit weight.

As an example, the product cost for toothpaste tube stock was analyzed¹. The raw material cost was \$0.950/lb, machine cost was \$0.075/lb and allocated cost was \$0.005/lb. Total cost was \$1.075/lb. Analysis of this example calculation shows that of the total cost, 88% is resin and materials, 7% is converted costs and 5% is indirect costs. These numbers are just an example of how to determine costs of extrusion coating products and are meant to demonstrate that most of the cost is material related. Therefore, the biggest target area for improving the overall economics of the operation should be resin and material waste reduction.

DISCUSSION – COST AND WASTE REDUCTION OPTIONS

Waste Reduction – Resin Related Structures & Coextrusion

Resins that have very specific purposes in Extrusion Coating/Laminating are usually expensive. Examples of specific purpose resins are resins that bond to foil, provide better control of oxygen or water vapor transmission, provide odor protection, provide a more printable or metallizable surface or improve sealing properties. Specific purpose resins are usually combined in a process called coextrusion. Coextrusion is a process that extrudes several layers of plastic at once. These layers usually consist of adhesive or tie layers to promote bonding of adjacent layers of plastic. This provides a way to get the properties needed in a product while lowering resin costs.

As an example of cost reduction, let's look at one of the main barrier resins, EVOH. Flexible barrier packaging has gradually been taking over some glass and foil laminations. The reasons for this are that flexible barrier packaging is less costly, easier to process and provides good transparency and long shelf

life. Although EVOH is replacing more complex structures to save money, it is a fairly expensive resin itself. Other new or refined resins are being developed to save money over the cost of EVOH. One such resin is 3-layer monoaxially oriented nylon (m-OPA). Although this resin has a higher oxygen barrier transmission rate, it can be used for less demanding applications. Material savings using m-OPA over EVOH are in the order of 41%².

Resins are often sold as blends to reduce costs. For example, surlyn ionomer resins blended with EVOH provide characteristics and processibility of EVOH at lower costs.

Another method would be to coextrude an inexpensive resin such as LDPE with EVOH (see Figure 1). The challenge in attempting coextrusion is matching resin properties. The viscosity, shear rate and velocity of the resins as they are combined should be almost the same. For example, if product A in figure 1 is EVOH and product B is 40% EVOH and 60% LDPE, resin costs would be 54% lower for the same coating thickness. This is because EVOH costs about 4.4 times³ more than LDPE. The downside of this product would be reduced clarity of the final product. A typical product would be for high barrier flexible cookie packages. These packages are typically OPP/EVOH/LDPE laminations.⁴



FIGURE 1

In addition to coextruding different resins to save money, multiple layer products can be created with a layer of recycled material in the center. The product shown in Figure 2 is a six-layer structure with anywhere from 20%-60% recycled materials.

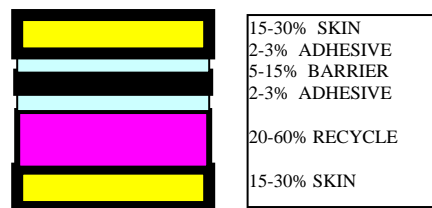


FIGURE 2

If a converter only had one extruder on his line, additional extruder(s) and a feedblock with a changeable plug would need to be added. This addition of equipment can be costly but resin savings and the flexibility for future products can easily make these costs justifiable.

Waste Reduction – Edge Bead Reduction Dies

Oxidation is an important effect needed for bonding in Extrusion Coating and Laminating. Unfortunately for high speed extrusion processing, long airgaps are required to allow adequate time for oxidation to occur, contributing to excessive edge beads. The larger the air gap between the die and chill roll, the more

the hot polymer will neck in. More neck in results in heavier edge beads. Other factors which cause increased edge bead are high melt temperatures, slow line speeds, lower viscosity resins and low melt strength resins. Most of these factors cannot be changed significantly enough to result in cost savings. The only other choice is to thin the polymer on the edges as it leaves the die, creating a flat profile after neck-in.

Edge bead reduction, as it is commonly called, is available in both external and internal deckled dies. The premise and basic parts for either die are very similar. Most edge bead reduction dies have three (3) deckles (see Figure 3). The graphics for this discussion are using an internally deckled die. In Figure 4, the upper deckle, lower deckle and rod start in line. A sample edge bead is collected and measured with a micrometer accurate to 0.0001". Rod "C" is kept in position while the upper deckle "A" and deckle flag "B" are moved together. This is the coarse adjustment. The "A" deckle is then moved which reduces the thickness of the bead. Once this is accomplished, the deckle system can be moved to decrease the width of the coating. Once the edge is flat, the process can be run with overcoat or without. Either way, the amount of edge trim can be reduced or eliminated. In addition to money and waste savings, wrap-ups at the chill roll can be reduced because edges are thinner and cool more rapidly. Nip roll life is increased due to a more even polymer thickness across the web. Both help reduce downtime.

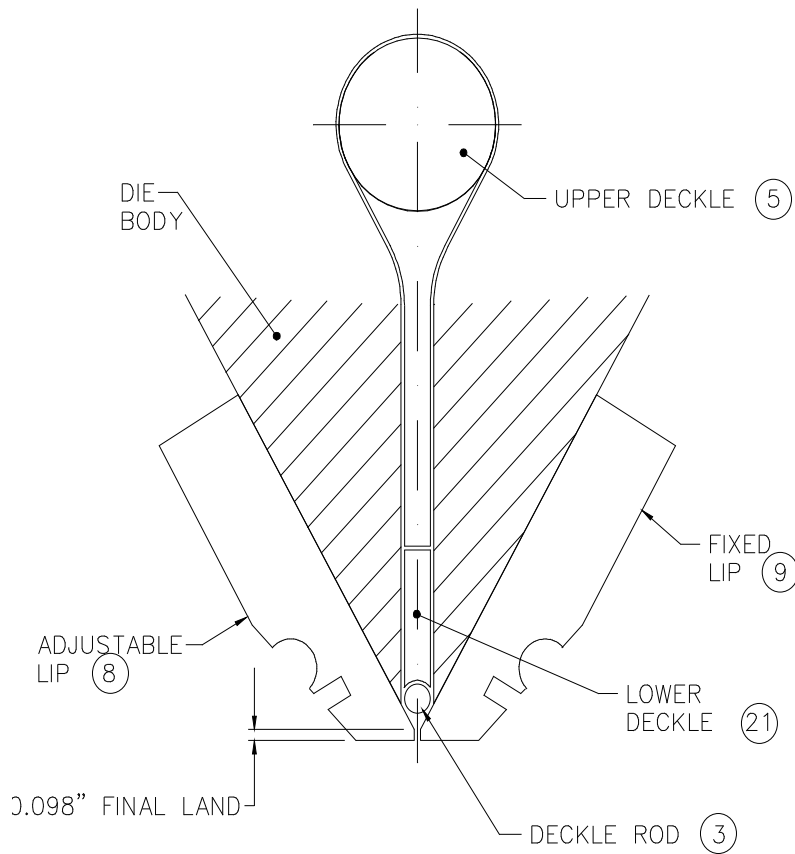


FIGURE 3

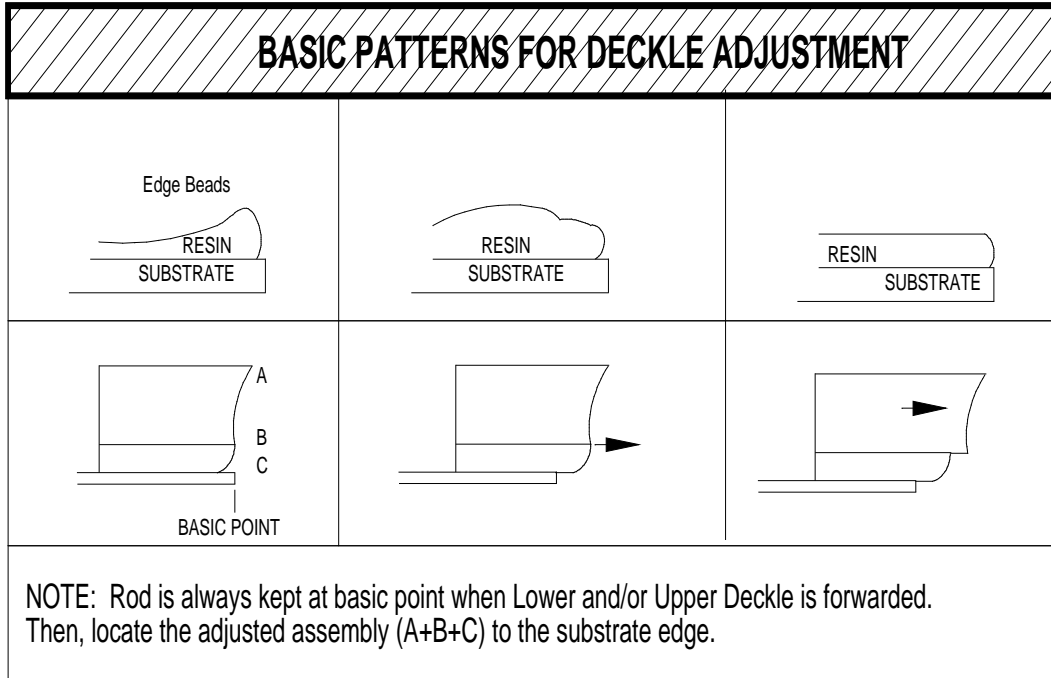


FIGURE 4

How much money can be saved using a Bead Reduction Die (BRD)? Table 1⁵ demonstrates possible savings in one year from a simple poly/base/poly product using edge bead reduction. As can be seen from the numbers, money is saved in areas of resin reduction, downtime reduction and waste reduction. As basestock costs and resin costs go up, the potential savings from this technology grow accordingly.

There are three obstacles that must be overcome for edge bead reduction to be successful. The first is the investment for a new die. This is the easiest because the money saved in resin alone means that the die will pay for itself in a matter of months. The next problem is operator mindset. Many operators are used to seeing a die with edge bead that needs to be trimmed off. The idea of running trimless is often difficult for them to accept. The biggest obstacle is the amount of practice that it takes to learn edge bead reduction and the possibility that some polymers may not be able to run beadless. It takes quite a bit of training and persistence on the part of an operator but the benefits can be substantial.

Table 1. Savings Analysis Using a Bead Reduction Die

| Structure Cost | | | | | |
|--------------------------|------------------|----------------------|--------------------|----------------------|-----------------|
| Structure | Weight (gsm) | Cost (\$/M sq. m) | Cost (\$/M sq. ft) | | |
| 16 gsm (10#/rm) LDPE | 16 | \$17.65 | \$1.64 | | |
| 80 gsm (50#/rm) Bl. Kr. | 80 | \$123.54 | \$11.48 | | |
| 16 gsm (10#/rm) LDPE | 16 | \$17.65 | \$1.64 | | |
| Totals | 112 | \$158.83 | \$14.76 | | |
| Waste Analysis | | Overcoat/trim | | | |
| Width (1500mm finished) | Before BRD (mm) | After BRD (mm) | Difference (mm) | | |
| 1st pass Poly Trim | 205 | 10 | 195 | | |
| 2nd pass Poly Trim | 205 | 10 | 195 | | |
| Paper Trim | 51 | 8 | 43 | | |
| Waste Savings | | Weight saved (kg/hr) | Savings (\$/hr) | Available Hours/year | Savings \$/year |
| Width (1500mm finished) | | | | | |
| 1st pass Poly Trim | 10 | \$11 | 6989 | \$73,596 | |
| 2nd pass Poly Trim | 10 | \$11 | 6989 | \$73,596 | |
| Paper Trim | 11 | \$16 | 6989 | \$113,602 | |
| | | | Total | \$260,794 | |
| Material Usage | | Metric | US | | |
| Line Speed | 305 mpm | | 1000 fpm | | |
| Width | 1.52 m | | 60 in | | |
| Sq. (m or ft)/day | 667,584 | | 7,200,000 | | |
| Downtime | 20% | | 20% | | |
| M Sq. (m or ft)/year | 194,935 | | 2,102,400 | | |
| Material Cost/year | \$30,961,841 | | \$30,961,841 | | |
| Waste (1% of total use) | \$309,618 | | \$309,618 | | |
| Downtime Savings | | | | | |
| Machine hour rate | | | \$1,000/hr | | |
| Edge bead web breaks | | | 50/yr | | |
| Downtime Cost | | | \$50,000/yr | | |
| Savings Breakdown | | | | | |
| Reduced resin usage | | | \$147,192 | | |
| Reduced substrate usage | | | \$113,602 | | |
| Reduced waste | | | \$309,618 | | |
| Reduced downtime | | | \$50,000 | | |
| | | | Total | \$620,412 | |

Waste and Downtime Reduction – Screw Design

Few extrusion coating lines run a dedicated product and resin through their extruders. If a screw has been optimized for only one particular resin, it may perform poorly on others. A screw change may be required for significant product changes. This can be very costly, depending on how much disassembly of equipment must occur. In most cases, the feedpipes, valve and screen changer must be removed. Depending on design, the die, feedblock or die support may need to be disassembled also. It is also

difficult, once the parts have been disassembled, to actually remove the screw itself. This process can take anywhere from 2-8 hours. For a machine running 1000 fpm, production of 120,000-480,000 feet of material is lost.

One of the answers to this problem is a general purpose screw design. The screw designer considers all the resins to be run on the screw, their product importance, amount of run time, cost and processing limitations. A screw design is developed capable to run all the materials within some defined processing limits. This is a good solution as long as the output is high enough to produce desired coat weights at top line speeds. When deciding on a new screw design, be realistic. Don't ask for a design that will run everything imaginable because it won't. Concentrate on your current needs. The cost of changing to a different screw at a later date may be much less than the cost of poor performance of a screw designed possible future needs.

A barrier screw design may be used as a general-purpose screw. This screw has an extra flight (see Figure 5) in the transition to the metering section. This flight is not as deep as the primary flight because its purpose is only to separate the melt from the unmelt. This is a very efficient method for melting the polymer with low shear input and output is improved. The smaller the screw diameter, the less of an improvement in output, however. This screw style is not always the best answer for very high temperature applications.

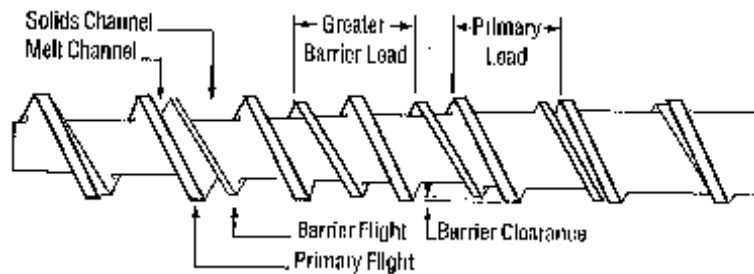


FIGURE 5

If desired output from a general-purpose screw is still not sufficient, multiple screws optimized for specific materials may be used to increase outputs and improve melt quality.

The time to change out the screw must now be addressed. A pull through valve/screen changer can be used in the place of a traditional valve and screen changer. This valve has a cap and stem that are removable. The screw can be pushed through this valve without any other disassembly. A specific resin screw can be used to achieve higher outputs while minimizing changeover time. It should take about 15 minutes to remove the cap and stem from the valve as compared to 2-8 hours of disassembly (dependent on system design).

Waste and Set Up Time Reduction – Extrusion Coater/Laminator

Today's extrusion coating machines incorporate many small details that save set up time and improve efficiency (see Figure 6). Starting at the back up pressure roll, it is double shell construction for more efficient cooling. This allows for higher extruder outputs. It provides the capability of nip load adjustment. Precision nip loading controls allow for repeatable and even impressions across the chill roll. This adjustability allows a wide range of products to be run on the line.

The rubber covered nip roll may need to be changed out frequently due to wear from the effects of overcoating. In addition, this roll can be easily damaged while cleaning poly wrap ups. However, this roll may be provided with mounting in the frames such that the roll can be lifted out easily. A nip roll can be changed out in 15 minutes.

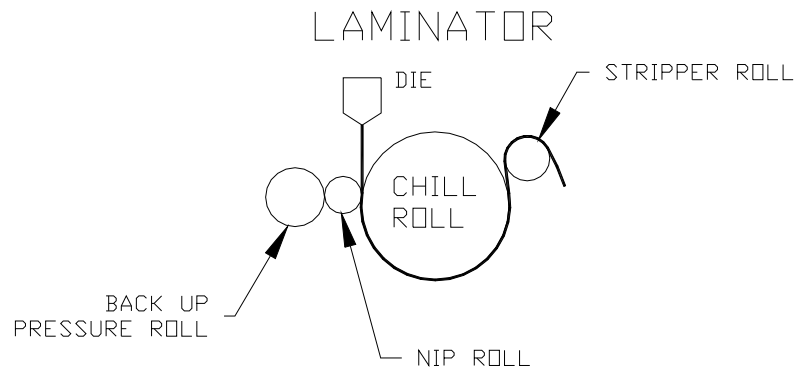


FIGURE 6

Chill roll design is very important. Typically a heavy inner shell supports the thin outer shell with spiraled flights for rapid and efficient heat transfer on heavy coat weights. This roll can also be designed for quick change out. Cartridge style bearings mounted in a housing and held in place by a quick removal retainer plate facilitate the change out. The mechanical drive can consist of two gears, one nylon and the other steel which allow for instant separation once the guarding is removed. Rotary unions with quick disconnects complete the quick-change package. When the plates that capture the chill roll bearings are removed, the roll with bearings, nylon gear and rotary unions lift out together. Another roll with bearings, gear and unions can be dropped directly in its place. The machine can be ready to run in less than half an hour. This is a great feature for lines that need a mirror finished chill roll for some products and a matte finish roll for others. Another time saver is to provide a threading chute that runs around the chill roll. It is one of the most difficult rolls to thread around on the line. This device works well with heavy paper products or board.

Most extrusion coating operations use teflon tape on the nip roll. This tape is expensive and quickly damages the rubber on the nip roll. Teflon belt systems are available to replace tape on the nip roll. The teflon belt systems use an endless teflon belt that winds around the nip roll with a tensioned take up pulley. There are two types of belts available, fiberglass or kevlar impregnated. The kevlar belts last longer than the fiberglass but cost considerably more. Heavy edge beads can cause heat distortion of teflon belts leading to premature failure. In order to combat this heat distortion problem, vortex air coolers may be used to blow chilled air on the tape to cool it. The entire belt system can be motorized and provided with an LVDT, for position feedback, when accurate and frequent positioning is needed. Set up can be reduced through the use of this system. The nip roll will last longer, meaning fewer removals for regrinds and recovering.

An automatic drool catcher is a unique feature that protects machine elements from the melt curtain as the extruders and die are driven on and off line. This not only makes operation easier but also reduces clean up, avoids possible wrap-ups and prevents polymer interference with the nip roll loading system.

Waste and Set Up Time Reduction – Unwinds and Splicers

It is important to consider the benefits of shafted versus unshafted operation. Handling of heavy core shafts can lead to operator fatigue and contribute to back injuries. On wider lines, aluminum shafts may not be strong enough for the roll weights. Steel shafts are very heavy, meaning more time and effort to set up the unwind. Carbon fiber shafts are lightweight like aluminum but with strength comparable to steel. These shafts are expensive. Composite shafts can be designed with a modulus greater than steel at a weight less than aluminum. Any of these shafts can be provided with automatic shaft inflation. This feature removes the chance of an operator forgetting to inflate the shaft and damaging machinery or wasting material. One width can be run on one spindle and another can be set up on the other, with shafted operation.

Shaftless unwind operation removes the extra handling needed for shafted operation, making it easier to load rolls. As with shafted operation, automatic inflation is possible on the chucks. Traditional shaftless operation does not allow dramatically different widths to be run on each spindle. If the width is different, the line must be shut down and both rolls removed. This problem is solved with the addition of individually adjustable arms on the unwind (see Figure 7). Shaftless operation saves money and the cost of replacement shafts over time as well as set up time. Cost wise, shafted winders are least expensive, followed by shaftless and shaftless with adjustable arms. Independently adjustable shaftless are the most expensive of all options.

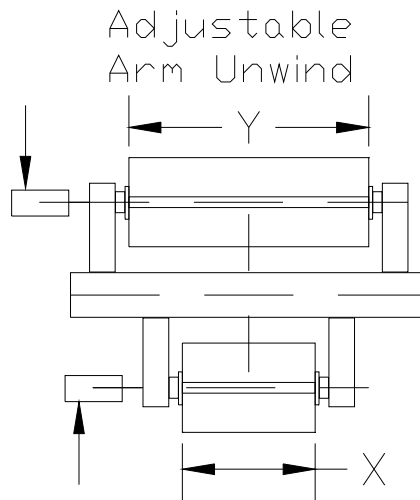


FIGURE 7

Additional savings can be found through the available features of modern splicers. Rolls as small as 25-33% of the maximum roll diameter can be spliced. This means that small foil rolls or small runs of material can be put into the machine without needing to stop the machine and make a manual splice. This saves material and time. Non contact diameter input is a feature that can enable the roll to be unwound as close to the core as possible without accidentally running the web off the core. Spindle splicing targets eliminate the need for reflective tape (which can fall off or become lost). The adjustable target is rotated to the prepared splice on the incoming roll to ensure a good splice. All of these features allow unwind splicing efficiency as high as 98% or better, reducing downtime and waste.

Waste Reduction – Automatic Roll Change Systems

There are many different methods for automatic roll changes. Several of these will be discussed in detail. They are bump & cut, static, core enveloper and stationary knife cut over. All of these methods have specific applications that are dependent on speed, materials and core preparation.

The bump and cut is the least sophisticated method of the four listed. It is usually used on slower speed lines of 1000 fpm or less. This method requires tape on the core for transfer and is the least effective method for waste reduction. The core is taped, the bump roll is actuated with a cylinder and the knife is fired (Figure 8). The disadvantages to this method, in addition to needing tape, are a large amount of foldback and poor core starts.

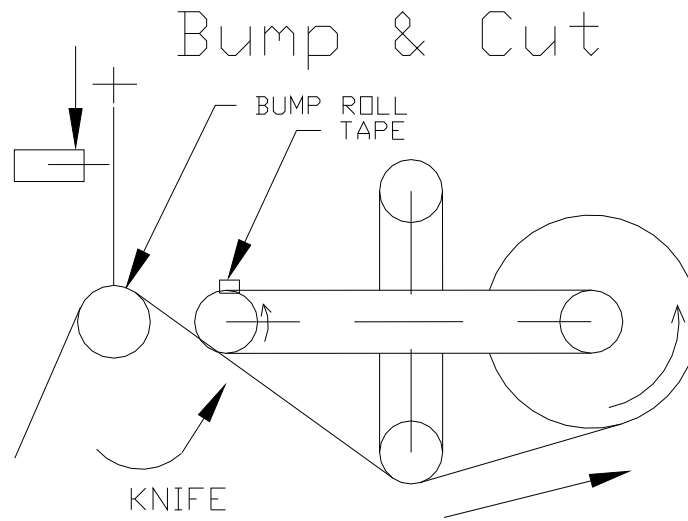


FIGURE 8

The core enveloper consists of a lay on roll (Figure 9) which nips the winding web against the new core and an enveloper roll and knife on an arm. The enveloper arm pivots around the new core to wrap it. The knife on the arms cuts the web and the cut web is drawn into the nip between the lay on roll and the core. This method needs no tape and is effective for speeds up to 1300 fpm. There is some foldback for this method but it is a small amount and is very uniform. This method saves the cost of tape and limits waste at core start. To be effective, the knife speed at cut must exceed the web speed. This requires a sophisticated system to accelerate and stop the knife in a short span that may be maintenance intensive.

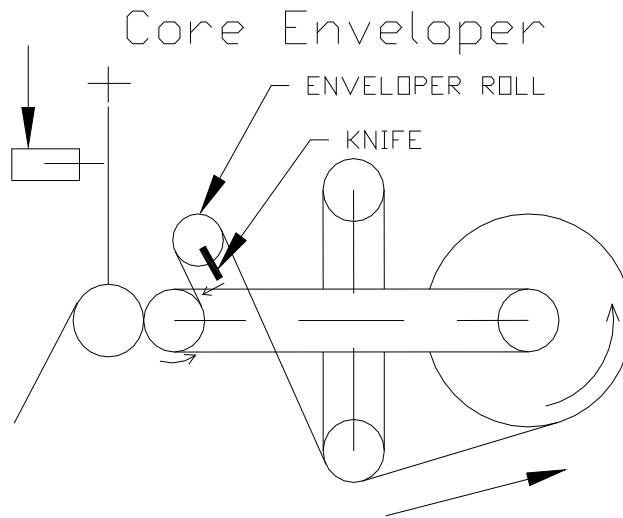


FIGURE 9

The static transfer puts a charge onto the web as it is cut. Here's how this method works (Figure 10). The finished roll is indexed into the outboard position. A layon roll nips the new core. An arm is pivoted into the web. As the arm approaches the web, a static charge is built up on the web, causing it to be attracted to the grounded coreshaft. Once the charge has developed, the knife cuts through the web. The static holds the web to the coreshaft and the transfer is complete. The biggest saving from this method is due to the elimination of tape. Less set up is needed to prepare for the roll change. This method is effective for speeds up to 1500 fpm. The amount of foldback on the start of the core is dependent on the mechanical design and web speed. The closer the knife is to the core, the smaller the amount of foldback. This method means that there will be only a small amount of waste at the start of the roll. Shafted winders are required for static transfer operation to provide a path to ground for the static charge. This method is only effective on light flexible products. Metalized foils, aluminum foils and heavy paper will not work. This technology is protected by US patents.

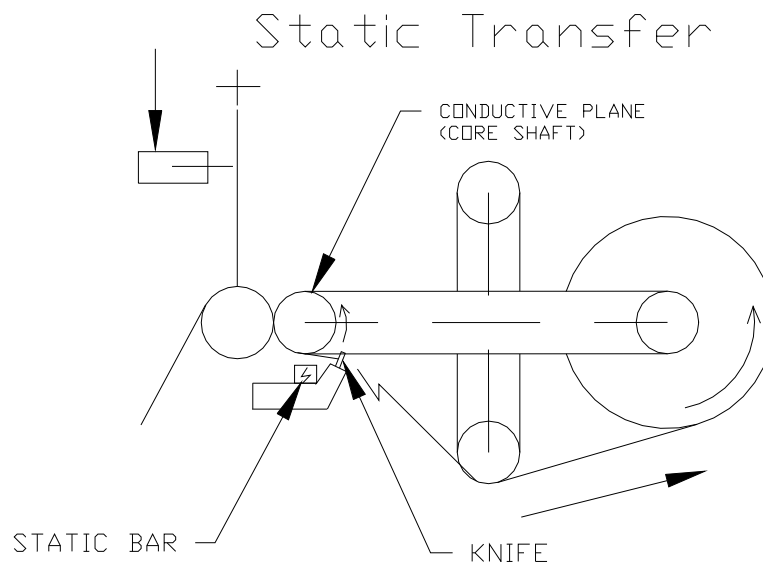


FIGURE 10

The last method is the stationary knife method (Figure 11). This patented method is the only one of the four that has cut off knives on the turret instead of the roll changer. The new core is brought into roll

change position. This position is 1 inch away from the lay on roll. The stationary knife cylinder is actuated, bringing the knife close to the core. The actual roll change takes place by indexing the turret into the lay on roll. The geometry is such that indexing moves the knife into the path of the web. In other words, the knife is not “fired” into the web. This provides a few key advantages over other systems. The first is that there is no practical speed limit. There is no foldback of material and a square cut in the material. All of these factors mean there will be an excellent core start, giving the best chance for a perfectly wound roll with waste at start eliminated. The only disadvantage for this method is that tape is required.

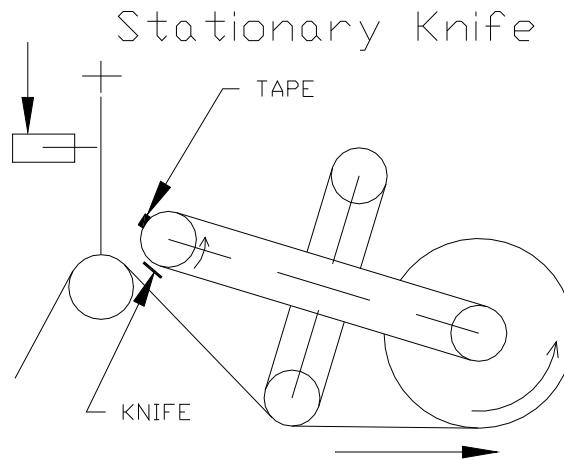


FIGURE 11

DISCUSSION – PROCESS REDUCTION OPTIONS

Waste Reduction – In Line Printing

A typical extrusion coating company has several different types of machinery. There is an area that contains extrusion coating and laminating lines. Another area has printing lines. Yet another area has slitter rewinders. In many cases, material is printed on one line and then brought over to another to be extrusion coated or laminated. Not only does this material need to be handled more than once; it has more chances for error or damage. There is also duplicate equipment on each of the lines used (i.e. Unwinds and winders). In line printing reduces equipment costs, number of operators needed, material handling and process time on the machine. However, there are many things that must be examined before attempting in line printing. The first is the amount of changeover needed for most printers. Production could be very limited due to this fact. The second item is the complexity of the printing involved. For example, if your products need six different ink colors, you could be introducing serious downtime into the whole process. If the printing jobs are simple and need few cylinder changes, in line printing may save you money.

Waste Reduction – In Line Slitting and Edge Trim

After printing and extrusion coating, the finished product is taken to a slitter rewinder for final processing. It is possible to avoid having to take certain products to a slitter rewinder. The conditions to accomplish this are proper web handling, edge trim and in line slitters. Web handling should be such that finished product rolls should be flat and square. The line should have edge guiding capabilities into each primer, laminator and laminate unwind path. Most converters take trim on their extrusion coating lines to remove the overcoat or edge bead. This edge is often retrimmed at the slitter rewinder. If the blades are properly maintained and changed out when dull, the edge trim slitters on the extrusion coating line can be the final edge cut. The best location for these slitters is directly after the laminator.

If the final width of product is narrower than the width being run, in line slitters should be provided on the roll changer just before the winder. This can be done with two methods. The first method requires taking bleed trims of 0.50"-1.00" in width between each finished product roll. A less costly method is to use dual expander rolls (see Figure 12). The two rubber covered bow rolls allow the slits to be spread apart without undue stress or distortion. No bleed trims are required. This method will not work for all products. For example, a slippery product will tend to slide around too much to get a decent finished edge. Although all products will not be able to be finished by this method, any that can are going to mean savings. Remember that in addition to generating waste with bleed trims, at this point in the process, trims can seldom be recycled back into the product and therefore disposal fees are incurred.

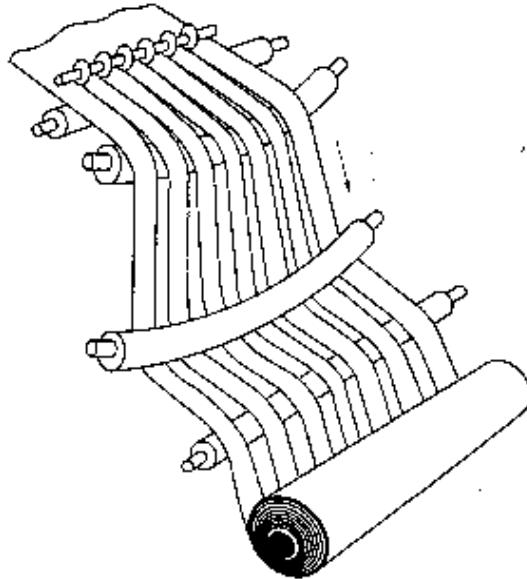


FIGURE 12

Waste Reduction – Tandem Extrusion Coating and Laminating Lines

Many coated products require each side of the substrate to be coated. A tandem extrusion coating and laminating line is more expensive but it offers many benefits over a single station line. This type of line eliminates having to double pass products. This not only saves in machine usage time but also may provide resin changeover savings. If a product consists of a base structure which has one resin structure on one side and a totally different resin structure on the other side, changeover for the second side is costly in terms of material and time. A tandem line enables a structure to be run all at once without any changeover. In effect, you can put twice as much product through a tandem line when compared to a single station line.

Another feature of this line structure is the set up time savings for products that need only a single station. If the first station is running product A, the second station is bypassed. The second station can be cleaned and preparation can occur for product B. When product A is done, the first station can be taken off line and the second is already set up for product B. The operators can start running immediately and get the first station ready for the next product. This type of setup is also ideal for flexibility for unknown future products.

Waste Reduction – Controls – Supervisory System

How many different panels do your operators need to go to before starting your extrusion coating line? When the line goes down, a splice is missed, or the web breaks, how many different areas must an operator be at before the line can be restarted? If the line will not start, how long does it take the operator to find the cause? The answers to these questions depend on the type of machine control. If the line is provided with a supervisory control system, most functions can be performed at one station. The supervisory station can contain a comprehensive list of operating parameters for the line. Recipes can be saved into a file for a particular product. Each time a particular product is run, the recipe can be called up and used. This eliminates the need for operators to remember or have to relearn the optimum running parameters. Many systems, such as resin handling and treating, can be monitored through the supervisory system. The operator can get a good view of the machine and current running conditions of all systems in one place. In addition to operating parameters, alarms can be displayed with detailed information on the nature of the problem. The operator only needs to go to one place to find out where the problem is. All functions, alarm history, tending and recipes can be stored and retrieved, making reports easy and accurate. A supervisory system can be easily adapted to each customer's needs. A supervisory system's touch screen interface and monitors provide more data, ease of operation, reduced maintenance, installation and calibration costs.

SUMMARY

A large percentage of the cost of producing an extrusion coated product can be attributed to materials consumed. Therefore, reducing the consumption of raw materials through careful selection of equipment along with selecting the least expensive resin or combination of resins for the desired product characteristics are key to reducing costs. There is no one method or type of equipment to accomplish this task. What is required is a thorough understanding of the product structure with careful consideration given to how best meet the requirements. This paper gives the reader a starting point and a variety of ideas to get on the way to a less costly product.

FOOTNOTES

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