MACRO
Letter
Announcing Solutions For Flexible Film
Spring 2007

50th Anniversary

PLAST-EX2007
Solutions for the next 50 years!

Booth 405/407
May 1-3, 2007
International Centre
Toronto, Ontario, Canada

Macro's Patented D10 PRO Automatic Dual Lip Air Ring

CONTENTS:

Editors: Andrew Erskine
Felix Guberman

Exceptional Thickness Control with Macro's D10 PRO Air Ring

By Andrew Erskine

Macro Engineering introduces an updated design for its most sophisticated member of the D10 air ring family, the D10 PRO Automatic Air Ring. The D10 PRO dual lip air ring was developed for use with an advanced thickness control system that incorporates intelligent control software, a thickness sensor on an oscillating ring and a touch screen interface.

Based on Macro's signature D10 dual lip air ring, the patented design of the D10 PRO guarantees excellent gauge control without negatively affecting bubble stability and cooling performance.

The initial setup of the air ratio between the primary and secondary lips is simple and done in the same way as Macro's conventional D10 dual lip air ring. This feature makes the patented design of the D10 PRO air ring stand out from other designs for its simplicity and operational efficiency. No additional blower or compressed air is needed, no excess air is blown away, and no heating of previously cooled air is required.

The air for the primary lip is taken directly from the mixing chamber and split into independent vanes that extend from the chamber directly to the exit of the primary lip.

Thickness correction is achieved by precisely adjusting the airflow on each of the vanes using a valve activated by a stepper motor. The air flow through the vanes is laminar, preventing any significant mixing of the air streams as they exit the primary lip. This feature assures precise localized thickness corrections.

Altering the volume of air flow through the vanes has two effects on the bubble: Firstly, a change in the air flow acts to change how quickly the film is cooled, which in turn affects it's thickness. Secondly, and more importantly, the change in air flow influences the geometry of the bubble. By reducing the volume of air, the melt is drawn out over the deflector lip thereby stretching the film and thinning the gauge. Conversely, when the air volume is increased, the melt is forced away from the deflector lip, thus preventing it from being drawn out and thinned.

These changes in bubble shape are minute - they cannot be perceived by observing the bubble - yet they have a significant effect on the film gauge. The end result is a rounder bubble due to the improved gauge uniformity.

In Europe, Macro Engineering has teamed up with DOTECO s.r.l. (Italy) to market the control system under the name PROFIX, Air Ring with Integrated Auto Profile Control.

By Andrew Erskine

During May 1 to 3, Macro will be exhibiting at Plast-Ex 2007, Canada's largest and most important plastics industry event. Macro's booth, No. 405/407, will be located at the south side of Hall 2, next to the CPIA Solutions Centre.

If you're not planning to attend Plast-Ex 2007 but will be in Toronto, give us a call and we'll be more than happy to give you a tour of our main office and plant.

Printable directions to Macro can be downloaded from our website.

For more information about Macro Engineering & Technology Inc., our products and services, and other upcoming events, visit us online.

www.macroeng.com

Macro's Booth at Plast-Ex 2004

Fundamentals of Cast Film Extrusion Technology

(Part 3 of 3)

By Alberto J. Rincon, PhD

Automatic Gauge Control System

Inline measuring and control of film thickness distribution across its width is the function of the gauge control system or APC (Automatic Profile Control). When the flexible lip on the die is manually controlled and the production process is well tuned, film thickness variations will be in the range of ±3 to ±5%. In automatic mode, it is possible to reduce these variations by half. The figure below shows an automatic die with the automatic control module mounted on the flex body of the die. The so-called thermal translators or thermal bolts form the module. The distance between the bolts is typically 1.125 inches.

Automatic Die
(Courtesy of Extrusion Dies Industries)

The gauge control system includes a radiation emission unit and a control console. The radiation unit travels in the machine cross direction, scanning the film in cycles (measured in minutes). Commonly, the radiation originates from a beta ray source; although, x-ray and infrared sources can also be used. In general terms, the film thickness is determined as a function of the film radiation rate of absorption. Thus, variations on the absorption rate translate into film thickness variations.

The control console is the interface between the control system and the automatic die. Each adjustment point or thermal translator on the die is spatially correlated with a position on the film. This is called mapping.

The control system applies power to the thermal translators, as required, and the lip gap is regulated via thermal expansion of the adjustment element. An important variable associated with APC is the time constant. It is defined as the time needed for an adjustment element to elongate 62.3% of its maximum elongation. The shorter the time constant the more responsive the system is, translating to gains in productivity.

Corona Treatment

In order to facilitate the adherence of inks or coatings onto the film surface it is necessary to apply a surface treatment. Corona treatment is the most commonly used of the existing methods. Corona treatment increases the surface energy of the film and consequently its surface tension.

Corona Treater (Courtesy of Enercon)

The system includes a power source and the treatment station. The power source transform 50/60 Hz plant power into much higher frequency power in a range of 10 to 30 KHz. This higher frequency energy is supplied to the treatment station and is applied to the film surface by means of two electrodes, one with high potential and the other with low potential, through an air gap that typically ranges from 0.5 inches to 1 inch. The surface tension on the film surface is increased when the high potential difference that is generated ionizes the air.

Corona treatment can be done inline or as a separate downstream process once the film is produced. If performed inline, special consideration must be given to the potential generation of toxic ozone. In some cases, it is necessary to provide a ventilation system in the production area.

Winder

In simple words winders are used to convert the extruded film into rolls of material. The winding process has to be such that the film preserves its properties and dimensions when these rolls are unwound and converted in other downstream processes.

There are three basic types of winders; surface winders, turret or center winders, and center/surface winders. Surface winders wind film through the contact between a large diameter drum and a winding shaft that is pressed against the drum with variable pressure. Turret winders or center winders are any style of winding machine that use a driven shaft running through the center of the building roll or on chucks supporting the core to drive the building roll. Finally, in the combination approach of a center/surface winder (or gap winder) a small gap is maintained between the surface winding roll or lay on roll and the winding roll. A center drive system drives the winding roll independently of the surface drum.

Films can be tacky or have some degree of slip, have high or low elasticity, thin or thick, the required roll diameter can be large or small; rolls can be narrow or wide, soft or hard. Winder technology is complex and the proper type of winder

used in a particular application depends on all of the above variables.

The use of turret or center winders is typical in cast film applications. With this type of winder the web tension decreases as the roll diameter increases. This is controlled by the rotational speed of the winding spindle.

Macro's AUTOMAX T Turret Winder

A lay on roll prevents or allows the entrapment of small amounts of air between the layers. The latter is recommended for winding films with high tack or for winding soft rolls.

In order to evenly distribute defects on the extruded film (thickness variations) a randomizer is used. The randomizer moves the film back and forth, as it is slit and wound. An alternative approach is to move the slitter and winder back and forth relative to the film.

Computerized Supervisory and Control System

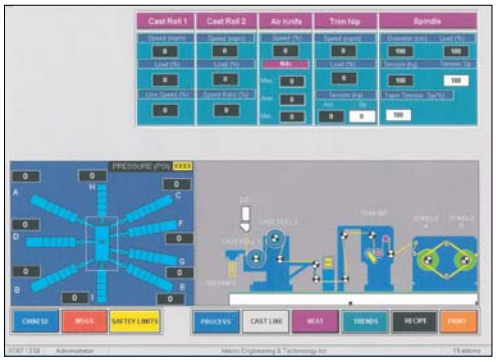
The main components of a cast extrusion line have been enumerated and described. These components do not act on their own but are integrated and governed by a computerized supervisory and control system.

The main computer is the brain that couples and drives the controls of all the line components in an orchestrated way.

The main tasks of the computer are:

- To control start-up, shutdown and speed of the line;
- To monitor the weight of material fed into the extruders and to control the speed of the extruders in order to maintain a constant throughput;
- To control all temperature zones and the temperatures of all the materials;
- To coordinate the interaction between the gauge control system, the response of the automatic die and the line speed;
- To control the web tension; and
- To store and handle all product recipes, store operational data and control the alarm system.

A good control system must provide operators with an easy to operate graphical interface or monitor system.



Control Monitor Display

SPECIALTY APPLICATIONS

This section describes some complex coextruded structures that include high added value materials that are a growing demand in the international food packaging markets.

The table below shows the specifications of these coextruded films. In the structures, EVOH is used to provide the oxygen barrier, the presence of PP as a skin layer facilitates the thermoformability of the film, and the PE used as a skin layer acts as a heat-sealing material. Combining PVdC with EVOH is an effective way to address the potential loss of oxygen barrier capabilities experienced by the EVOH when exposed to moisture like in the case of meat packaging. Nylon material is used in combination with EVOH to provide added barrier when the film is to be thermoformed and the rigidity of the EVOH limits the thickness of the EVOH layer.

As seen, the specification process of these structures is not a simple task and multiple variables need to be considered.

Structure 1	PP	Tie	PA	EVOH	PA	Tie	PE
Thickness	28	9	11	6	11	8	27
Structure 2	PA	Tie	PA	EVOH	PA	Tie	PE
Thickness	10	15	11	4	11	19	30
Structure 3	PA	Tie	PE	Tie	PA	Tie	PE
Thickness	12	8	24	8	18	8	22
Structure 4	PP	PP	Tie	PVdC	Tie	PE	PE
Thickness	20	6	8	6	8	20	30
Structure 5	PE	PE	Tie	PVdC	Tie	PE	PE
Thickness	20	8	8	6	8	20	30

Specialty Films - Coextruded Structures for High Barrier Applications (Thickness in microns)

Companies wishing to diversify their product portfolio with the inclusion of specialty films need to be aware that the high cost of added value resins and the constantly changing market are factors that demand the use of high technology process equipment that is sufficiently flexible to be effectively used in the production of both commodities and specialty films.

CONCLUDING REMARKS

This article has enumerated and provided the basic functioning parameters of all the main components of a cast film production line. The technology of each component is complex, as is also their interaction and functional integration in the line.

In order to prevent premature technological obsolescence of the equipment, special consideration needs to be given before purchasing your equipment.

It is imperative to establish a clear understanding of what product, and its application, is to be produced on the line. The idea of an all-encompassing "universal" line may be attractive, but in reality no such line exists. The more generalized a line is designed, the less optimized the product can be manufactured because the line components may not be suitable for product-specific process requirements. In addition, industrial sized cast lines are built for long production runs that are not well suited for frequent product changes - the operation of cast lines regularly requires a significant number of process adjustments. Production of complex and sophisticated films often consume large amount of time for fine-tuning, especially during the development of a film structure. Even with Macro's comprehensive software, which aids the process engineer to predict the behavior of multilayer structures, many trials are typically required to achieve the targeted mechanical, physical, optical and technological parameters.

All cast line components will affect the overall performance of the complete line. In order to get a first class line that is suitable of producing an excellent quality product, each of the individual components or systems must be of equally high quality.

It is expected that the concepts provided above serve the purposes of introducing cast film technology to those new to it and of solidifying the knowledge base of those already familiar with this production process.

More Customized Winding Solutions from Macro

By Andrew Erskine

In addition to providing complete blown and cast extrusion systems, Macro Engineering & Technology Inc. specializes in designing and building customized winding and web handling equipment.

Customized Turret Winder

Macro recently designed and manufactured two highly advanced customized winders for roofing material, such as PET woven, non-woven glass TPO and EPDM. The winders consist of an entry accumulator, a 3-blade slitting station with trim nip, a dancer/accumulator, a two-spindle automatic turret winder, a core magazine, core loader and cart.

Prepared Roll Supported by Roll Cart

The winders are designed for 120” wide roofing material with thickness ranging from 0.020” to 0.100” at speeds up to 80 fpm, and for rapid indexing of small rolls of 100 or 200 ft per roll. To achieve this, the winders are highly automated to minimize operator involvement. Each winder incorporates a tucking assembly to eliminate the requirement to apply adhesive or tape to the empty cores. Automatic roll changeovers are initiated based on roll length. An airshaft removal system, automatic core loader, automatic airshaft inflation system and a roll unloading cart are incorporated into each winder to assist the operator.

The dancer/accumulator provides the necessary accumulation time to allow the web to stop at the winder for a square cut without shutting down upstream equipment. The entry accumulator provides up to 2 minutes of accumulation time for process changeovers, sample cuts, and routine maintenance, such as replacing a knife while continuing with production at reduced line speeds.

Macro will be participating in the following upcoming exhibitions:

Plast-Ex 2007 - Toronto, Canada
(May 1-3, 2007)

Brasilplast 2007 - Sao Paulo, Brazil
(May 7-11, 2007)

Chinaplas 2007 - Guangzhou, PR China
(May 21-24, 2007)

CMM07 - Rosemont, Illinois, USA
(June 4-7, 2007)

K-2007 - Dusseldorf, Germany
(October 24-31, 2007)

Visit our website for more details.

www.macroeng.com

Macro Engineering is a global supplier of extrusion and coextrusion systems for barrier and specialty films, including equipment for custom coating, winding and web handling applications.

MACRO ENGINEERING & TECHNOLOGY INC.
199 Traders Boulevard East, Mississauga, Ontario
Canada L4Z 2E5
Tel: +1 (905) 507-9000 · Fax: +1 (905) 507-3000
E-mail: sales@macroeng.com
Website: www.macroeng.com