ABSTRACT

The growing market for Packaging Materials drives the Packaging design to develop ever more complex structures to meet the new demands of the industry. Clever converters are combining the benefits of several processes to gain a market edge. Additionally, the high global growth rate is driving production capabilities to higher levels for better quality at higher machine speeds.

New manufacturing technologies will be presented which sequentially combine different, usually separate processes in one line to create complex multi-layer products. Some of these machines combine solution coating, cast film and sheet production with the extrusion coating process. Here, one line may create unique, high value composite webs with many layers and diverse materials. We will review these new developments and how they can be applied.

Quality demands for packaging are becoming more stringent in this rapidly changing competitive industry. Production speeds of 400 to 700 MPM are becoming common for extrusion lamination machines for commodity packaging. The key criteria required for high speeds and improved quality levels will be explored.
OUTLINE

The need for Multi-layer and Multi-component webs for today’s packaging market.

• Review of basic structures and processes.
• Combine these processes to make unique, high value composite webs with many layers and materials.
• Review of equipment designs for dual and multi-purpose process.
• Improved quality levels.
• New machine features to achieve these
Multi-layer and multi component webs

Packaging requires the combination of many layers where each layer has a different function.

The value of the package is achieved through the combinations of different polymers with various substrate webs such as aluminum foil; paper and oriented films.

The package design may require layers which are very thick and layers which are very thin – 200:1

Each substrate or layer has a function
Function within a structure

Polymers
- Heat seal ability
- Barrier – $O_2$, $H_2O$
- Stiffness

Aluminum foil – High barrier; stiffness

Paper – Bulk, some barrier

Oriented films – metallized, printed
EXTRUSION COATING PROCESS

Granulate

Extruder

Substrate
- paper
- board
- aluminium
- film

Melt

Die

Cooling roll
LAMINATING PROCESS

Granulate → Extruder → Melt → Die → Substrate 2 → Cooling roll

Substrate 1
Simple Lamination  Paper – Foil Wrapper

- Paper
- PE – (Tie Layer)
- Al Foil
Snack Food Packaging

- Paper, PET or BOPP
- Reverse printed web
- Primer
- Tie
- LDPE
- Tie
- Metallized BOPP
Paper – Foil – Polymer Pouch

Paper - printed
LDPE
Al Foil
Tie Layer EAA
Top sealer LDPE
OPP – Foil Pouch

- OPP printed
- LDPE
- Al Foil
- Tie Layer EAA
- Top sealer LDPE
Tooth paste structure with Al-foil

- Film
- PE
- EAA
- Al- Foil
- EAA
- PE white 10% TiO
- EAA
- LDPE Film

Tandem Lamination
Toothpaste structure without AL-foil

- PE white Film
- PE Layer
- EVOH Barrier layer
- PE Layer
- PE Film

Single Coextrusion Lamination
Liquid Packaging

Tandem Lamination with Coating

First layer
Seals in the liquid

Adhesion layer

Aluminum foil
Oxygen, flavor and light barrier

Adhesion layer

Paper
For stability and strength

Top layer
Protects against outside moisture
Manufacturing
Complex Packaging Materials
Package Design Complexity

The number of combinations of substrates and extruded polymer layers is evolving in search of improved properties:

- Improved physical, barrier, optical, seal & performance properties
- Use of thin Al foils for high barrier reducing need for expensive resins
- Controlled respiration (O2 & CO2 transmission)
- Combining incompatible polymers and webs in one step: Al foil, paper, board, oriented polymer films
- Reduced product cost
- Combining thick, bulk layers with thinner functional layers in one step
- Application of functional coatings for new material applications or to modify the surface properties.
Thin & Thick webs are used together to create a functional package

- High barrier top seal film
- Complex layers
- Rigid high barrier tray
- Complex layers
Process Combinations produce the necessary Package Design Complexity

• Solution Coating then extrusion lamination.
• Thick sheet followed by coatings or film laminations.
• Casting a film, then orienting and then extrusion laminating or coating.

Consider the individual processes which can be combined in one machine.
Processes for Combining in a System

- Cast Film
- Embossed Film
- Extrusion Coating
- Extrusion Lamination
- Sheet
- Gravure Coater
- Smooth Roll Coater
Machines can be designed to do Process A or Process B and……

Machines can be designed to do Process A and Process B.

This is an added benefit of this machine design as it can be operated with each process individually or in sequence.
Solution Coating Process

Gravure Coater

Smooth Roll Coater
Liquid Coating Methods

- Direct Gravure
- Offset Gravure
- 5 Roll
- 2 or 3 Transfer Roll
- Rod
- Reverse Roll
- Flex Bar
- Die
- Curtain Coating
- Air Knife
- Knife over Roll
- Dip & Squeeze
Adhesive Lamination
Product Details

Gravure Primer Coater / Dryer

Stairway Storage position
Solution Coating and Extrusion Coating

Capabilities can be easily expanded by adding winder and unwind.
Solution Coating and Extrusion Coating
Solution Coating and Extrusion Coating

Ext. Coating

Combination EC & Adh Lam

PE

OPP

OPP

Sealant Film

PE

OPP

Adh

Sealant Film
Curled Film

Cast with no post-conditioning, asymmetric film will curl towards the PE side due to differential shrinkage.
Cast Film then Extrusion Coating Coextrusion

Allows for the creation of a high barrier film and then subsequently coated with bulk layers or sealant.

End product can be asymmetric.
Allows for the creation of a rigid sheet and then subsequently coated with high barrier + sealant coating. End product is *highly* asymmetric.
Part II: High Line Speeds for Lamination

The Opportunity

The market for flexible packaging continues to grow.

Size: +80 Billion USD Globally

• Growth Rate: Globally @ 3.5% through 2018 – Source: Smithers

Regional Growth Rate:

• China 12%
• India 22%
New Applications continue to be developed
Part II: High Line Speeds for Lamination

Many flexible packaging webs can be produced at speeds from 450 to over 700 MPM.

The productivity benefit is proportional to the increased line speed.

Common concerns of Laminate Bond Adhesion & Quality can typically be addressed successfully using adhesion promoting techniques.

The machine requires specific capabilities for these speeds and quality and they are identified in following.
Increased Quality at Higher Line Speed

Tight Melt Quality Control

• Fixed position melt temperature and Cross channel melt temperature will not vary by more than a few degrees C.
• Total pressure stable to within small % in adapter pipe
• Properly sized melt flow pipes, temperature control and heating

High Speed Web Handling Requirements

• Tighter tolerance alignment standards
• High Precision idler bearings
• Coordinated machine drive provides higher level of stability
Increased Quality at Higher Line Speed

Unwind Splice Efficiency

• Reduction in splice tail waste. Double direction lap splice at full line speed (no slow down)

• Electronics provides repeatable, dependable high speed splice

Quality Winding

• Single direction winding with transfer at full line speed (no slow down)

• Stationary Knife System reduces waste of fold over from other methods.

• Electronics provides roll to roll transfer ability for minimal waste
Increased Quality at Higher Line Speed

Lamination Bonding Excellence

- Polymer melt temperatures in range for best adhesion and uniformity
- Optimum melt curtain condition – repeatable with recipe functions.
- Priming, corona treatment and ozone as product experience dictates
- Regularly achieve speeds of 450-700 MPM.
Flexible Packaging Line Configuration

It is an end-use product-configurable solution, engineered to fit your needs.

The dsX flex-pack™ is optimized for the competitive flexible packaging market where high reliability and high productivity are critically important.
Summary

Dual Purpose Machines which combine processes reduce manufacturing cost

- No intermediate product storage
- Similar benefit to Tandem over 2-pass machines

Allows for unique product structures - asymmetry

- Added Value products

Increased Flexibility with Multi Purpose

Capital Investment utilization is improved by using one investment to produce a variety of products
Common combinations of processes

Cast film/extrusion coating/lamination

Solution coating/extrusion coating/lamination

Sheet forming and extrusion coating

Sheet forming and liquid coating
Summary

• Higher line speeds of 400-700 MPM are common for the global leading suppliers

• Developments in resins, process and adhesion promotion have led to these productivity advancements

• Machines for the production of flexible packaging using one process or another allow for flexibility.

• New manufacturing concepts for the production of unique packaging webs use the combination of processes to produce high margin webs in a single step.