Chapter 3

BLOWN FILM PRODUCTION

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SUMMARY

The manufacturing technology for blown plastics film has developed considerably in recent years. Advances have been made in die construction (often with computer aided design), in film cooling methods through internal bubble cooling and dual-lip air-rings, and in process control using microprocessor aided automatic systems. The improvements in machinery have increased film output rate, improved quality and reduced scrap while maintaining the inherent flexibility of the process. Additionally, its scientific principles have been studied, producing a greater knowledge of the rheology of film formation and the effects of processing conditions on film properties. The major tonnage of blown film remains in polyethylene, both high and low density, recently augmented by linear low density. Other blown film materials include PVC, EVA, ionomers andnylons. By blending or using co-extrusion, combinations of materials can confer advantageous properties to the resulting film.

1. FILM EXTRUSION PROCESSES

Since the first blown film plant was patented in 1939 in the United States, the growth of the blown tubular process for manufacturing plastic
film has matched the increase in the amount of plastics materials used
generally. Above all else the process has been used to manufacture low
density polythene (LDPE) film and represents by far the biggest outlet
(more than 70%) for LDPE material. LDPE film is used mostly for
packaging where, in particular, the changes in the way food is marketed
have contributed to an enormous growth in packaging material sales,
giving longer shelf life and cleaner products in self-service supermarkets.
A sign of the growth rate is the ubiquitous polythene carrier bag, which
has only been used widely in the last 15 years.

Basically there are two alternative processes for the manufacture of
thermoplastic film, the flat film process and the blown film process.

1.1. Flat Film Process
In this process, melt at a high temperature is extruded through a straight
slit die and drawn on to a polished roll. The heat from the film is rapidly
removed either by positioning the roll in a water bath (quench process)
or by cooling the roll internally (chill-roll process). Adjustments to the
flat die lips give overall film thickness tolerance of about ±5% after
removal of thicker edges from the film. The flat film process produces
a rapidly chilled uniaxially oriented film with outstanding optical
clarity and gloss. By installing an in-line reheating and transverse
stretching unit (tenter frame), biaxially oriented film can be made.
The process is inherently a high investment, high output process. It is
used to manufacture polypropylene, polyester and nylon films where
control of cooling is necessary in order to obtain the required optical
properties.

1.2. Blown Film Process
By contrast the blown film process extrudes a lower temperature melt in
the form of a tube which is stretched lengthways and inflated sideways as it
is cooled by air directed on to its surface. The tube is flattened into its
layflat form and can either be used as a flat tube of film or it can have the
edges slit off to produce two single sheets of film. The relatively low melt
temperature and the slow cooling employed give rise to a product which
is less glossy and clear than the flat film process. Additionally film
thickness variations are normally kept to only about ±10%.

The capital investment in a blown film line is much less than for a flat
film line (but output is less). Over the years, the investment cost per
unit of output has fallen dramatically. Schenkel\textsuperscript{1} claims that if present