

The Biaxial Orientation of Expanded Films

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The importance of industrial films is increasing. For holographic and semi-permeable films, foamed films, synthetic papers and blend formulations, growth rates of 15 % and more are forecast. It has now become possible for the first time, using a new process, to biaxially orientate expanded films with functional layers.

Biaxially oriented films that can be produced by sequential or simultaneous processes are being increasingly used in the field of industrial film. In Europe, for example, around 75,000 t/a of breathable polyolefin film with a water vapour permeability of between 4,000 and 10,000 g/(m² x 24h) are currently being produced for the hygiene and building segments (diapers, roof underlinings). By 2005, demand is expected to rise to 250,000 t/a. The world-wide capacity for breathable films is currently around 150,000 t/a.

The production of such films normally takes the form of multi-stage, monoaxial stretching processes or biaxial processes such as blow moulding [1]. Alongside PE, PP also has a share of the market - currently between 5 and 10 % - and here, too, significant growth rates are anticipated. Brückner has succeeded for the first time in producing breathable films from PP with a water vapour permeability of over 6,000 g/(m² x 24h) (INDA standard) using the LISIMÂ technology (Linear Motor Simultaneous Stretching).

Another important new development are simultaneously biaxially oriented expanded films with particularly low density (down to 0.31 g/cm³). Interesting variations in the basic structure can be achieved by using polymer blends or copolymers and by adding pigments. The next step, which has already partly been implemented in practice, is to apply functional layers in order to be able, for example, to write on or print the films. In all cases, PP was used as the base material or main component.

Technical Possibilities

Brückner has in principle two possibilities for manufacturing simultaneously stretched film. For a particularly efficient predevelopment, cast films can be produced on a laboratory scale in the desired formulations and with a low material consumption using a twin screw extruder with a dosing system and a chill roll with a water bath underneath. Subsequent simultaneous stretching is carried out by means of a discontinuously operating stretching frame. With this device, the parameters of stretching velocity, stretching ratio and stretching temperature can be varied over a broad range. The manufactured specimens are analysed mechanically, optically and chemically by the in-house chemical laboratory.

With a well equipped laboratory facility for simultaneous stretching, the different films can be fed into a semi-professional production process in order to test the machine suitability of the new products and to supply potential customers with samples. It can produce films up to a net film width of 1,270 mm with 1 - 5 layers at a production speed of up to 150 m/min.

Stretching by the LISIMÂ Principle

The stretching of expanded cast films on sequentially operating stretching units has not been very successful until now because the expanded films stretched in the machine direction split open when they are stretched in the transverse direction. Although it is possible to stretch a tubular expanded film extruded through a circular die through suitable internal gas pressure when stretching in the molten form, films stretched in the molten state tend to have much lower mechanical data than films stretched in the solid state.

The LISIMã technology works with much lower deformation velocities. As a result, it is no problem at all to produce one-layer, biaxially oriented film structures. Preliminary trials were performed on laboratory extruders and laboratory stretching frames. The best foaming agent concentration was 2 %. The following materials were expanded and oriented:

- straight PP for BOPP applications,
- PP with additions of long-chain branched PP grades, which lead to an increase in the melt elasticity and thus to finer pore structures,
- block copolymers with an ethylene content of approx. 12 % in order to obtain softer, paper or fabric-like materials with fine foam structures, and
- highly crystalline PP [6].

Conclusion

The production of expanded biaxially oriented films of PP and PP copolymers has become possible using the simultaneous LISIMã technology. The described examples demonstrate the many possibilities for varying the final film properties through formulations, machine settings and processing methods. The field of application for such films is correspondingly broad. Suitable blend formulations of PP and PA 6 or PET can also be converted by simultaneous biaxial orientation into high grade new technical film products with defined properties using the LISIMã process.

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