

Films and Foils

Transparent films are used in thousands of different applications. Whether shrink film, blister or medical films – each application asks for specific behaviors in the material selection and processing conditions. Flower packaging should be very clear, protecting and presenting its content in the same way. Films for grocery bags are expected to diffuse the light. Consistent transparency can only be guaranteed if the key material and process factors are under control and a standardized sample preparation is used.

Influence of material and process parameters

Besides polymer selection, several decisions can influence the appearance, such as the choice of cast versus blown film production process. Cast film with its fast quench capabilities has better transparency and gloss, and can be controlled by the roll surface. Many parameters affect the final film quality e.g. density, mass distribution or melt index on the polymer side, as well as processing influences like melt homogeneity, cooling rate or blow-up ratio. Often additives to control properties like crystallinity or anti-blocking need to be adjusted to guarantee the desired effect.

Inner haze versus surface haze

A hazy appearance of films can be caused by internal scattering in the bulk material due to voids, crystallinity or other irregularities, referred to as "Inner Haze". On the other hand, light can be scattered at surface structures, which is called "External or Surface Haze".

At cast films, surface roughness can often be reduced by the chill rolls surface and the temperature control in the cooling process. On blown film with its free-surface flow, the surface roughness is mainly caused by melt-flow phenomena and crystallization.

In the development and optimization of production parameters, it is important to know the source causing the scattering and which parameters offer potential for improvement. Thus, inner and surface haze are to be differentiated. A liquid with similar refractive index as the sample, is used to cover the surface structure, which allows minimizing the scattering by the film roughness during measurement. Appropriate liquids can be found in the optical laboratory supplies for refractometry and microscopy.

BYK-Gardner Solution



Transparency
haze-gard i



Film and Sheet Accessory
sample holder



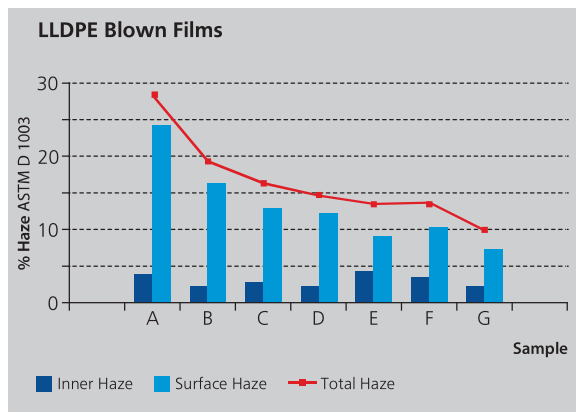
Thin Film Accessory
thin film Holder



First, the sample is measured without the liquid to get its "total haze" value. Then, the sample can be placed in a cuvette containing the liquid, or often a thin film of the liquid is applied on both sides of the sample to measure its "inner haze". In this case, care has to be taken to apply a uniform layer without dirt or air bubbles. Finally, the difference between both values will provide the "surface haze":

$$\text{Surface Haze} = \text{Total Haze} - \text{Inner Haze}$$

The example graphs the haze results of different linear low density PE blown films. The data show a strong impact of surface related causes to the total haze quality, which is characteristic in blow film production. Influencing parameters besides the resins itself are e.g. the melt viscosity, blow-up ratio and process speed.



Accessories for Liquids
cuvette holder



Accessories for Liquids
Cuvettes