26.4.4.1 Polypropylene

The plastic that has had perhaps the greatest impact on the packaging of confectionery is polypropylene (PP), although in most applications this is co-extruded in three or more layers (see Figure 26.16) and bi-axially oriented (BOPP) whereby the extruded film is stretched in both the transverse and machine direction. This is a close cousin of polyethylene; both are polyolefins derived from ethylene, but PP has an even wider range of applications. As a packaging film it can be made very thin, down to 10 µm (0.39×10^{-3} in); but, due to the film's desire to stretch, it is not commonly used for printing below 15 µm (0.59×10^{-3} in). However, in the United States, central impression flexographic print presses are used to print BOPP below 15 µm (0.59×10^{-3} in). It is the least dense commonly used plastic material, so it is very light; the combination of these characteristics gives very high yields. (Yield is the area of material contained in a given weight, generally expressed as m^2/kg or in^2/lb.) It can be coated with other materials or co-extruded with them to give any combination of properties required in a package. It runs well on automatic packaging lines, having a low coefficient of friction with metal, and it has a wider sealing range than its competitors, provided the machinery has adequate heater controls where heat sealing is employed.

For heat-sealing purposes, it should be note that, in BOPP structures, the sealing layer is very thin typically ~1 µm (0.039×10^{-3} in) with the core layer not readily wanting to heat seal to itself (Figure 26.16). CPP is co-extruded in the same way as BOPP but without the bi-axial stretching process; therefore, the sealing layer in the co-extrusion is thicker and provides greater opportunity to produce tight heat seals.

In its clear form, PP has largely captured the boxed chocolate market, and most confectionery bags are now made from BOPP or laminates incorporating BOPP or CPP. PP can be used to make thermoformed trays, although these are more difficult to form, more rigid and less user friendly then the un-plasticised PVC versions. On the other hand, blown PP shrink film, although rather more difficult to handle, gives more protection than PVC.

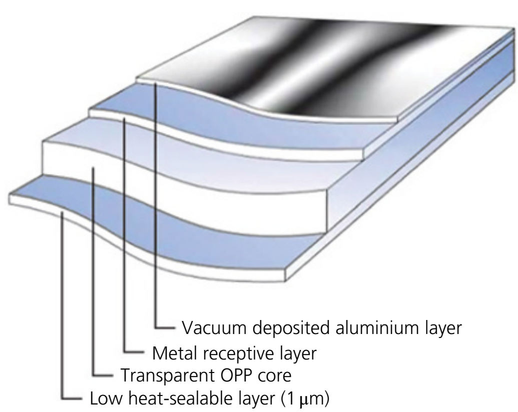

Figure 26.16 BOPP structure metallised format.

BOPP has dominated the market in recent years for flow wrapped chocolate tablets and countlines in cavitated, solid white or metallised forms, in mono-web and laminated formats. However, the PP that has shown the most rapid growth worldwide is white opaque (cavitated) PP whereby the core layer of a co-extruded film (typically three to seven layers) contains air pockets. As well as being light, thus giving a high yield, it is relatively rigid and crisp, and it can be made either with high or low sheen to look like paper. Perhaps its biggest advantage for use with chocolate-coated products is that it eliminates optical staining (when wet or greasy marks show through), a constant problem with paper, glassine and transparent film.

The film can be white with a pearl-like colour, where the outer layers are transparent, or "super white", where the outer layers are coloured white providing a deep white and glossy surface for printing. Development work is continuing and several manufacturers have reduced density even further while increasing opacity and stiffness, without impairing the barrier properties of the cavitated material.

Other structures used include solid white BOPP for a more rigid feel, metallised transparent BOPP for added moisture, oxygen and light barrier and laminated films such as metallised BOPP/PET for high barrier and quality feel, particularly for heat seal applications. In recent years, metallised cavitated OPP has become available due to its higher yield over transparent solid metallised film and therefore potential lower cost per square metre. Metallised films are often used for their ability to retard light induced rancidity, for example with white chocolate, thus extending shelf life. It also minimises optical staining or "show through". In many ways, metallised films are superior to aluminium foil, which they closely resemble, but none has the same dead-fold properties, so they are primarily used on horizontal flow wrap and vertical bagging equipment.

Where moisture barrier is the key criteria for product shelf life, for example chocolate-coated wafers, then metallised polypropylene has been the material of choice either in mono-web form for cold seal applications or in laminates for both cold and heat seal applications. It must be noted that, in simple laminations, the metallised layer provides the majority of the moisture barrier. The addition of a transparent BOPET to a metallised BOPP for example will add almost no additional barrier to the structure. In the example shown in Table 26.3, the daily water vapour transmission rate (WVTR) of the metallised BOPP is 0.8 g/m^2 (0.052 g/100 in^2) at 38 °C (100 °F) and 90% relative humidity (RH. The addition of BOPET with a daily WVTR of 40 g/m^2 (2.6 g/100 in^2) has almost no impact on the total barrier property of the laminate, changing the theoretical daily WVTR to 0.78 g/m^2 (0.050 g/100 in^2).

Today, metallised cast polypropylene films (met.CPP) can match the barrier properties of standard met.BOPP films. A thicker sealing layer and superior flow properties (caulking) under heat compared to met.BOPP has meant met.CPP has become popular in hot humid climates for heat seal applications, especially for flow wrap operations.