Polyolefines is a name used for a range of plastics, which are normally injection moulded. Many of them are very suitable for printing such as polystyrene, A.B.S. and PVC. However plastics such as polyethylene, polypropylene and polythene will not accept print in their natural state. For a plastic to accept ink, it is necessary for it to be wettable by that ink. For this to be so, the surface tension or surface energy, measured in dynes/cm, must be greater than the surface tension (energy) of the ink.

Polyethylene, polypropylene and polythene have a surface tension of 30 dynes/cm. This has to be altered to be a minimum of 38 dynes/cm, preferably 42 dynes/cm.

This can be achieved in three ways: -

1) By applying a liquid primer.
2) By corona discharge.
3) By flaming with a calor/butane/natural gas - air mixture.

LIQUID PRIMING

This method is limited in the range of plastics, which can be successfully treated. It is probably the least favoured method.

The fluids used are inconvenient to apply, ideally by spraying or dipping. Care must be taken not to inhale the vapours or allow the fluid to come in contact with the skin. It has varying effects on different materials and is not suitable for all. There are various primers available. Experimentation is necessary but even then selected changes in material batches can alter the effectiveness.

CORONA DISCHARGE

This process uses a high voltage discharge. An electrode is ranged over the surface to be treated in a line. Underneath the material is another receptor electrode. The distance between the electrodes is critical and ideally it should remain constant. A high voltage is generated (several thousand volts) and the discharge arcs between the two electrodes producing a plasma. This ionises the surface of the material to be treated, thus altering its surface tension. The process is clean and relatively safe.

There must be adequate guarding to protect operators and it is essential that the Ozone generated is exhausted to atmosphere, as it is a highly toxic gas.

Corona discharge is most successful when used for treating film where the distance between the electrodes is reduced. There are some very sophisticated systems for three dimensional objects, which are very effective. These are used where high volumes can justify the capital costs.

The process will not work if there is any break in the surface being treated, as the discharge will find the path of least resistance and short directly through the hole.

An alternative to this method is where components are bulk treated in a chamber that is charged with electrical plasma. This is a very effective method and will treat every surface of a moulding no matter what the shape. It is however really only suitable for large numbers of components as the capital cost of the equipment is quite high.

FLAMING

This is the most widely used method of pre-treatment. It is flexible and reliable if carefully controlled. It enables uneven and curved surfaces to be treated. It uses a mixture of air 20 - 50 p.s.i. and gas at low pressure 0.25 p.s.i. The gas can be Butane, Propane, Natural Gas (Methane) and Coal Gas.

For the flame to be effective it must be oxidising, that is, blue.

Correct flame control is very important. A basic flamer will do simple work but for regular use and long production runs it is recommended to use specially designed flame control systems. These are fitted with gas and air control valves to compensate for pressure fluctuations ensuring that the mixture is always at its optimum.

Safety devices such as flame failure are fitted as standard. Automatic ignition is also normal.

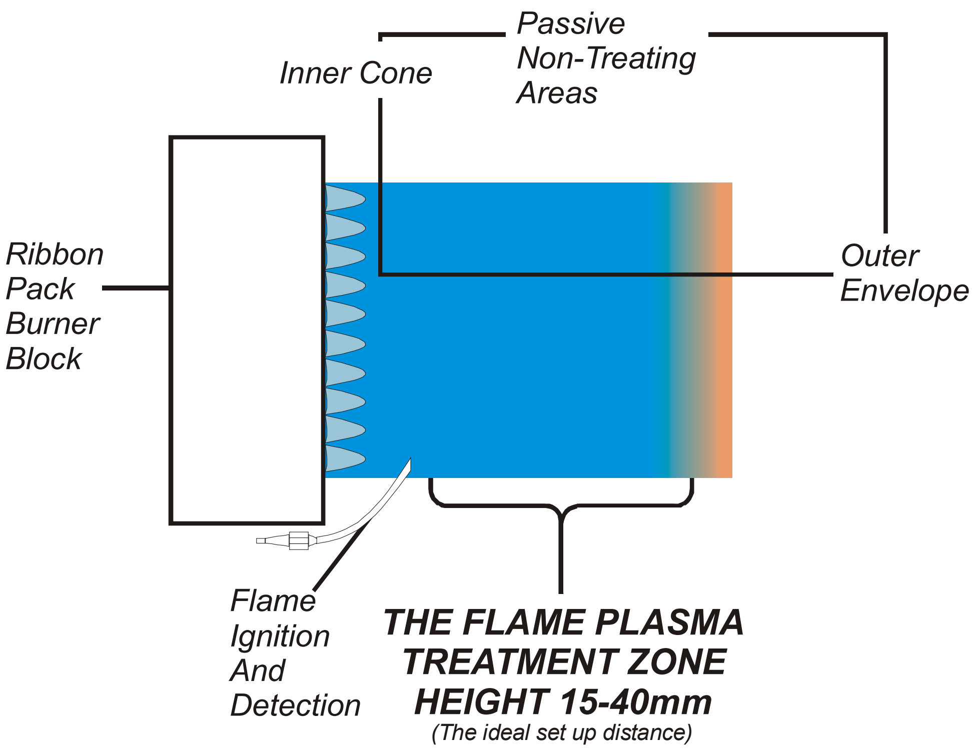
Flame nozzle design is important and these are normally single or double row ribbon burners. This will give a more stable flame shape and characteristic. "Flame throwers" are inefficient and unreliable. Flame control and position of the item in the flame are critical. Setting up the flamer is very important. See Figure 1.

Over-flaming will damage the surface of the product and along with under flaming means the ink will not stick.

Speed of the conveyer greatly effects the flaming. As a rule the higher the speed of passage of the item through the flame the less likelihood there is of damage to the surface. High gloss surfaces are susceptible to blooming which reduces the gloss. Higher speeds help reduce this.

Conveyers are constructed from metal mesh. Ensure they are of sufficient length to allow the mesh to cool. Hot meshes will mark plastic components.

FIGURE 1 IDEAL FLAME SHAPE



PLASMA TREATMENT

Cold gas plasma technology is emerging as an efficient way to treat polymers, dramatically improving their surface properties for high performance printing, painting and adhesive bonding. In some cases plasma provides the only acceptable solution to these common surface treatment problems.

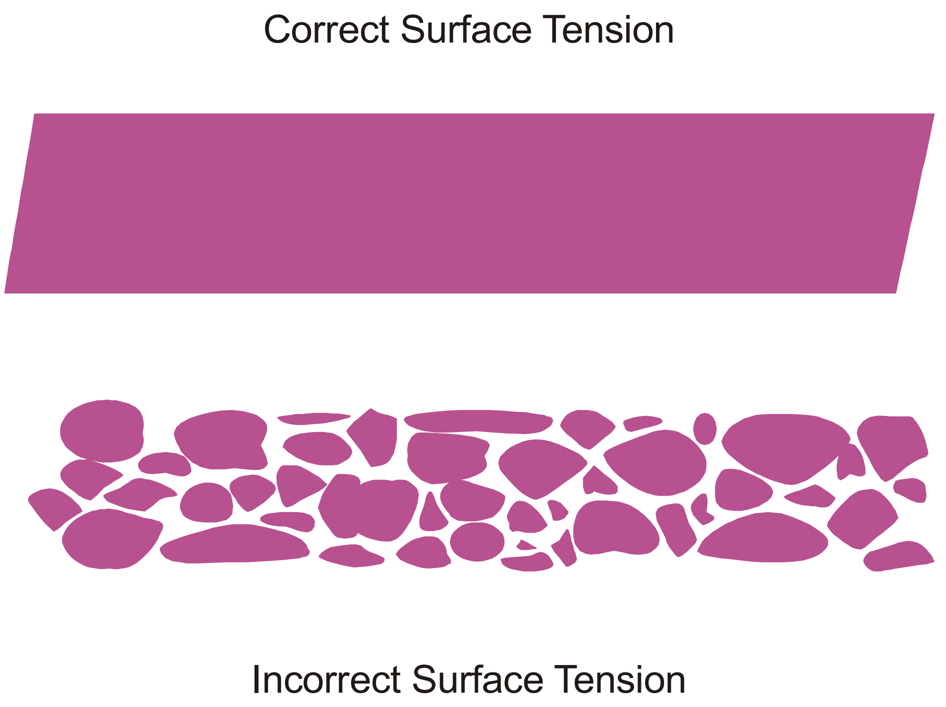
TESTING FOR CORRECT PRE-TREATMENT

To enable checks to be carried out on pre-treated surfaces, it is necessary to establish the amount that the surface tension (energy) has changed. Applying a glycol-water mix of a specific surface tension best does this. These mixes can be contained in glass bottles and applied by brush or more conveniently by felt tipped pen.

If the mixture spreads evenly across the surface, then satisfactory pre-treatment has been achieved. If, however, the liquid forms into globules, then the pre-treated surface has a surface tension less than the glycol-water mix applied.

Checking the results with a test pen or test kit is essential. See Figure 2.

FIGURE 2 EXAMINATION OF SURFACE ENERGY USING TEST FLUIDS



TEST KITS

Kits normally consist of 6 to 8 mixes giving indications of surface tensions from 28-56 dynes/cm. This testing method can be applied to pre-treated surfaces no matter what form of pre-treatment is being used. It is imperative that the lids be firmly replaced after use. Gloves and goggles should be worn to prevent contact with the skin and eyes.

FELT TIP PENS

Test fluids can be supplied in the form of felt tip pens; these are adequate for determining a minimum level of treatment. Both methods use hygroscopic fluids, it is imperative that the lids be firmly replaced after use. Gloves should be worn to prevent contact with the skin.

Running Water

A rule of thumb is simply to hold the object under running water. Upon removal the water will show even wetting followed by slow de-wetting.

On an untreated surface the water will form globules.

Scotch Tape

Another simple test is to heavily mark the component with a ball pen. Stick a strip of clear Scotch Tape on the mark and strip off. Correct pre-treatment will show most of the ink adheres to the plastic. This is not ideal and should only be used as a last resort.

Other Factors Affecting Adhesion

Treatment level is a decisive factor for the adhesion of printing inks onto PE and PP. There are, however, other factors such as the migration of slip additives which can affect adhesion, but whose effects cannot be detected when measuring the level of treatment. It is, therefore, possible that printing inks will not adhere despite favourable results when testing the treatment level.

It is also possible that surfaces with the same treatment levels will give varying degrees of print adhesion.

If Polyolefines are being printed and no pre-treatment is available, then primer less inks should be considered. Efficient post-treatment in the form of either infra-red drying, hot air drying, flame drying or UV drying, will make ink selection much easier, as all of these processes will enhance the final characteristic of the relevant ink system. A typical example of this is printing onto polyoxides, such as Delrin. Here, single part ink can often be used as long as it is post-treated with a flame. Without this, the highly stable structure of the material makes satisfactory adhesion impossible.