

## THE USE OF EMULSION COPOLYMERS IN COATED PAPER AND BOARD

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### The production of coated paper and board.

The process starts with a dispersion in water of cellulose fibres, obtained by the mechanical or chemical breakdown of wood. The dispersion is fed to a paper making machine where it is dewatered over a moving wire mesh, forming a semi-dry mat. This mat is carried by the mesh to heated drying units to produce the basic paper or board product. Board differs from paper primarily in having a greater weight per unit area, normally being made with several layers of fibre mats, and is familiar to the public in the form of cereal, cigarette and confectionary packaging.

If the product is to be coated the coating can either be applied as a second stage on the paper making machine itself (on-line), or in another operation on a separate machine (off-line). One or both sides of the sheet may be coated, and one, two or even three coats may be applied to a side, depending on the effect desired.

The coated product may then be passed between calender rolls to improve gloss and smoothness. Again, the calendering process may be carried out either on-line or off-line.

### Why Coat?

Base paper and board, being essentially a mat of cellulose fibres is relatively rough on the microscopic scale. The product is coated in order to improve its appearance and to increase smoothness to provide a better surface for the printing process.

### What is in The Coating?

The paper and board coatings in use today consist mainly of clay or calcium carbonate particles (known as the coating pigment) bound to each other and the fibrous substrate by a suitable emulsion polymer. This use currently consumes about 500,000 tonnes of emulsion polymer per year in Europe, split between styrene-butadiene copolymer (73% of the total), butyl acrylate-styrene copolymer (25%) and vinyl acetate homo and copolymers (2%).

Commercial coating formulations also commonly contain small quantities of other important materials, such as viscosifiers which give control to the coating process and optical brightening agents which further improve the product's appearance.

### The Coating Process.

The coating is applied as an aqueous dispersion using specialised coating units, for which several designs are in common use. Immediately after applying dispersion to the sheet, the excess is removed, usually by passing under a suitable metering blade.

This process can take place at speeds of up to 1500m/min. (56mph). Coating weights are in the range 5 to 25 g/m<sup>2</sup>.

Immediately after it has been applied, the coating loses some water into the fibrous substrate and soon after all the water is evaporated as the coated product passes into high temperature driers. During drying, the coating consolidates, driven by the pressure difference across liquid menisci which form between the particles of pigment and polymer. Commercial coatings consolidate leaving a significant amount of air filled voids between particles within the coating structure - voids typically occupy 15% to 40% of the total coating volume.

### How Does The Emulsion Copolymer Contribute?

The primary function of the emulsion copolymer is to act as an adhesive between the pigment particles and the substrate. It therefore controls the mechanical strength of the coating, particularly important in lithographic printing where highly viscous inks are applied to the coating at high speed.

However, as the technology has developed, it has become clear that the emulsion copolymer can contribute much more than this. The coating process itself requires the emulsion to have very good chemical and mechanical stability. The particle size and stabilisation system are chosen to be compatible with the inorganic pigment dispersion, in order to achieve satisfactory coating rheology under the high shear conditions present in modern coating devices.

During drying, the final packing achieved by the coating is influenced by the ability of the polymer particles to deform and flow as the coating consolidates. Polymer design can therefore be used to help control the void system, which in turn governs many of the key properties of the finished coating. The voids scatter light and are therefore fundamental to the opacity and whiteness of the coating. They are also the main route through which ink components enter the coating during subsequent printing, and so their size and number influence print density and quality. The extent of coating consolidation during drying also affects the packing and orientation of the inorganic pigment particles (particularly if they are anisometric) at the coating surface. This has a marked influence on the gloss achieved in the calendering operation.

Finally, there may be particular requirements asked of the emulsion copolymer for specific sectors of the industry. For example, low odour in the packaging board area, stiffness for lightweight papers and wet strength for coatings to be litho printed.

In summary, emulsion polymers are much more than simple adhesives for the coating pigment. They have a significant influence in the high speed coating process and on all the important performance characteristics of the finished paper or board.