

Technology talkback

7 Why does lithography work?

The way lithography works is largely understood, and to an extent that has led to many recent developments in platemaking.

Dr W. H. Banks, Pira's chief chemist, explains to Brian Blunden some of the ideas behind this understanding

BB Most people are familiar with the basic idea that lithography depends for its operation on the antipathy of grease and water. Can you explain in layman's terms what prevents grease and water mixing? Is it, for example, the chemical structure or molecular structure of the materials? What is it that makes a substance in one case mix and in another separate?

Banks In some respects the behaviour of materials is similar to that of people. People socially tend to form into groups, and mix, or resist such mixing, and this is based on their affinity for one another. So it is with substances like oil and water, which are composed of molecules and these, like individuals, have an affinity for each other because there are forces acting between them. The forces arising between the molecules of one material are called cohesive forces and hold the molecules of a particular substance together to give the form, shape and characteristics to the materials that surround us. There are also forces existing between the molecules of two different materials which are called adhesive forces and these hold the molecules of two different substances together. The cohesive forces of oil and water are greater than their adhesive forces for one another, therefore they do not mix. So it is with water and oily ink presented with the alternatives of accumulating on one or other of the two surfaces of a plate, that is, either on the image or non-image area. Oil molecules will associate with other oil attracting molecules that comprise the image areas of a plate, and the water molecules will associate with the water attracting areas. Platemaking with etches and lacquers is the process of making just these two kinds of areas – oil attracting and water attracting – and arranging the balance between adhesive and cohesive forces to achieve the ink and water separation required for good image formation in lithography.

BB When listening to discussions about research related to lithography, one often hears the terms 'wetting'

and 'non-wetting'. Can you explain what these terms mean?

Banks Previously we have talked about the relationship of ink and water and said that substances have cohesive forces which enable them to remain as a coherent material. We have also seen that some substances will have an affinity for others, and this is described in terms of the adhesive forces which exist between the two materials. If the two materials are liquids and the adhesive forces are equal or stronger than the cohesive forces, then the substances will mix. They are miscible. If, however, one is solid and does not dissolve in the liquid, the liquid shows its adhesion by spreading over it. The extent to which the liquid spreads over the solid is described as wetting, and depends on how much greater are the adhesive forces than the cohesive forces.

BB One also hears reference to contact angles and contact angle measurement. Could you first of all tell us what is meant by a contact angle and what

Forces between molecules across the boundary of two materials in contact. The cohesive forces of oil and water are greater than their adhesive forces for one another and so they do not mix

