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Session 4: Prof. M. Judt

IT BECAME obvious at session 4 with its subject of barrier and absorption properties, the requirements for paper as a substrate, that we touched only the tip of an iceberg top. Very little is known about coating, although it has been carried out for 2 000 years.

Very little systematic scientific research incorporating the substrate and its properties is published. Maybe it has been done, but is in the files of the paper and coating mills.

In a very fine and concise review paper by Prof. Stannett, it was shown that many polymer materials are available to make more and better and sometimes cheaper functional, mostly unpigmented coatings and films for the packaging field. The mechanism and the differences of penetration of gases and water through composite materials were explained. Attention was drawn to the fact that the solubility of gases and water in the polymers is another critical point.

In the field of functional coatings and wrappings, many large chemical companies are involved and much money and effort are spent in research, because far greater public risks are involved when packaging and storing food (health, leakage, loss of odour and taste) than when printing coated papers, say, for a glossy magazine. Most of these functional coatings are extrusion-coated, solvent-coated or emulsion-coated, but 10–20 times more tonnage is coated with aqueous coatings.

If there had been a review paper at the symposium on the fundamentals of aqueous coatings, we should have realised very quickly that we know little about coatings as a science.

The approach by Hoyland, Howarth & Field is a new and refreshing way to collect data on some of the variables that occur during aqueous coating.

It was proved that some of the mathematical approaches, assuming a substrate to be homogeneous and to have pores of cylindrical shape with smooth surfaces in the Z-direction, are too primitive and need correcting factors—for example, for swelling of fibres, fibre orientation in the machine-direction, impurities on the fibre surface and deposits on and within the fibres.

It was moreover very well demonstrated by Oliver & Mason that surface irregularities cannot be overlooked when wetting surfaces. It will be interesting to have similar pictures taken showing the spreading of water on substrates

and, besides measuring spreading speeds, observe how surface irregularities like wire marks and felt marks swell up, increase the surface roughness of substrates and thereby interfere with wetting. An old controversy whether or not a substrate is to be machine-calendered before coating might be answered with this fine technique. It is doubtful whether oil penetration measurements as carried out by Gate & Windle will shed new light in the coating knowledge jungle.

Printing inks like coating colours migrate by particle filtration and absorption processes into the paper surface. To achieve good coverage and coating or ink hold-out on the surface, this penetration has to be stopped as quickly as possible. This is done in many cases by correct viscosity and vehicle or water retention control.

We do not know exactly how various drying systems like convection and infra-red drying affect the setting or immobilisation of pigments and binders. Some attempts have been made to find out, but in most cases no detailed information on the substrate is given.

In modern high speed blade coating operations, one may assume that there will be a pressure and time penetration dependency, for which the Z-direction compressibility or (to use the better term of Parker) flexibility has to be taken into consideration. Nothing at all is known in this area today.

Dr Youngs mentioned that entrapped air in soil pores acts as a solid material when water penetrates it. Maybe we have to look at this matter again very carefully when doing high speed coating and extrusion coatings, especially two-sided coatings in one nip as with the Bilblade coater.

Bergh & Thomin showed us cross-sections of starch surface-treated papers and starch-coated papers and made visual such effects as viscosity of starches, drying of coatings and application methods. The new spraying techniques for starch and coatings will have a new impact in the future, though we still need better and finer staining techniques to study where and how the binder penetrates into the top layers of substrates.

There is no published information how the pretreatment of fibres affects coatability. It makes a difference whether one works with slush pulp or air-dried pulp or cylinder contact-dried pulp or flash-dried pulp.

A few examples of what we do not know at the present—

1. If a 7 m wide substrate does not run well, after a storage of four weeks, in most cases it does run well. Why?
2. Should it not run well, we make the reels smaller and put the substrate over a smaller machine. Then, in most cases, it performs well. Why?
3. Baseboard for cast coating after some weeks' storage or seasoning makes the coater run twice as fast. Why?

4. Paper coated today and printed tomorrow will perform and print poorer than after one or two weeks' storage. Why?
5. Bursts occur in finished lightweight coated papers. Why?
6. They occur more often in smoother papers. Why?

Ideas for the future—

1. Studies of electron microscope pictures of coated papers broken open to reveal new details of substrate structures. Maybe tracer-marked binders or pigments will help to explain to us what actually happens during coating. Rheology problems of coating colours predominate in high speed blade coating. Penetration into the base paper has to be avoided, strike-through on to the back-up roll, too, because operating problems are caused by it.
2. From my practical experience in the field of coating, I know that 90 per cent of the operating problems originate from the substrate properties and their variations.

Perhaps research workers in the future will have more patience in relating the behaviour of pigments, binders and additives chiefly towards a certain substrate grade—and to stop (as is so often done) working with glass plates, polyester films and similar non-paperlike substrate materials.

And a warning to end with. I feel that looking at and testing smaller and smaller areas like 1 mm^2 of paper and drawing correlations how such a paper then behaves as a substrate for coating is very dangerous and maybe misleading in the field of coating.

We have to find the weakest link in a chain and, because there is (as said by Parker) a lateral spreading of water ten times faster than in the Z-direction, many smaller defects are evened out in the surface, but sheet structure failures and irregularities in the Z-direction will show up in operation in the coating machine, at the supercalenders and on the printing machine. This, together with the drying methods used, will influence the coating colour hold-out.

Here is a new field for basic research and maybe at one of the next fundamental symposia more work in this very interesting field of coating will be presented and discussed.