New melamine resins—less pollution

A. O. Bohler

Manager, Surface Coating Resins Laboratories, Dyno Industrier A.S., Oslo, Norway

A graphical representation of the increasing number of people in the world throughout time would show an exponential curve. By no means the least cause for such population increase is on account of industrial science and technology. Without developments in technology and science there would be no industrial development, and without this the increase in living standards would be extremely slow, whether viewed from the material or health aspects.

It follows, therefore, that as the world's population increases so too will industrial pollution. Now that Man has experienced pollution in such high degrees, he has come to realise that some positive action must be taken, and with urgency!

Whose duty is it to solve this pollution problem? It must, of course, be that of Industry. Each industry must solve its own pollution problems and must do it at a rate commensurate with that of the population explosion being experienced in the world today.

If one looks at industrial pollution, and in particular at pollution in the paint and lacquer industry, one can safely say that there is considerable room for improvement. A marked improvement in reducing pollution from surface coatings can be made by decreasing the amounts of solvents used. In addition, solvents with a lesser tendency to pollute can be used.

Certainly, it would be unreasonable to say that as from tomorrow—"No solvents". One can hardly do that. However, the time is fast approaching when Industry must act to develop products which, when viewed as a whole, are just as good if not better than existing products and are no more expensive.

It is this relationship between better products and favourable prices which all our Industry should endeavour to achieve.

If one looks at the properties of industrial finishes, that is to say paints and lacquers for use in industry having ease of application, rapid curing characteristics together with good appearance and durability, the amino resins are a good initial choice. Both urea and melamine resins can, in combination with many other film forming materials, provide both simple application and favourable curing characteristics. They can be cured at any temperature between room temperature and about 400°C.

The binders which are used in combination with amino resins can be chosen from a wide variety of substances such as alkyds, polyesters, acrylic resins, epoxy resins, nitrocellulose, acetobutyrate, polyvinyl butyral. Amino resins possess functional groups which react satisfactorily and have better compatability than a number of other cross-linking resins. Furthermore, amino resins can be produced from raw materials which are inexpensive, using relatively simple production processes which are short in duration and give high yields.

This has lead us to the urea and melamine resins being widely employed in industry in automotive applications, domestic appliances, metal and wooden furniture (both office and domestic) as well as board finishes and lacquers for floors, doors, etc.

How are amino resins formulated to be less polluting whilst retaining their usefulness?

Amino resins as one knows them today are produced by the reaction of urea or melamine with formaldehyde and an alcohol. They approximate to one of the following structural formulae shown at the top of the facing page.

As one can see, these resins contain methylene, methylol ether, butyl ether and methylol bridges.

It is almost certain that at elevated temperatures the methylol ether groups split in such a way that they can react with substances containing -OH groups. With the addition of acid, on the other hand, splitting of the butyl ether groups occur, again capable of reacting with substances containing -OH groups. In the latter case butanol is splitt off.

Since the production of etherified amino resins takes place with an excess of alcohol, the resins which are etherified with butanol will contain a quantity of butanol as solvent.

The question arises, how can such cross-linking amino resins be produced at higher solids and/or with less objectionable solvents and still maintain their sphere of applications?

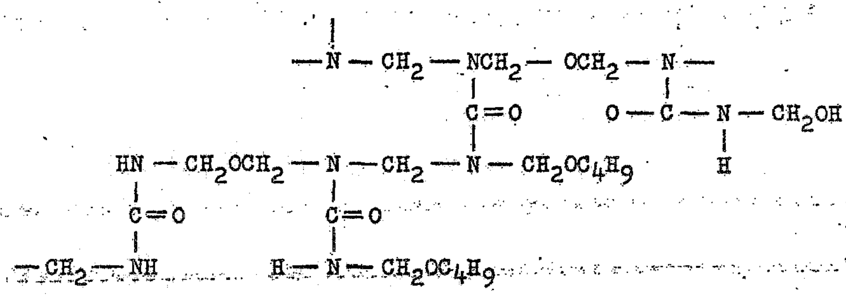
If one can visualise a resin with all the solvent removed yet having a viscosity similar to that used in industry today, the resin must be of low molecular weight. If it is not possible to completely remove the solvent one should endeavour to use solvents which are less objectionable. It is in this direction that the Industry appears to be proceeding. Let us consider melamine resins—100 per cent solids types have been produced where the resultant splitting during curing yields methanol. The product, which is generally known as hexamethoxymethyl melamine or, more correctly, polymethoxymethyl melamine, has been shown to possess excellent properties with regard to its cross-linking characteristics. On the other hand the product has no methylol nor methylol ether bridges but only methyl ether bridges which means that addition of an acid is needed to cause splitting and reaction.

It should be mentioned that the near monomeric structure of the products will influence the speed of cure such that it will react more slowly than that of a conventional amino resin. This, however, in many instances, can be compensated by using higher stoving temperatures.

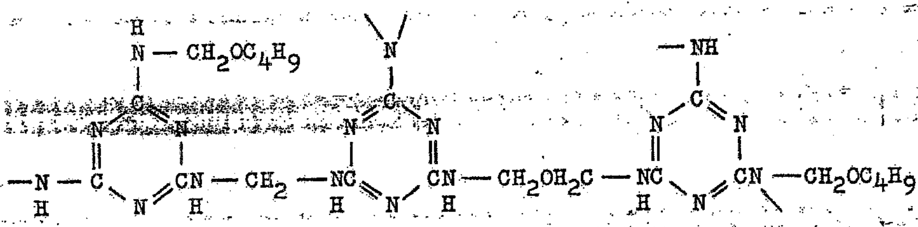
One has now arrived at a product which is not only more acceptable from the pollution point of view, but also shows exceptional compatability with a number of -OH containing binders which are either dissolved in water or an organic solvent. In addition, the product also shows, in comparison with other amino resins, excellent adhesion to untreated metal surfaces. When the product also has excellent flexibility together with a high surface hardness, then it is clear that a remarkably useful resin has been produced.

The product has certain limitations in that an acid catalyst must be employed or alternatively it must be used with other film formers having a certain degree of acidity as well as having to use relatively high curing temperatures to obtain a satisfactory cure.

Research into methods for alleviating these limitations has resulted in an alternative to a fully 100 per cent pr



Urea resin



Melamine resin

accepting a somewhat lower solids content with a flexibility and adhesion more comparable with conventional melamine resins. It has been possible to produce methylated melamine resins having up to 80 per cent solids content which cure rapidly under ordinary conditions without the addition of acid. Furthermore these resins are compatible with binders soluble in water and/or organic solvents.

Superior products at higher prices are not usually the most desirable answer. When it can be demonstrated that methylated melamine resins, given the right conditions, may be produced at similar prices (calculated on solids content) to conventional melamine resins, then it can be fully appreciated that research into reducing the pollution problem has also yielded other very positive results. These will lead to strengthening the market position of amino resins by producing less expensive and more versatile cross-linking agents.

Polyester film aids European nuclear research

A major piece of experimental apparatus, designed at a Government research laboratory and manufactured by British companies, has been installed at the laboratories of the European Organisation for Nuclear Research (CERN) in Geneva.

The "Muon" experiment, mounted on the CERN intersecting storage ring, demands a three-dimensional observation system so that the co-ordinates of the sparks can be determined. For this purpose, 100 mirrors for simultaneous viewing are required.

Glass vacuum-metallised with aluminium could not be used for the largest mirrors because, at the time, aluminium evaporation plants could not accommodate glass of the required size.

A solution was found in the use of a selected grade of "Melinex", ICI's polyester film, vacuum-metallised with aluminium, which was made into "Mirrorlite" mirrors of the required sizes by Pearson Mirrorlite Ltd. of Sheffield.

The mirrors were checked for accuracy by employing telescopic sighting techniques over the working length of the light paths. It was found that distortion was very low—less than ½ mm. (0.02 in.) over 17 metres (56 feet) and well within the maximum error specified for the experiment.

An important advantage of the use of "Melinex" is its dimensional stability, and it was found that when the mirrors were subjected to temperature variations their planar accuracy was considerably higher than that of equivalent glass mirrors. Because the "Mirrorlite" mirrors are very light in weight by comparison with conventional mirrors, the framework required to support them for the experiment is relatively simple, so a substantial reduction in cost was achieved.

Corrosion protection of light section steel in buildings

A document recently published by the British Standards Institution enables an architect conveniently to select a suitable anti-corrosion protective treatment for the light section steel elements in a building or structure in terms of the environmental factors prevailing and the desired life of the protective system. This approach to corrosion protection conforms with the modern philosophy of considering at the design stage the cost of corrosion prevention over the whole life of a structure.

The document which uses this new and, as yet, unproven concept, is a Draft for Development, DD 24: 1973 *Methods of protection against corrosion on light section steel used in building.* If it is successful it will become a British Standard when sufficient knowledge and experience have been accumulated in its use. DD 24 covers cladding and components made from light formed section of up to an arbitrary thickness of 5 mm. It does not cover weathering steels or stainless steels to BS 1449: Part 4, nor hot finished sections, although the recommendations may in the latter case, be appropriate where appearance is important.

Protective systems recommended in this document include paints, plastic coatings, metallic coatings and vitreous enamel and many of them are specified in British Standards.

This Draft for Development is a replacement for a previous BSI publication, PD 420, which was similar in subject matter, but much less comprehensive. Price, including postage, £1.90 (plus 20p for orders under £2.00). From BSI Sales Branch, 101 Pentonville Road, London N1 9ND.

Sim-Chem at ACHEMA Exhibition

Sim-Chem, a division of Simon-Carves Ltd., Stockport, England, will be exhibiting in Hall 5, stand A26 at the Achema exhibition in Frankfurt, June 20-27, 1973.

They will be offering a complete world-wide chemical engineering and construction service for turnkey contracts of any size, including refinery and metallurgical process plants.

Visitors to the stand will be able to see a scale model of a multi-million-pound caprolactam plant built for Nypro (UK) Ltd. at Flixborough, Yorkshire, England.