

# UV/EB CURING IN AUSTRALIA

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## ABSTRACT

Progress in UV/EB curing is reviewed in Australia. Generally the technology is used by those industries where curing is well developed in Europe and North America, however the scale is an order of magnitude lower due to the smaller market size. The Asian economic crisis does not appear to have affected expansion of the technology in Australia. EB continues to be successfully used in the packaging and foam fields whilst in UV, security devices, particularly banknotes are steadily expanding especially in export markets.

## 1 INTRODUCTION

The radiation curing field in Australia continues to expand at approximately 10% per annum with continuing emphasis in some fields at the expense of others. In this respect Australia reflects developments in Europe and USA but on a smaller scale. The economic downturn in Asia, whilst directly affecting some businesses in Australia during 1998, had a far greater effect in the uncertainty that it caused to businesses in general. This was evidenced by the postponement of decision making for purchases of new equipment and the upgrading of existing plant. The strong Australian economy and the containment of the Asian economic downturn has seen during 1999, a steady return of confidence to industry.

There are several exceptions or field emphases in Australia's growth in UV and these will be given detailed treatment in this paper. In particular, the security printing area continues to excite and provide new products of interest, especially with the unique radiation cured banknotes.

## 2 APPLICATIONS

UV curing is widely accepted and used throughout industry in Australia. Currently the major areas of use are as follows:

- \* Clear coatings - predominantly in the graphic arts
- \* Inks - litho, screen and flexo narrow web - wider web flexo on paper and board is of growing interest but numbers are still small
- \* Pipe coating - essentially metal with some plastic contribution
- \* Automotive - glass including repair kits
- \* Metal decorating - three piece cans
- \* Security devices - banknotes, passports, travellers cheques, stamps, bonds, phone cards
- \* Adhesives - both paper and plastic substrates.
- \* Wood coating - pre-finished flooring and blind slats using a wide range of timbers.
- \* Optical fibre - coating and colouring

Overall, clear coatings and printing remain as the significantly larger fields of UV applications. In the label area, there is a tendency to move from letterpress to narrow web flexo. The expansion of flexo printing to wide web lines continues to be of interest but has encountered problems in use, particularly with plastic films. In this instance, the film tends to absorb heat and stretch because of the thinness of the film in the press and this heat cycle during printing leads to distortion of the final printed film. One method attempting to overcome this problem is to pass the web over chill rollers to maintain a constant temperature throughout the film.

Free radical initiators continue to be the major curing accelerators widely used, with the latest Irgacure materials from Ciba Geigy like 1800, 819 and 2959 finding increasing application. Cationic systems continue to be used but on a much smaller scale especially for printing on plastic films. However problems have been encountered in this process with certain cationic photoinitiators. From one such photoinitiator, uncured propylene carbonate has been observed as showing a tendency to migrate through the film during use. Such detrimental migratory problems have previously been encountered in UV curing with benzophenone from the benzophenone/amine complex when used as a low cost photoinitiator.

Wide web flexo printing on paper particularly, is of interest in this country however the small size of the market at this time, for such applications does not justify the use of the technology in Australia. This is a typical example of how the relatively small size of population of countries like Australia can limit specific applications of radiation curing technology.

Of the remaining major areas of interest, apart from Security printing which will be covered in depth later, wood coating, particularly for pre-finished flooring and slats is expanding steadily. There are a wide range of timbers obtained from local and overseas sources including hardwood, spotted gum, Tasmanian oak, cypress pine, ash, beech, oak, maple, jarrah and birch. A unique application of UV in this field is the production of prefinished, recycled hardwood for flooring, mainly from mountain ash (*eucalyptus regina*) and tallow hardwood (*eucalyptus microcorys*). The UV process improves the calibre of the recycled timber product.

With the Asian economic crisis at its peak during the past two years and Australia's bigger export markets being in that region, areas like optical fibres have suffered significantly because of lower demand. This situation now seems to have bottomed out and alternative export markets have been developed, so optical fibres are again showing stronger growth.

### **3 DEVELOPING PROCESSES**

Extensive interest has emerged in a number of UV areas and in many of these areas, R&D has been performed and commercialisation is imminent:

- \* UV pigmented coatings - role of photoinitiator especially in exterior coatings
- \* Release coatings
- \* Medical devices
- \* Powder coating
- \* Excimer sources in curing

Extensive work is being performed with pigmented coatings, especially comparisons with the analogous EB products. Exposure trials under accelerated weathering conditions are being

carried out because of the large potential in this field. Interest in UV powder coatings remains intense, with the operators in this area seeking to run liquid UV lines whilst exploring the corresponding powder technique. Research into the use of the Fusion Excimer source technique continues, particularly the use of new chemistry involving the charge transfer complexes originally proposed by Jönsson, Hoyle and co-workers (1). Work in this country is centred on the possible occurrence of concurrent grafting with photoinitiator free curing since the observation that grafting can occur in such processes, may influence the fate of the final product (2).

#### **4 SECURITY PROCESSING - BANKNOTES**

Because of the unique character of the UV cured banknote developed in Australia, an update on the process is reported here. Currently the significant features of the note are as follows:

- \* To date there have been no reported forgeries
- \* Note possesses increased life in circulation (factor of six over previous notes)
- \* Lower note costs and lower production needed
- \* Note is recyclable
- \* Technology applies to other security devices

Despite the above advantages, properties of the note continue to be improved by appropriate R&D. Thus the application of the photoinitiator free chemistry concept would be valuable since the elimination of photoinitiators would remove residual odour levels from the presence of such components. Replacement of acrylate chemistry could also lead to improved handling and feel with a more flexible coating. Currently the technology is being exported to a number of additional countries in the world.

Finally, the advantages of the new note, predominantly longer life, freedom from forgery and lower production costs have been extremely valuable in preparing for the oncoming Y2K bug. As a precaution for that time, excess currency is being produced and the UV process is ideal for this purpose.

#### **5 UV SYSTEMS**

There are three Australian manufacturers of UV systems and approximately ten representatives of imported UV systems. The graphic arts market is well catered for, as are some industry specific applications such as metal deco, optical fibre and CD/DVD.

Price ranges, service levels and technical support vary significantly across vendors and process outcomes vary accordingly.

Imports from USA, Japan and Europe continue to dominate the market with other Asian equipment gaining market share on price. Many new UV systems enter the country installed on OEM presses and coaters, without the customer being involved in the selection of the UV equipment.

A Fusion Excimer lamp system at University of Western Sydney, Nepean is enabling R&D on new photoinitiator free chemistry to be at the forefront of developments in this field.

The spot cure lamp market is also growing with applications in the electronics and medical devices fields. Chemistry for these applications is generally imported as the application is proven and the volumes relatively small.

## **6 CONCLUSIONS**

Radiation curing continues to expand at approximately 10% per annum in Australia. With EB, curing and crosslinking of foams continues to be strongly supported, whilst with UV curing applications, strong interest is being maintained in the banknote developments, especially as a valuable export commodity to other countries, not only in the geographic region but also worldwide.

## **7 ACKNOWLEDGEMENTS**

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## **8 REFERENCES**

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