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ABSTRACT

Radiation curing of coatings of wood based products is expanding and being used for curing of coatings of table tops, parquet, wood panel, furniture, curtain railing, etc. UV curing of over print varnish is still the main application of UV curing in printing industry. However, curing of printing inks has also been extended in the printing of CD and VCD in addition to other printing such as paper, magazine, label on bottles, metal-can, etc. In the electronic industry, the manufacturer of printed circuit board is still the main consumer of UV curable resins. On the other hand, low energy electron beam machine is used mainly for cross-linking of heat shrink films.

INTRODUCTION

UV curing is widely used in Malaysia, particularly in the printing, electronic and wood based industries. In the printing industry, UV irradiation is used to cure over print varnish for magazine, poster etc. or to cure printing ink for label, packaging materials and to some extent in silk printing. In the electronic industry, UV irradiation is used mainly in the manufacturing of printed circuit board (PCB) such as etched resist and solder mask. Other minor applications are for curing of conformal coatings and marking ink. In wood based industry, UV irradiation has gained wide acceptance for curing of coatings of parquet, table top, wood panel etc. On the other hand, electron beam irradiation for curing of coatings is still at infancy stage due to high capital investment and limited volume of radiation curable products. However, low energy electron beam is being used in Malaysia for cross-linking of plastic films. There are 5 low energy electron beam machines in the industry with the energy ranging from 170 keV to 500 keV.

RADIATION CURING OF WOOD COATINGS

Wood based industry is one of the main industries in Malaysia. In recent years, the timber industry has moved away from the manufacture of primary processed products to those of higher value added such as moulding and joinery, medium density fibreboard (MDF) and furniture. In 1997, there were 50 plywood and veneer mills located in Peninsular Malaysia, 80 in Sabah and 48 in Sarawak. Moulding and joinery has also shown tremendous progress with 141 joinery mills in Peninsular, 182 in Sabah and 21 in Sarawak.

The reconstituted panel products industry comprises 12 blockboard plants, 11 particleboard/chipboard plants, 9 MDF plants and 6 wood-cement board plants. Of these,

MDF plants had registered the highest growth and most the mills are capital intensive and equipped with the latest technology to optimise raw material utilisation. Beside the above, there were also 10 wood chips plants, 2 pulp and paper mills and 27 parquet manufacturers.

Furniture and furniture components manufacturing has been and still is the most promising sector of the industry. Most of the furniture factories, numbering more than 2,900, were small scaled with about 600 plants currently involved in the export market.

In addition to the forest timber, Malaysia has started to utilise rubber wood as another renewable resources of wood. Now a day, rubber wood has become one of the major wood sources for furniture and parquet manufacturing. In 1996 and 1997, there are about 9.7 and 9.5 million cubic meter of rubber wood available for further utilisation. The systematic forest re-plantation programme and the abundance of rubber tree as a source of wood make the Malaysian wood and wood product industries to continue playing a major role in the economy development of the country.

The application of UV curing technology in wood based industry was established in the early 90's. During that period, there were four industrial UV irradiation systems for curing of rubber wood parquet, table top, wood curtain railing and wood skirting board. In 1995, about 12 companies utilised UV curing technology. The situation has since improved. In 1997/1998, more than 22 flooring and furniture based companies utilised the UV curing technology. Although the number companies using the UV curing technology has not increased in 1998 compare to 1997, it is still represents a significant increased over the last 5 years. On the other hand, the volume of UV curable materials consume by the companies increased. The products range are parquet, table top, wooden chair and wood panel, curtain railing and skirting board.

There are about 8 suppliers of UV curable wood coating resins in Malaysia. The most common resins used are water based acrylate, polyurethane acrylate, polyester urethane acrylate, epoxy acrylate and polyester acrylate. It is estimated that the total consumption of UV curable resins for furniture industry in Malaysia has increased to about 480,000kg per year. The main application is for coating of table top. On the other hand, the total consumption of UV curable resins for parquet industry in Malaysia is estimated around 360,000kg per year. It is estimated that 40% of the radiation curable materials are produced locally. The consumption of radiation curable resins is in the increasing trend since the government has encouraged the local manufacturer to focus on the export market. Parquet, MDF and furniture are the main sectors of wood based industry for this technology.

RADIATION CURING OF PRINTING INK/VARNISH

UV curing of varnish is one of the major applications of UV curing technology in Malaysia. In early 90's the curing of over print varnish by using UV radiation is considered the most efficient due to the increase in productivity by reducing varnish drying time from hours to seconds and produce excellent quality and high gloss. OPV is the major application of radiation curing in the printing industry till today. It was estimated that UV varnish is among the highest volume of UV curable materials consumed in Malaysia which is around 250,000 to 300,000 kg per year. However, most of the OPV materials are imported in view of its low

price. Curing of coatings of compact disk is another application of UV curing technology and shows an increasing trend. The estimated consumption is around 10,000 kg/year.

UV curing of printing ink for labels, sticker and name card are another application of UV technology. The volume of printing ink used is rather small for such applications and it is estimated around 15,000 kg/year. UV screen printing ink for outdoor/indoor advertising billboards, banners, graphic display, plastic signage keyboards are amongst the application of UV curing technology. However, such application is still small and the volume of UV screen printing ink estimated to be around 5,000 kg/year. Nevertheless, the application of UV curing of printing ink is expanding to other products such as printing on CD and VCD.

RADIATION CURING IN ELECTRONIC INDUSTRY

UV curing technology is widely used in the manufacturing of printed circuit board. Etch resist, solder mask are the common and most applications of UV curing in electronic industry. It is estimated that the consumption of UV curable resins for etch-resist and solder mask is about 400,000 to 500,000kg/year. In term of number of the industrial UV units employed in the electronic industry, it can be considered the electronic industry as the second largest user of UV curing technology after printing industry. However, most of the radiation curable resins used in this sector are imported directly from over sea.

In recent years, UV curing of coating of fiber optic cable has started in Malaysia. However, the volume is still small and it is produced on the order basis. In 1998, the consumption of radiation curable materials for such purpose is estimated 360 kg/year for a single company.

RESEARCH AND DEVELOPMENT

To complement the industrial sector, the Malaysian Institute for Nuclear Technology Research (MINT) is providing research contract services, physical testing for surface coatings, coating process and radiation curing services. MINT has IST UV irradiation system with 80 and 200 Watt/cm² lamps and a maximum of 40 m/min conveyor speed. The low energy electron beam machine at MINT has a maximum 200 keV energy and 20 mA beam current. MINT laboratory is also equipped with roller coater, curtain coater and sprayer suitable for coating at laboratory or semi-industrial scale. Several testing equipment such as pendulum hardness, abrasion tester, scratch tester, tensile machine are available together with analytical equipment such as IR, GPC, DSC and DMTA.

Malaysia has abundant of indigenous materials that have the potential to be developed for commercial use. The industrial applications of palm oil and natural rubber have never been exhausted. New products and applications are being developed from time to time. In recent years work has been carried out in synthesizing acrylated palm oil to be used for coatings, pressure sensitive adhesive (PSA) and in printing ink. The use of palm oil acrylate for coatings has been reported earlier in several reports and journals. Preliminary work using palm oil acrylate as pressure sensitive adhesive has started and shown promising results. On the other hand, epoxidised natural rubber (ENR) is degraded into liquid ENR in order to be utilised in the cationic polymerisation.

CONCLUSION

Radiation curing technology has developed and well accepted by industry in Malaysia. Wood based industry has shown significant increase in the utilisation of UV curing technology in particular for coatings of parquet and furniture. In view of its export oriented products, the 1997/1998 consumption of radiation curable materials in these sectors increased slightly. Further effort is required to expand the utilisation of radiation curing technology in the existing area and to assist the user in the selection of radiation curable resins and in radiation and chemical safety. At the same time, new area needs to be found and developed such as curing of laminated board. In this particular area, the utilisation of electron beam is essential. Unfortunately, the success of the electron beam technology is strongly dependent on the capital cost which in return require high volume of products.

Although, the utilisation of radiation curing in printing and electronic industries has much earlier developed and established, the number of user has not much increased in the past 5 years. However, the applications have been diversified into CD, VCD and coating of fiber optic cable. In general, radiation curing technology will continue to develop in Malaysia.

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