USE OF UV/EB CURING TECHNOLOGY IN BRAZIL. PRESENT SITUATION AND PROSPECTS .

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INTRODUCTION :

The researches aimming to the commercial use of radiations to polymerize certain substances started in 1960, originating then the radiation curing. The term curing by radiation is used to describe the instantaneous polymerization of a liquid system containing 100% of solids, solventless, started by radiation. Many different radiation sources can be used to initiate the reaction. However, this technology uses exclusively ultraviolet (UV) light or eletron beam (EB).

UV curable inks, varnishes or other coatings, contain a mixture of liquid pre-polymer (oligomer), monomers, additives and a photo-reactive (photo-initiators) compound. When the UV light of a specific wavelength and an adequate intensity enhance the coating,the chemical bonds of initiator are broken resulting free radicals. Then these radicals start a fast addition polymerization reaction through out unsaturated bonds which are present in the polymer and monomer.

Electrons produced by an accelerator have high electric potential and due to its energy being higher than the photons of UV light they are able to start a chain polymerization reaction, without any presence of external initiators. This is the reason why a pure polymer is obtained. As the electrons cause ionization in the surroundings where they pass, they are called ionizing radiation.

ADVANTAGES OF CURING BY RADIATION:

Until some years ago, the main argument in favor to the technology of cure by radiation compared to other conventional methods of heat curing was the low energy consumption of the process. Saving of energy nowadays is still very important but most presently the outstanding issue in favor to the use of radiation is the non emission of organic solvents and combustion gases into the atmosphere.

The inks and varnishes used in a curing system by heat comprise basically a polymeric resin dispersed or dissolved in an inert or volatile liquid solvent, which has to be immediately removed after the application. The displacement of this solvent occurs by an evaporation process which requires high consumption of energy and promotes undesirable emission of pollutant to the atmosphere.

In many countries, mainly in the european continent, there already exist regulations to control the emission of materials to the atmosphere. It was proved that organic compounds such as pure hydrocarbons, solvents and so on, when emitted into the atmosphere can be considered as precursors of pollutants in the air which in the presence of NOx causes injury to the development of vegetables.

The curing by UV and EB involves 100% of solids, that is, the oligomer is diluted in one or more monomers. When this ink or varnish is irradiated, the monomers polymerize rather than evaporate, therefore becoming a solid component of finished coating.

Other main advantages of curing by radiation compared with thermal process are the following :

-low energy consumption;

-the curing can be processed at low temperatures and therefore applicable on sensible substrate;

-higher curing speed ;

-cured material presents excellent physic chemical and mechanical properties;

-high gloss;

-smooth surfaces.

DISADVANTAGES of RADIATION CURING

The main disadvantages of curing radiation process are:

-high initial investment cost;

-higher radiation material cost;

-inert atmosphere (mainly for EB);

-precautions for the use of acrylate compounds;

-presence of residual monomer and oligomer (mainly UV curing.)

PRESENT SITUATION OF RADIATION CURING IN BRAZIL

The industrial application of radiation curing in Brazil started in the late 60's, in the wood finishing area when they employed unsatured polyester diluted in styrene, cured by UV light.

In the early 70's, Bergamo Companhia Industrial, a furniture brazilian industry, acquired a low energy electron beam accelerator for finishing the surface of particle board panels.This accelerator was shutted down about 15 years ago.

With the developments started in 1970 of acrylated systems, low energy electron beam machines and higher power UV lamps, the radiation curing application grew significantly in the word being nowadays considered one of the major industrial applications of the radiation.

Unfortunately, the application of this technology in Brazil has presented a slow growing. This fact can be observed by analizing the volume of UV and EB curable materials consumed in the country,compared with other world regions. This volume started to increase significantly after 1991, as shows table 1.

A R E A S	1991	1993	1996	Estimated (5years)
Wood finishing (includ. filler)	550	900	1550	181%
Ink and varnish printing	53	75	110	110%
Electronics	30	45	65	116%
Others (plastic,optical fiber,compact disc,adhesives)	7	12	17	142%
T O T A L	640	1032	1742	172%

Tab. 1 - Estimated consumption radiation curable materials (ton/year)

In Brazil, the consumption of radiation curable materials in the wood finishing area is still by far the largest.

Table 2 shows the UV lines growth in different application areas.

A R E A S	1991	1992	1993	1996
wood finishing	12	20	30	60
Ink and varnish printing	45	53	64	85
Electronics	40	60	60	80
Varnishes on metals	2	4	4	6
Plastics	--	--	1	2
Graphic art (varnisher)	2	2	3	5
Others (compact disc,optical fibers)	--	4	4	7
T O T A L	101	143	166	245

Tab.2 - Growth estimative of UV lines installed in Brazil.

In Brazil there are 5 low energy electron beam accelerators installed, 3 of them are designed for heat shrinkable film production, 1 for ink printing curing for packaging and 1 for wood finishing which was shutted down 1n 1978. Two medium energy (up to 1,5 MeV) electron beam accelerators are in operation and a third one has been installed to be used for crosslinking of wire and cable insulation.

PROMOTION OF RADIATION CURING TECHNOLOGY IN BRAZIL

Since June 1992, the IPEN has been coordenating a work group involving industrial representatives from different segments related to radiation curing. The main objective of this group is to promote this technology around the country and also to search for the reasons why the effective use of this technology is growing so slowly.

Within the problems stressed, it was realized that the lack of technical information about the use of UV/EB radiation frightens the potential users, avoiding the expansion of the UV/EB use in the country.

For this reason, the group gathers once every two months and organizes many didactic activities to improve the promotion of this process to potential users.

In November 1992, a session entitled The First Basic Course about UV/EB Curing Application was hold at IPEN. 360 participants from different brazilian industrial areas took part at it.

In April 1993 the IPEN organized a round table discussion about UV/EB Curing Applications on Packaging and Graphic Arts. During this meeting, it was discussed the main practical problems occurred in the application of the technique.

Besides that, the IPEN has presented seminars about specific subjects at industrial exhibitions and class associations. Such experiences will lead to the organization and foundation of a national entity, The Brazilian Association of UV/EB Suppliers and Users.

The prospects of the progress of the use of this technology, in a short term, are very promissing because presently, after the opening of the importations, the brazilian market can buy sophisticated equipment, moreover there already exist local new UV line producers. The number of formulators of radiation curable materials has also increased, what imparts more efficient technical support to the users. The quality of the chemicals improved significantly since the formulators can have higher local stock at sale representatives of raw materials.

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