4.7 Current and Future Industrial Application of Electron Accelerators in Thailand

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1. Introduction

It was in 1997 that industrial application of accelerator in Thailand was first introduced. A Swedish own company started to commercialize some radiation sterilized products such as doctor gown, pampas, feminine napkin etc. for export to Europe. This might result from Thai government's policy to welcome foreign investment in the country, also from our relatively cheap labor and of course from our developed infrastructure. Later on in the year 2000, another American company installed a high energy electron accelerator together with a cobalt-60 irradiator aiming at producing new value added products like gem stones, topaz, tourmaline and zircon in particular. The company gave irradiation services also for food irradiation and sterilization of some export items using the company's cobalt source. Research and development in electron accelerator started last year, 2001, starting from assembling used components donated by few local hospitals. One machine is currently operational, the second is being reassembled. Both machines operate in pulse mode with energies of 20 and 4 MV respectively. Gem stone irradiation and radiation grafting of some polymers will be focused among other activities. The need for low and medium energy electron accelerators with moderate power for R&D in radiation technology is becoming more pronounced, hopefully, to be installed at the new national nuclear research center north east of Bangkok.

2. The need to conduct R&D using electron accelerators in Thailand

Current uses of electron accelerator by two private companies in Thailand now (Table1) are considered to be exceptional in view of establishing new technology and technology transfer to the local manufacturing companies. The technical-know how, process control, irradiation techniques, etc. are still proprietary and many of the useful data are kept secret. This is common for a high tech production process in business. It is, however the task of the governmental research institutes as well as universities to disclose some useful information and publicized to local businessmen and investors. A cooperation with JAERI / JAIF or FNCA to share expertise from source personals through seminars, meetings, workshops is a very effective way to reach the goal to achieve such purpose. The first of its kind was in 1993, when JAERI, JAIF and OAEP organized a workshop on the Utilization of Electron Beam in Bangkok. Although most of the participants were from the governmental sectors, a few from private sectors were apparently shown their interest, not yet to establish one in their factories but they follow the possible way to learn more about this radiation technology. It is expected that this kind of seminar will be organized again and again in Thailand.

As an electron accelerator is still new to our local industrial sector, also the machine with biological shielding is very costly, too costly and too doubtful for the investors to have courage to make any decision whether or not the machine can make profit in short or long

term. The problems of machine maintenance, know-how of the processes among other things are still obscure for the industrialists and investors. In order to solve these problems, the responsible governmental nuclear research institute like OAEP should make a role to support facilities: low and medium energy electron accelerators, hopefully to be installed at our new ONRC (Onkharak Nuclear Research Center) to serve for - demonstration pilot unit using electron accelerator for - production of value-added products from local raw materials- using electron beam processing (EBP) to manufacture products of high quality with low cost- HRD to support private sectors on EBP- provision of technical assistance for private sector through training course, seminar, workshop, etc.

R&D using EBP should be emphasized on technology transfer rather than develop our own technology at least at the beginning. This is to shorten the time to move forwards to pilot scale and industrial scale respectively.

3. Electron accelerator v.s. gamma irradiation facility

Electron accelerator and gamma irradiation facility are known to be complementary in radiation processing. While an electron accelerator is good for irradiation of thin film, laminated, flat, small rod shape, free falling powder, lamina flow liquid or solution products with very high dose rate and continuous irradiation capability, gamma irradiator is very good for bulky, high density, thick container products. In many cases, certain kind of products can be well adapted to use both electron accelerator or gamma irradiation, the proper choice is to be determined by the user whether machine source or isotopic source will be installed depend upon over all unit cost, process control and through put. In developing country like Thailand, another main factor to be considered is the need to have high caliber personal for electron accelerator maintenance. The readily supply of spare parts, availability of technical advice are also among other factors to be considered. For an electron accelerator in the lab using for R&D, a timely maintenance may be acceptable but in an industrial production process, any failure of the process by all means even in a short time is indeed a serious problem.

In Thailand, gamma irradiation facilities both for R&D and for commercial purpose are available only in Bangkok and near by cities (Table 2). The commercial facilities are operated in under capacity. Campaigns to convince people to become their customers are common. New application like pasteurization of pharmaceuticals, simultaneous radiation vulcanization of natural rubber latex and allergenic protein removal is also welcome if the customers can find the market. In other part of the country, irradiation facilities for R&D are needed in universities and some glove manufacturing factories in the south of the country may need the machine for sterilization of their products and put it for good use in removal of latex allergenic protein.

4. Role of OAEP and Universities to stimulate the utilization of radiation processing

4.1 conduct R&D on radiation processing related to immediate and potential uses for local industry

4.2 provide research result of new development related to radiation processing both from abroad and in house

4.3 encourage related industry to upgrade their product by using radiation technology

4.4 provide demonstration radiation processing plant using low and medium energy EB machine (if available in the future) for industry to make a test production

5. Immediate and potential uses of EBP in local industry

5.1 Cross linking of electrical wire and cable

There is at least one electrical wire and cable local manufacture shows strong interest to invest for an EB machine 1.5 – 2.0 MeV, 25 kW to upgrade the products of thermal resistant, low smoke, non halogen wire and cable. This is in response to the government new policy to add import tax to finished products and cut import tax for raw materials (Table 3). In addition, Asian countries shall have an agreement to reduce import tax of all items to 0 – 5 % by the year 2003. Local supply of polyolefin and EVA may cut unit cost of the products and ensure a steady supply of raw materials.

5.2 Heat shrinkable materials

Heat shrinkable tubes for electrical appliances, auto industry, telecommunication, corrosion prevention of pipeline can be manufactured in parallel with cross linking of wire and cable mentioned above. Irregular shape of heat shrinkable materials can be irradiated in limited air using readily available Co-60 irradiators.

5.3 Low protein concentrated rubber latex

The newly developed process of Dr. K. MAKUUCHI (JAERI) using low energy EB can be well adapted to produce low protein concentrated natural rubber latex without radiation pre-vulcanization. This is to meet requirement of sulfur vulcanized glove producers and meet requirement of US. FDA's new regulation to keep water soluble protein (allergenic protein) in rubber glove to less than 200 $\mu g / dm^2$. However, most of the glove manufacturers now can make a longer leaching time to cope with this problem. Only if the US. FDA lowers the protein amount to less than the mentioned value, the factory may consider radiation process. Table 4 shows our current export of HA latex and pertinent rubber products.

5.4 Rubber wood furniture and parts

One of the top twenty export items from Thailand is furniture and parts. Unlike the top export value of electronics and electrical appliances which led the country's export for several years, it relies on 80 – 90 % import content and generate only 5 – 10 % in added value, furniture has very low import content. Value of about 60 % of export wood furniture, rubber wood furniture has a steady increase in export of about 20% per year. Rubber wood does not involve in rain forest destroy as we cultivate the tree for latex. Supply of rubber wood is also very secure as we have the largest rubber plantation area in the world of about 5 million acres. The export value of rubber furniture and parts account for more than 10,000 million Thai Baht per year. Curing of surface coating by EBP can generate more value added to the mass production of these products with relatively low cost.

5.5 Degradation of silk protein by radiation

Degradation of silk protein by gamma irradiation is under investigation by OAEP staff in collaboration with JAERI. The products may find application in cosmetic industry as well as tonic food industry. Very high radiation dose is required to degrade the protein so silk waste can be flatten and efficiently irradiate by EB machine can be done.

6. Conclusion

Although two of commercial electron accelerator has been installed in the country, electron beam processing is still considered to be new technology. In order to strengthen the use of EBP to improve the finished product quality with an added value, FNCA may help in publicize this new technology to our industrial sectors through seminars, workshop, demonstration, etc. and finally an introduction of joint venture between Japanese side and Thai local company may lead to the success of establishing the technology very soon. This is also to comply with our government's policy to promote manufacturing of finish products with high quality for export.

Table 1 Current uses of commercial and R&D electron accelerators in Thailand

Name of company / organization installed	Year installed	Maker	Accelerator voltage	Beam current	Purpose of Use
Thai Klinipro Co. Ltd.	1997	Minilac USA	1.8-2.4 MeV	10 kW	Sterilization of doctor gown
IBA S&I (Thailand) Ltd.	2000	MEVEX Canada	15 MeV	8.5 kW	Upgrading of gem stone

Field	Target	From when	Title (contents)	Remarks
Particle physics	Research	2002	Production of far infrared coherent radiation	Reassemble From medical unit (20 MeV)
Materials modification	Research	2002	R&D on radiation processing	Reassemble From medical unit (4 MeV)

Table 2 Industrial gamma irradiation facilities in Thailand

Name	Year established	Shielding capacity	Source Activity	Purpose of irradiation	Remarks
Kendal Gammatron Co.Ltd.	1984	500 kCi	150 kCi	Sterilization of medical supplies	Nakorn Prathom
Thai Irradiation Centre	1993	3 MCi	450 kCi	R&D on radiation processing	Government own (OAEP) Pratumthani
IBA S&I (Thailand) Ltd.	1999	3 MCi	1 MCi	Sterilization and others	Rayong
GAMMASTER (Thailand) Ltd.	2000	6 MCi	1 MCi	Sterilization and others	Chonburi

Table 3. Four categories of new regime for import tax

Category	%
Raw material	5 (max)
Primary product	6 – 10
Intermediate or semi-finish product	10 – 15
Finish product	15 - 20

Table 4. Export of HA latex and medical use products in 2000 and 2001

Products	2000	2001
HA latex (metric ton)	538,418	276,305 (Jan-Jun)
Rubber gloves (1000 pairs)	6,959,300	5,625,200 (Jan-Sep)
Hygiene medical products (1000 items)	70,600	31,000 (Jan-Sep)