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2.2 Radiation Processing Technology in Malaysia

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Abstract

Radiation processing technology is widely used in industry to enhance efficiency and productivity, improve product quality and competitiveness. Efforts have been made by MINT to expand the application of radiation processing technology for modification of indigenous materials such as natural rubber and rubber based products, palm oil and palm oil based products and polysaccharide into new and high value added products. This paper described MINT experiences on developing products through R & D from the laboratory to the pilot plant stage and commercialization. The paper also explained some issues and challenges that MINT encountered in the process of commercialization of its R & D results.

Introduction

The current industrial application of radiation technology fits well into the country's development program such as Industrial Master Plan. The integration of resource-based materials is the production of advanced polymer and composites is very much supported by the government including the utilization of by-products that can be value add. Those materials can be modified through radiation cross-linking, radiation grafting and synthesis to produce composites and new materials of different functionality.

Malaysia is rich of natural polymer such as natural rubber and rubber based materials, palm oil and palm oil based materials, starch from sago and cassava, and chitin and chitosan from shrimp shelves. These materials are currently being used in the country and the technology to support the production and utilization of the materials are well established. Being natural polymer, they are environmental friendly and biodegradable and they are well known as 'green polymer'. With the current low market price of these

materials, it is more prudent to diversify its usage and to give more value added to the materials.

R & D CYCLE: LABORATORY TO MARKET

The following is the typical R & D cycle (Figure 1).

- Research work at the laboratory stage
- Developmental research at pilot stage
- Industrial stage.

In pursuing R & D on radiation processing of indigenous natural polymer, the main issues and challenges faced by MINT are to find industrial partner and to develop applications for new products. Each product has to go through the above stages of development before enter into the market.

Laboratory stage

At the laboratory research, MINT is well equipped with polymer processing facility such as melt blend mixers, compounder/extruder, cold and hot roll pressed, hot and cold press, table top injection molding machine, rheometer, etc. Subsequently, the materials will be subjected to physical, mechanical, analytical and thermal analysis in order to establish the material specifications.

For the physical and mechanical testing, MINT has sufficient equipment such as several tensile machines, impact tester, and hardness tester; melt flow indexer, scratch and abrasion testers, adhesion tester, etc. For analytical and thermal analysis several equipment are available such as FTIR, SEM, STEM (under procurement), GPC, HPLC, DSC, DMA, TGA (under procurement), etc.

To facilitate the commercialization efforts, the industrial partner should be identified and selected as early as at laboratory stage of research. Given the scenario of local Small and Medium Size Enterprise (SME), which lack of technical personnel and scientists and inadequate R & D facility and capability, to find and identify right partner from SME is a real challenge. In most cases, MINT carries out research at laboratory stage alone without industrial partner. However, prior to research, consultation was made with selected industrial sectors and following the government Industrial Master Plan and

various other government policies and guidelines. Where do we go after this level of research?

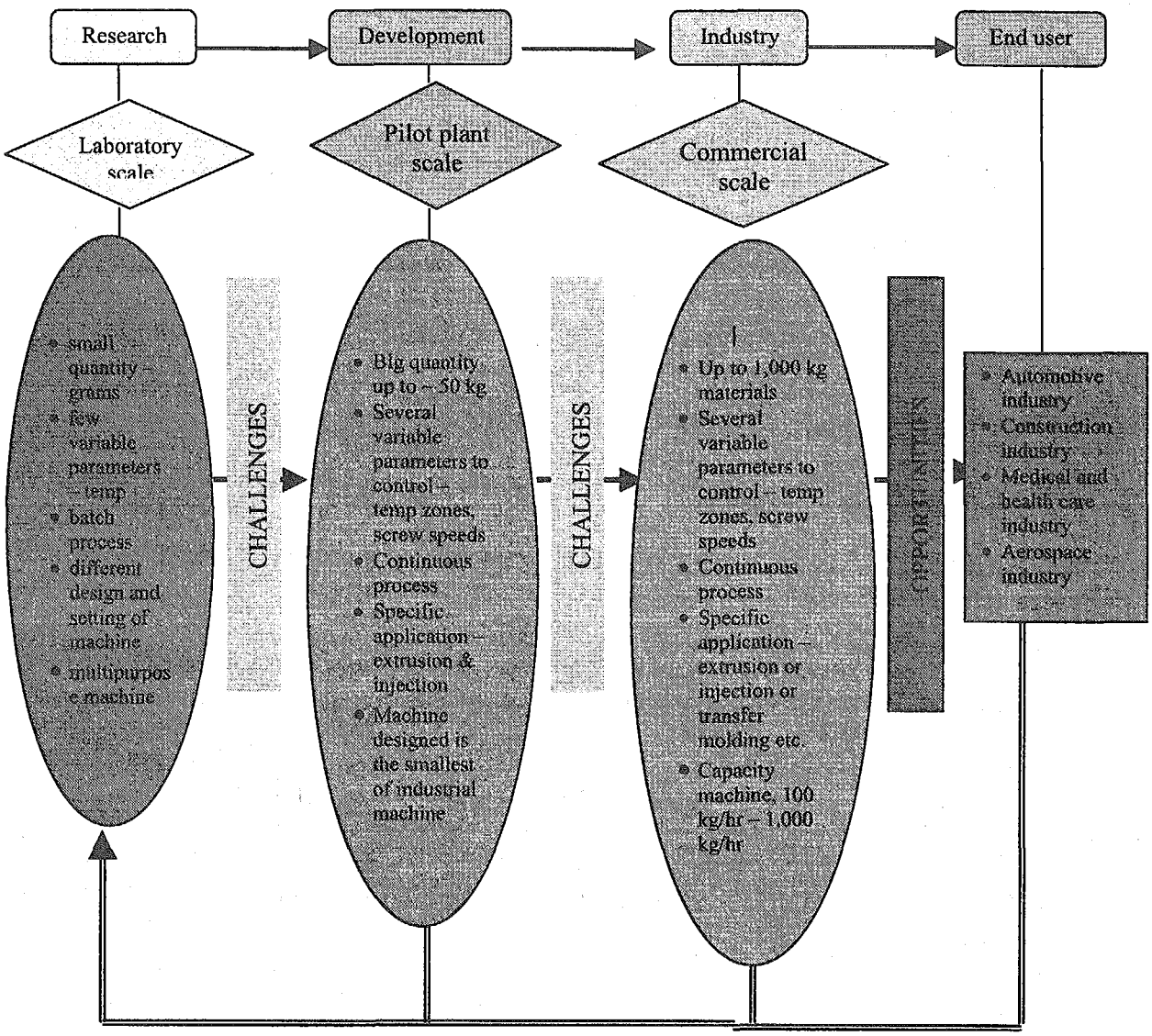

Figure 1. R & D Cycle

Pilot plant stage

Most of the research activities in relation to new material development is carried out by the government research institutes. Meanwhile, R & D by the industrial sector is focused on product improvement and problem solving type. Therefore, the government research institute is expected to follow through its R & D from laboratory up to the industrial scale production. However, for R & D institution to invest on the industrial scale production is not justifiable. Therefore, the setting up of a pilot scale plant/line that can demonstrate the industrial processing capability is appropriate. Usually at this stage, it involves the development of process and products at the minimum scale of industrial processing using pilot scale machine. Currently, MINT has five pilot scale facilities namely;

- Gamma sterilization plant with the maximum Co-60 strength of 2.0 MCi for sterilization of medical disposable items, irradiation of food items, herbal and other products (SINAGAMA)
- Electron beam processing facility for crosslinking of tubes and wire & cables (ALURTRON) - (Figure 2)
- Continuous gamma irradiation of latex using gamma pilot plant (RAYMINTEX) – Gamma facility is designed specifically for irradiating natural rubber latex (liquid) to produce pre-vulcanized latex for dipped products such as surgical gloves, balloon, condom etc.
- Pilot plant to process animal feeds from palm oil empty fruit bunches wastes using gamma irradiation (STERIFED).
- Flue gas treatment using electron beam accelerator: a semi-pilot scale of the out put of 400 cubic meter/hr gas from diesel generator (Figure 3).

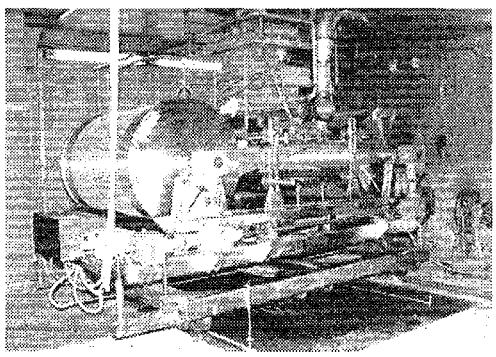

Figure 2. Electron beam facility

Figure 3. Flue gas irradiation vessel

For the polymer materials processing, several machines have been installed such as a twin-screw compounder of 15 – 50 kg/hr out put, extrusion machine for profile and for continuous products such as for insulation of wire. Injection molding machine of 60 – 80 ton clamping force is under procurement. These machines are crucial for inter-phasing the laboratory scale research with the industrial scale requirements. Several work for the processing of new compounds using the above machines have been established and ready to be transferred to industry such as:

- Flame and heat resistant compounds for tubes and wire insulation (Figure 4)
- Heat shrinkable tube - commercialization stage (Figure 5)
- PVN-ENR compounds for under-hood automotive parts
- Agro-fibers polymer compounds for automotive and non-automotive applications

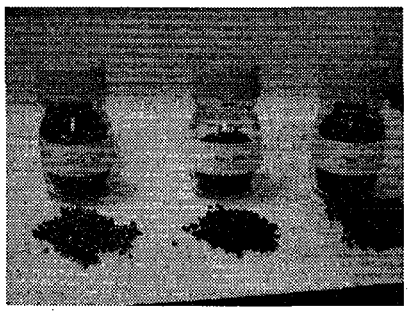

Figure 4. Flame and heat resistant compounding

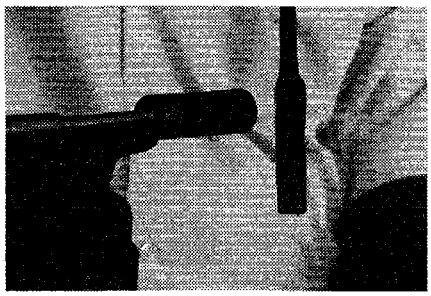

Figure 5. Heat shrinkable tube

In addition, electron beam processing of the following materials are under development and some are in the process of commercialization;

- Hydrogel from sago-starch - commercialization stage
- Modified sago-starch – commercialization stage
- Starch modified compounds for biodegradable foam products
- Starch modified compounds for biodegradable packaging film

On the other hand, the acrylate based oligomers as one of the important ingredients for radiation crosslinkable compounds synthesized from palm oil products have also been developed and a semi-pilot scale synthesis facility is under procurement. Several applications of acrylate-palm oil oligomers are:

- Pressure sensitive adhesive
- Printing ink
- Coatings

Industrial stage: commercialization

For research organization to develop the materials and products until stage 3 is costly and high risk. It is the role of private sector to commercialize the technology. The cooperation of private sector can be in various formed such as:

- make available the existing plant at their factory for the industrial small production study
- provide funds to setup facility
- sponsor the cost for the trial run conducted at the machine manufacturer facility, oversea.
- request for a government support through the commercialization research fund scheme and from industrial grant scheme.

In most cases, the industry chooses the last option whereby they will request government funds for the commercialization of the research finding.

After the successful pilot scale trial, it is important for the project group to follow through the development of the project up to the initial commercial production. The role of inventor in every stage of R & D till commercialization is essential. Scientists today should equip themselves with the knowledge on market needs and trends in their own fields. They should be sensitive to the political, economy and social changes around them. The implementation of AFTA (ASEAN Free Trade Agreement) within these few years will have strong bearing on the economy of Malaysia and ASEAN countries. AFTA will result less trade barrier, high competition with less profit margin and high volume for bigger market size. The target market is regional and global rather than local. This can be a threat and challenge for Malaysia in the near future and the Malaysian success is depend on how to turn this threat into opportunity.

CONCLUSION

There was a significant progress and development on the application of radiation processing in Malaysia. Government continues to support R & D in this field by providing the necessary infrastructure, facility, training and research funds. Thus, MINT continues to spearhead R & D in the application of radiation processing technology in particular to provide high added value to the indigenous materials for economic competitiveness of the country. However, there are issues and challenges need to be addressed in order to facilitate the process of commercialization.