Status of Radiation Treatment of Liquid Samples in the Philippines*

Estelita G. Cabalfin
Philippine Nuclear Research Institute
Quezon City, Philippines

INTRODUCTION

As an institute committed to improve the quality of life of the Filipino people, the Philippine Nuclear Research Institute (formerly the Philippine Atomic Energy Commission) undertakes research and development programs and projects, where the unique advantages of nuclear energy and radiation are exploited.

Aware that radiation has diverse industrial applications such as in radiation sterilization, radiation cross-linking, radiation curing and food irradiation, the Philippine Nuclear Research Institute (PNRI) has been at the forefront in research and development work on the application of radiation processing for about three decades now. In the early days, R&D work has been limited because the available irradiation facilities then were a ^{60}Co gamma garden, a Gammacell-200 and a 740 TBq (20,000 Ci) ^{60}Co source stored in the pool of the PNRI nuclear research reactor.

A more vigorous R&D program on radiation processing has been on going with the availability of a pilot scale multipurpose gamma irradiation facility, which was commissioned in 1989. With the technical assistance of the International Atomic Energy Agency (IAEA), PNRI has strengthened its capability on radiation chemistry and radiation processing, both in terms of manpower and equipment.

RADIATION TREATMENT OF LIQUIDS

So far, all research and development work on radiation treatment of liquid samples has been done utilizing the gamma irradiation facility of PNRI. The irradiator, a Gammabeam 651PT from Nordion International had an initial loading of 1.1 PBq (30,000 Ci) ^{60}Co in 1989. Additional ^{60}Co were loaded in 1993 and 1996, making the total loading about 5.5 PBq (150,000 Ci) in 1996. At present the ^{60}Co loading is about 2.6 PBq (70,000 Ci).

At the start, studies were initiated to synthesize new products from coconut oil and lauryl alcohol by radiation graft polymerization. Coconut oil and laurvl alcohol

* Presented at the FNCA 2002 Workshop on Application of Electron Accelerator, Takasaki, Japan, December 16-20, 2002

were mixed separately with methyl methacrylate and irradiated at different doses. Soft and hard solid products were obtained depending on the coconut/ methyl methacrylate or coconut oil/ laurvl alcohol ratio. The products were characterized by solubility tests, FT-IR spectrophotometry and thermal gravimetric analysis.

Because the Philippines is not a large rubber producer, the government has initiated moves to improve the rubber industry. In 1993 with support of the French government, the Philippines established a Center for Rubber Research at the University of Southern Mindanao. It is based in the southern part of the Philippines, where the rubber plantations are located. In support of the government's effort and recognizing the potential application of radiation to the rubber industry, the PNRI started its program on radiation vulcanization of natural rubber latex (RVNRL) in 1993.

Under the scientist exchange program of the Science and Technology Agency (STA) of Japan, a fellow from PNRI started R&D work on RVNRL at the Takasaki Radiation Chemistry Research Establishment (TRCRE). Also under an IAEA project, experts on RVNRL from TRCRE visited the Philippines. Several researchers attended training courses and workshop on RVNRL under the RCA/IAEA/UNDP regional Industrial Project.

R&D on RVNRL was conducted in collaboration with the Philippine Rubber Industries Association and the University of Southern Mindanao. This project was supported by the Philippine Council for Advanced Science and Technology Research and Development (PCASTRD) of the Department of Science and Technology and the IAEA.

The response of local rubber latex to radiation was investigated and the vulcanization dose was established. Experiments have shown the suitability of radiation vulcanization for local natural rubber latex. Results showed that the mechanical properties of the cast films from RVNRL have good mechanical properties, which were within acceptable limits even after twelve (12) months of storage. Radiation vulcanized natural rubber latex (RVNRL) can be used for the production of dipped rubber products, such toy balloons and surgical gloves, which are non-toxic and less allergenic. The possibility of producing finger cots from RVNRL for use by the semi-conductor industry was explored.

The antioxidant properties of some non-water soluble amino acids, such as cystine, alanine and asparagine were tested on RVNRL. Results indicated that these amino acids exhibit good anti-aging effect on RVNRL. Studies to identify antioxidants from natural sources (peroxidase from radish, lignin from rice straw and keratin from chicken feathers), which could replace toxic chemicals presently used to prolong the shelf-life of rubber, were undertaken. Only keratin in reduced form indicated good anti-aging property on RVNRL.

APPLICATION OF ELECTRON ACCELERATOR FOR LIQUIDS

The Philippines accounts for about 80% of the world's supply of *Eucheuma* seaweed, making it the world's largest producer of this seaweed, the source of carrageenan. The Philippines is also the number 4 world supplier of refined carrageenan.

Most of the local and international demand for carrageenan is for food applications. About 80% of carrageenan products are utilized by the food industry. Other major applications are in the cosmetics and personal care industries.

To maintain this advantage, the Philippines should therefore search for diversified applications of carrageenan. Studies to explore the potentials of carrageenan for non-food applications are being conducted using radiation treatment. Since the Philippines has no low energy electron accelerator, so far all R&D work on carrageenan are done utilizing PNRI's pilot scale gamma irradiation facility. Studies on the preparation of hydrogels from carrageenan and polyvinyl pyrrolidone (PVP) have been undertaken. Clinical tests showed that the carrageenan-PVP hydrogel compares favorably well with commercially available hydrocolloids used as burn dressing.

Though not directly the radiation treatment of liquids, studies on solutions of irradiated carrageenan to determine its potential as a plant growth promoter were also undertaken. When solutions of irradiated carrageenan were mixed with growth medium for rice seedlings under hydrophonic (soilless) conditions, stimulation of growth was observed.

A colleague from PNRI is presently working at the Takasaki Radiation Chemistry Research Establishment under the nuclear researcher exchange program of the Ministry of Education, Culture, Sports, Science and Technology (MEXT). Studies on the degradation of kappa carrageenan by low energy electron accelerator, gamma radiation and high energy electron accelerator is on going.