removal); composite materials and carbon fibers irradiation; irradiated grafting ion-exchange membranes for fuel cells application; natural polymers irradiation and biodegradable blends production. For high-energy EBA ($5 - 10$ MeV), they are sterilization of medical, pharmaceutical and biological products; gemstone enhancement; treatment of industrial and domestic effluents and sludge; preservation and disinfestations of foods and agricultural products; sugarcane bagasse irradiation as pretreatment to produce ethanol biofuel; decontamination of pesticide packing; soil remediation; organic compounds removal from wastewater; treatment of effluent from petroleum production units and liquid irradiation process to treat vessel water ballast.

On the other hand, there is a growing need of mobile EB facilities for different applications, as well as, an emerging opportunity of using low-energy electron beam accelerators for the curing of inks, coatings and adhesives in order to eliminate VOC's, and for less energy use than thermal process in South America.

SM/EB−04

Growing Industrial Applications of Electron Accelerator in Japan

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Japan is a pioneer for application of electron accelerators. There are 248 electron accelerators used for industrial applications and 148 for research/development in Japan. The first commercial production of radiation cross-linked heat resistant wires was started in 1971. All major wire and cable companies are using several electron accelerators each for production of heat, flame and chemical resistant wires. More than 90% of automobile tires are produced by partial cross-linking of rubber using electron accelerator. Electron beam cross-linked heat shrinkable tubes and sheets are also extensively produced. More recently commercial production of electron beam cross-linked PVA hydrogel wound dressing has been commercialized. Only Japan is applying radiation grafting by using accelerator for commercial production of battery separator and deodorant, and further developing new applications. Curing of surface coating and printing inks by low energy self shielded accelerator is increasing in Japan because of better quality of products, non emission of VOC and energy saving. Efficient sterilization of medical products and food packages including PET bottles is new and growing application of accelerator in Japan. Accelerator application for cleaning environment is an important challenge. Removing SO_2 and NO_x by using electron accelerator was first developed in Japan and successfully being used industrially in Poland and China. Moble electron accelerator is used for removing smell from drying of sewage sludge at waste water treatment plant in Japan. Major R/Ds for electron accelerator applications in Japan are (1) radiation grafted absorbent for recovery of uranium from sea water and rare metals from hot spring water, (2) cross-linked hydrogel, (3) VOC removals from flue gases for environmental protection, and (4) processing natural 2 polymers to value added products such as plant growth promoter or elicitor. Challenges of electron accelerator application are (1) expansion of commercial application in developing countries to enhance of industrial development through technology transfer, (2) improvement of accelerator design and production in terms of reliability and cost, (3) enhancement of R/D of new technology and application to meet social needs, such as environmental protection and energy saving.

SM/EB−05

Evaluation on Physical Properties of Irradiated Cabbage (*Brassica Oleracea* L. var. *Acephala*)

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The Brassica family is well known all over the world, and among their species, the cabbage (*Brassica*

oleracea L. var. *acephala*) is the most consumed in Brazil, as an ingredient of salads and also usual in preparation of a typical Brazilian dish called *feijoada*. Food irradiation is a world wide spread technology used to improve the quality of vegetables extending the shelf-life and reducing microorganisms present in leafs. Color is the first sensorial aspect realized by consumers, being an important factor of refuse. The objective of this paper was to analyze the color of irradiated cabbage treated by electron beam from a linear accelerator at different radiation doses. The cabbage samples were irradiated at IPEN–CNEN/SP in an electron accelerator (Radiation Dynamics Inc. USA, 1.5 MeV, 25 mA) at doses of $1.0 - 1.5$ kGy and also a control sample. Statistical analysis was done to compare the efficacy of different radiation doses. Slight differences in color measurement were observed in the irradiated samples, although the quality of cabbage was maintained until the 7^{th} day of storage.

SM/EB–06

Advances of E-beam Processing for Food Preservation in Brazil

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Food irradiation is a well known process in which food products are exposed to a controlled amount of ionizing radiation to kill harmful microorganisms, to delay ripening and also to inhibit sprouting. During last years the demand for this technology had increased in order to reduce losses all along food chain supply. E-beam processing trends to be the future's choice, once besides the possibility of being disconnected when not in use, is easily available, does not need reloading and streamlines the process, reducing logistics costs. In Brazil, the use of this technology is gaining importance day by day, mainly due to the necessity of food industry on guarantee food assurance and enhances its shelf-life. Although only few industries has already installed e-beam accelerators to its processing systems and also not many provides irradiation services to local companies, this scenery trends to change due to knowledge diffusion, high cost effectiveness relationship and government support.

SM/EB–07

Electron Beam Irradiation Effects on Some Packaged Dried Food Items

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For radical sports practitioners, small nutritious snack foods are needed. At the same time, food preparation must guarantee long shelf life and be compact or lightweight for easiness of carrying. Commercial individually packaged foods can be used either for sports practitioners like adventure racing or eventually as military rations. Irradiation processing of foods is an important preservation technology. High-voltage electron beams generated from linear accelerators are an alternative to radioisotope generators as they require much shorter exposure times (seconds vs. hours for γ irradiation) to be effective and are currently used to pasteurize meat products among others food items. This work describes the application of electron beam irradiation on some food items used in sport training diets: fiber rich cookies, fruit cereal bars, instant dehydrated asparagus soup and instant Brazilian corn pudding. Each kind of sample contained 3 groups of 15 units each. Irradiation was performed with an electron beam accelerator Dynamitron (Radiation Dynamics Inc.) model JOB 188, with doses of 5 and 10 kGy. For the evaluation of irradiated samples a methodology based on the Analytical Norms of the Instituto Adolfo Lutz, one of the South America Reference Laboratories was employed. The microbiological and sensory analyses of the diverse irradiated samples are presented. Electron beam irradiation resulted in significant reduction of the fungus and yeast load but caused dose dependent differences of some sensory characteristics.