SESSION 1: IMPROVING QUALITY of LIFE

PANEL 1.2: Nuclear technologies in industry, material sciences and beyond

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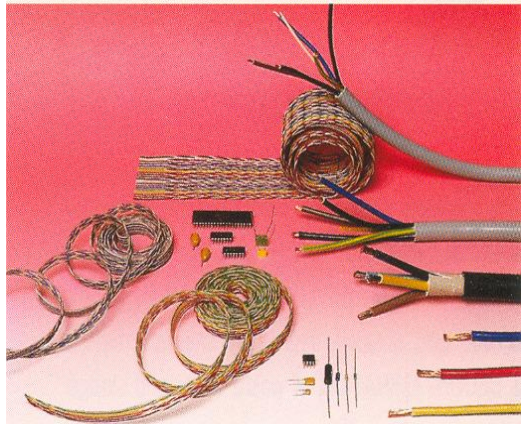
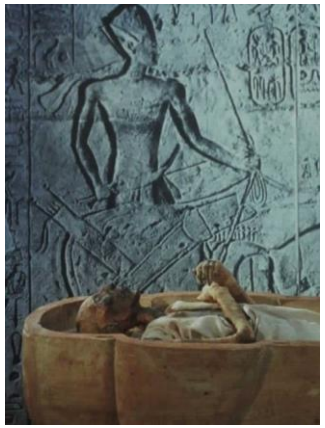
Radiation Technology: From High Performance Materials, To Preserving Cultural Heritage







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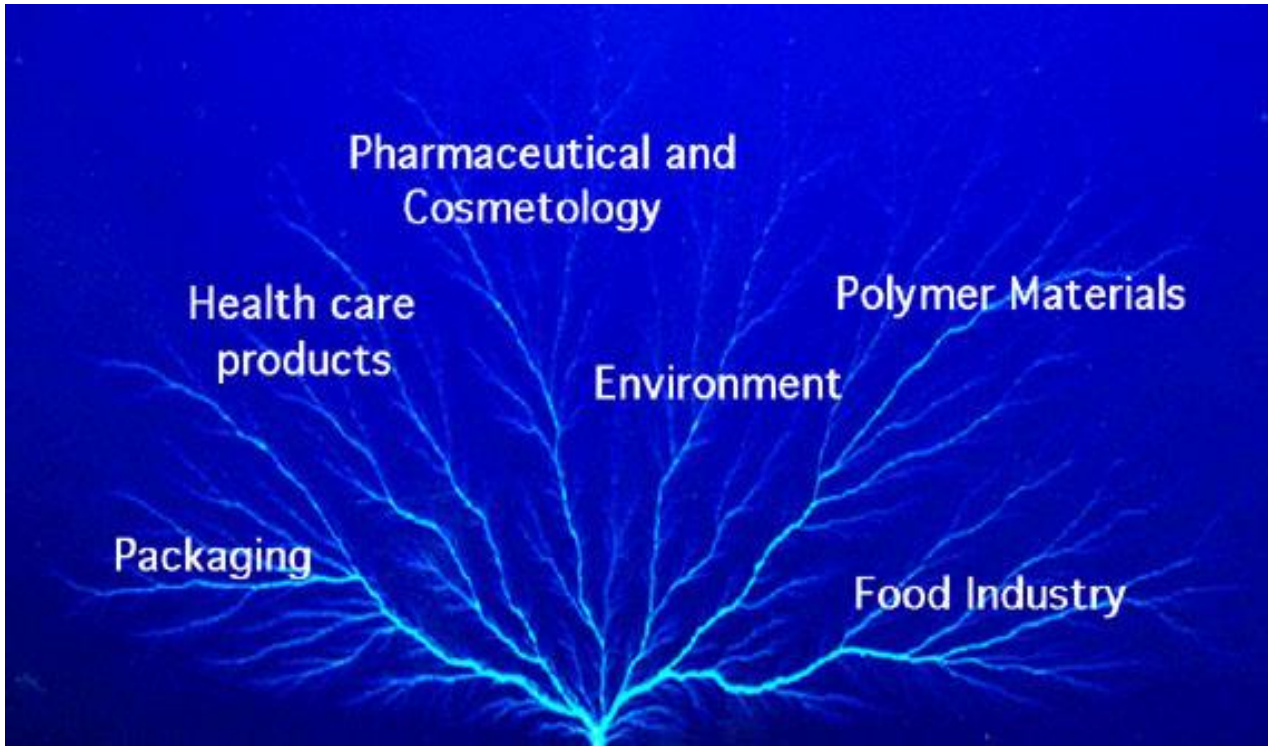
Radiation Technologies are present in daily life

People around the world are benefiting from the use of radiation technologies



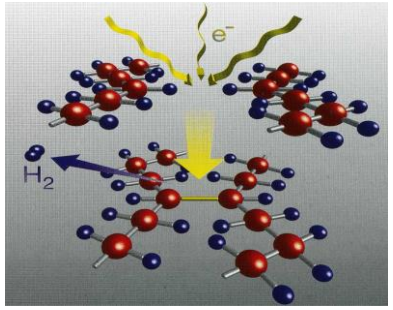
Radiation Processing

- Practical application of radiation chemistry;
- Use of the energy of ionizing radiation - high energy - (gamma, electrons and X-ray) by introducing biological, physical and chemical effects in the irradiated product.

https://www.youtube.com/watch?v=ePiNdzWjoWM

Challenges and advantages of Radiation Processing

Radiation Crosslinking for production of polymer products



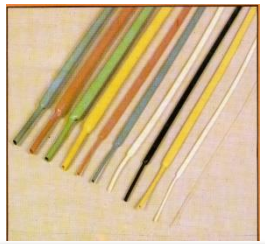
Rubber vulcanization Foamed polymers

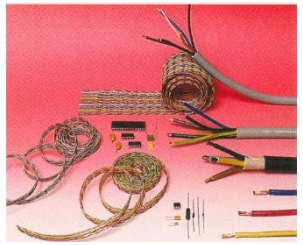
Radiation crosslinked wire

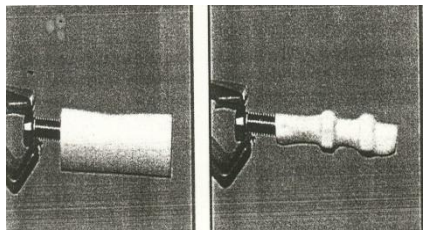
heat resistant, abrasion resistant, high mechanical properties

Wire and cable insulations

Heat shrincable products:







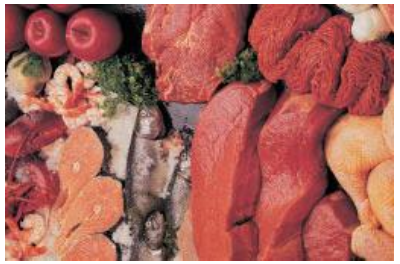
- Production of new materials with special characteristics;
- Less chemicals (e.g. organic solvents) are needed;
- Less energy consumption;
- Less environment pollution ;
- Economically favourable technologies;

Standardized process control methods;

Food Irradiation

- to decrease food losses during storage (20-30 % of food production is lost due to pests, insects, bacteria, fungi);
- to decrease microbial contamintion (pathogens, parasites result in food-borne deseases);
- to avoid infection it looks to be the best solution;

Human Tissues and prothesis Sterilization

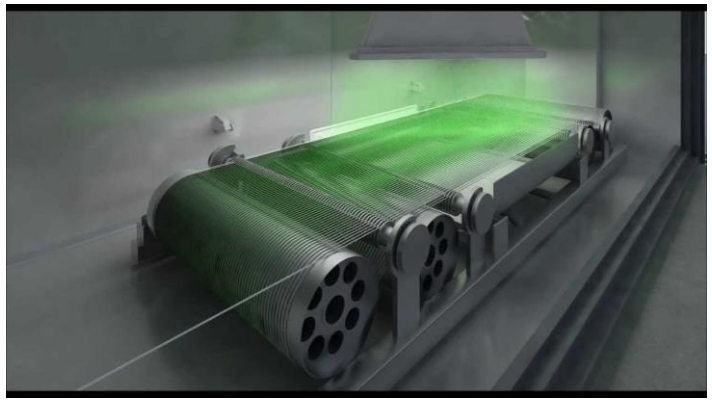


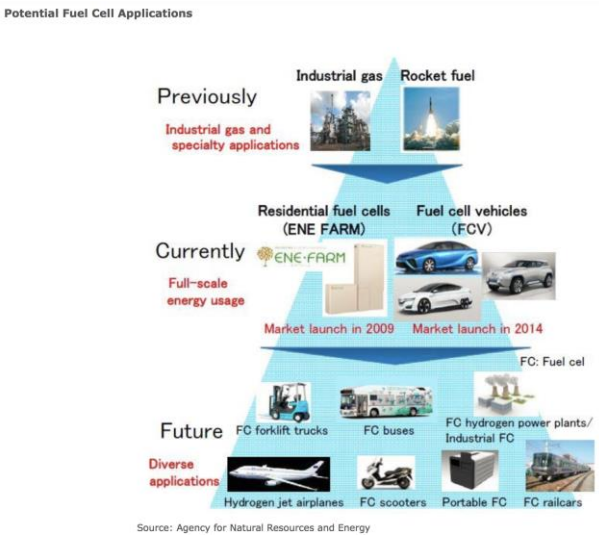
-Based on microbiological effect:
- Single use medical devices (60 % of production)
- food packaging materials;
- food for astronauts and for hospitals;

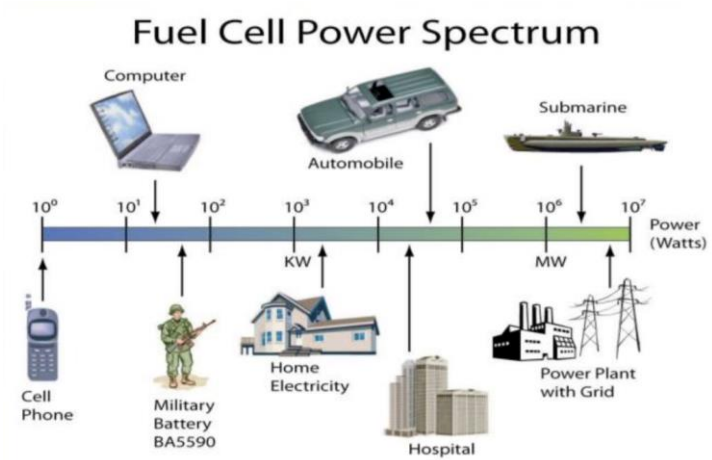
Radiation Sterilization

Surface Coating

- Simultaneous radiation polymerization and crosslinking of monomer and oligomer molecules on the surface of e.g. wood, metal, paper, ceramics, film resulting in a homogeneous layer in room temperature without using solvents
- Industries: printing, furniture, building, etc.
- New: low energy curing of pigmented coatings on metal coil (energy saving).







Radiation Grafting

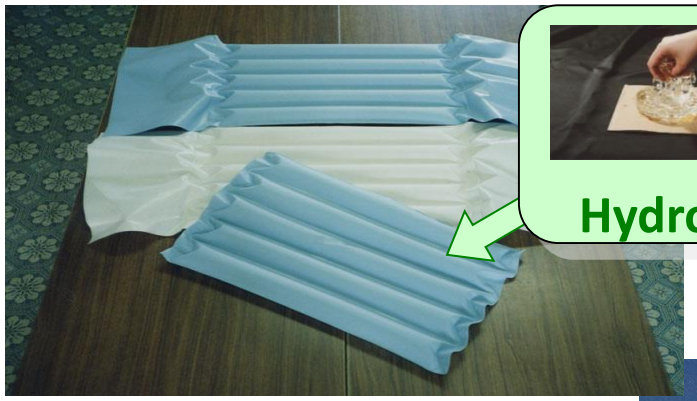
Monomer or oligomer function group is connected to a polymer molecule by ionizing radiation resulting in new product of new characteristics.

Application fields:

- packaging materials (PE coated Al foil)
- textile products (better colourization)
- health care products (increased biocompatibility)
- battery separators
- FUEL CELL MEMBRANES GRAFTED USING IONIZING RADIATION

Release Technologies

- **Biomedical products – production of hydrogels: (hydrophylic polymers: PVP, PVA) -Wound dress and prevention of bedsore.**
- **Radiation treatment of postal packages (anthrax).**
- **Composite materials – e.g. SiC (°C) for space research; carbon fibers for e.g. car industry;**
- **Nanogels for controlled release drug-delivery systems;**
- **Surface decontamination of packaging (asseptic) materials**
- **Radiation degradation:** natural (cellulose, polysaccharides) and artificial (teflon) polymers to smaller molecular weight parts of smaller viscosity: - viscose industry (less chemicals and energy requirement); paper industry; ink production (from teflon waste); cellulose containing waste to produce, animal food; agriculture (chitin e.g.)



Environmental Protection Technologies

Waste water and drinking water treatment:

Remove impurities of biological (pathogens) and/or of industrial origin (organic compounds);

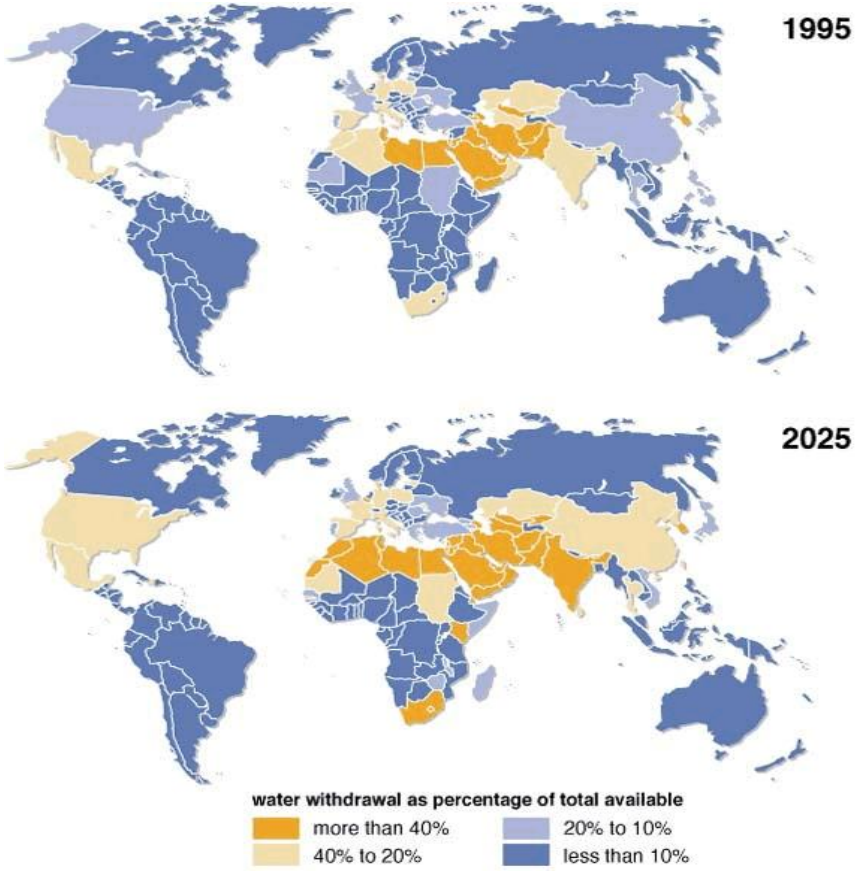
Advantages:

- on-line technology;
- no chemical contamination;
- combined treatment is possible

(chlorination, ozone, filtration);

Industries:

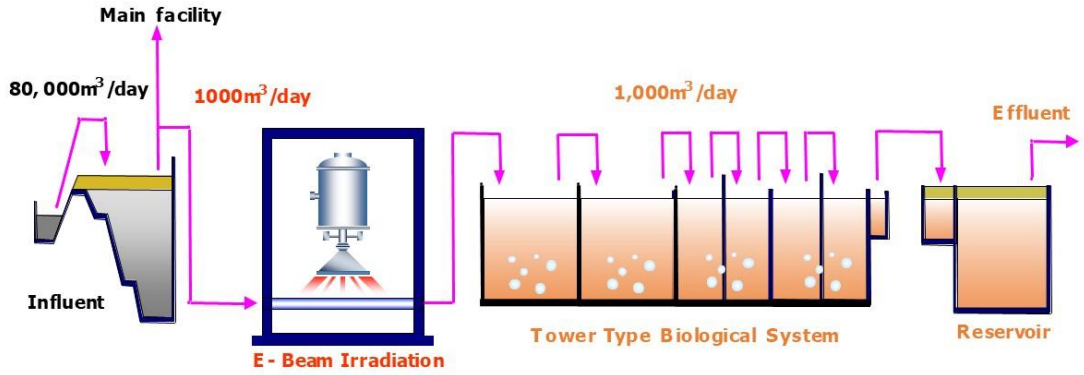
- Paper production and textile industry;
- Communale waste water;



Environmental Protection Technologies

Sludge treatment:

Utilization of irradiated sludge (5 – 10 kGy) as fertilizer in agriculture, if its heavy metal content is negligible. On-line procedure.



Flue gas treatment:

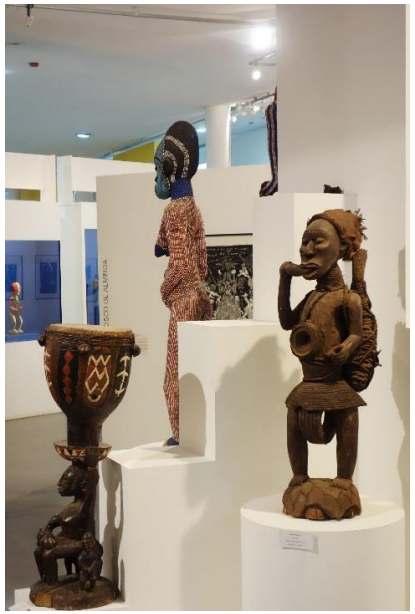
Coal and oil based power stations emit sulphur and nitrogen containing gases, resulting in „acidic rain". Responsible also for the formation of smog and green house effect.

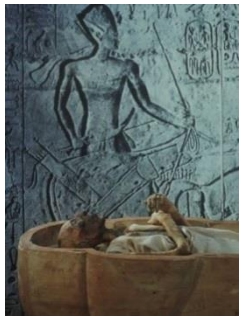
SO_2 (~ 95 %) and NO_x (~ 80 %) removal.

NH_3 addition to produce fertilizers.

Use of low energy accelerators.

Cultural Heritage artefacts and archived materials disinfection and consolidation







https://www.iaea.org/newscenter/news/culture-meets-nuclear-science-in-brazil

Thanks!

terial Conference on Nuclear Science and Technology: Addressing
merging Development Challenges

28–30 November 2018, Vienna, Austria