CLEANER ENVIRONMENT THROUGH RADIATION TECHNOLOGIES

Meera Venkatesh
Director
Division of Physical and Chemical Sciences
Department of Nuclear Sciences and Applications
International Atomic Energy Agency

M.Venkatesh@iaea.org

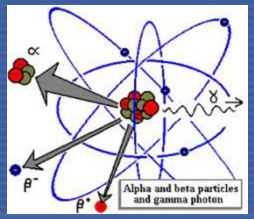
IAEA
International Atomic Energy Agency

Radiation & Applications

- Radiations
  - Radioactive nuclides – natural; artificial
  - Machine produced : X-rays; e-beams

W.H. Rontgen

- Radiation & Radionuclides
  - Energetic
    - Can be easily detected
    - Powerful to cause changes
      - in living as well as inanimate things
    - Loses energy on passing through matter



Henry Becquerel Marie & Pierre Curie

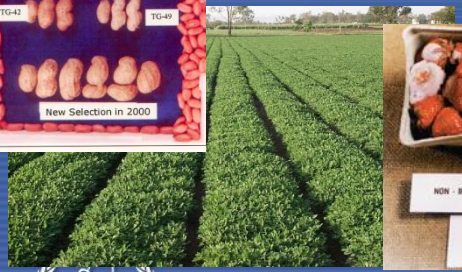
- Varied Uses; applications

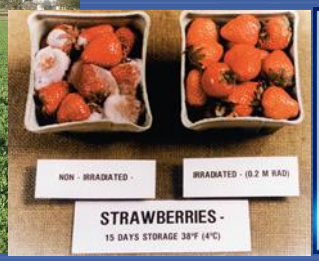
George Hevesy

IAEA

Applications of Nuclear/Radiation Techniques

- Nuclear /Radiation
- Radiation based
  - Varied Uses; applications

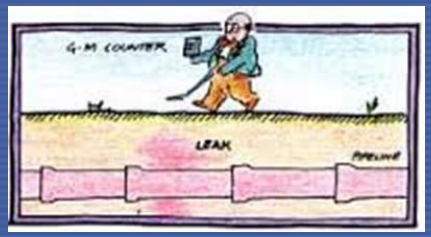




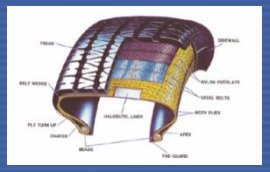
IAEA

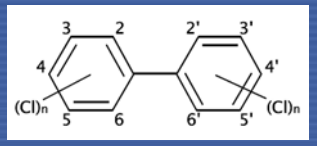
Radiations : How are they useful

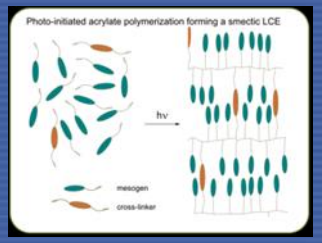
- **Easy to detect** and can provide information wherever they are (like spies!)



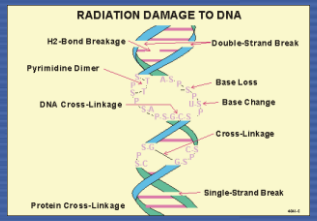
- **Alter materials**

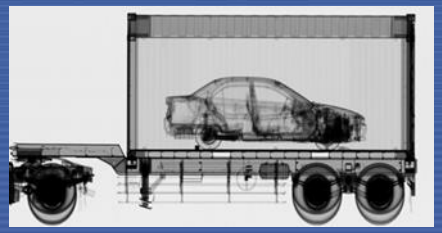






- **Damage** and **break** tough chemicals
- **Link/Polymerise** molecules
- **Damage/kill** germs/bacteria/virus/cancer cells
- Their ‘attenuation’ behavior can provide information about the material they pass through





IAEA

Environment & Nuclear/Radiation Technologies

Direct impact

- Mitigation of pollutants in effluents
- Sanitizing municipal/hospital waste – reduce the load of microorganisms/germs
- Pre-treatment of used chemicals for disposal – e.g used transformer oil with tough 'PCB's

Indirect impact

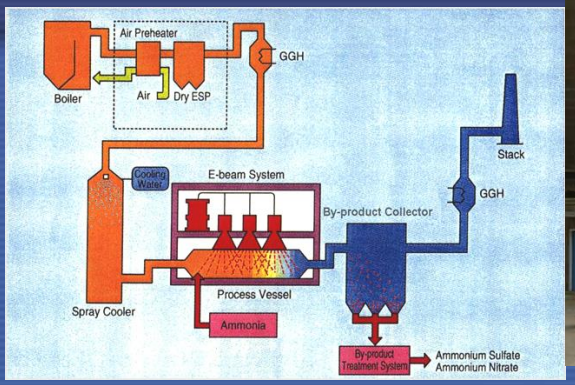
- Avoiding use of chemica
  - Cross-linking – vulcanization of rubber
  - Sterilization – medical

- Bio-degradable materials production
  - Novel polymeric materials from products
  - For food packaging etc.
  - As Fertilizer - (e.g. shrimp shells or cassava roots or bagasse treated to produce nutraceuticals – 'wealth from waste'!)

- Optimization of chemical processes
- Radiotracers/NDT in coastal management

IAEA

Radiation Treatment of Flue Gases for Cleaner Environment



Cosmic Ray

SO_2、NO_x CO_2:

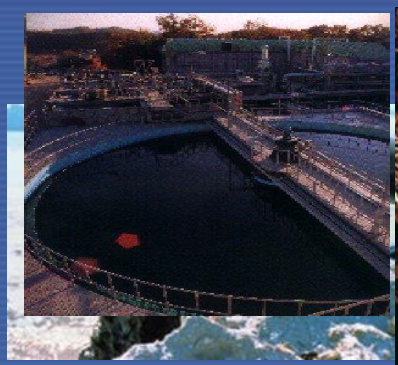
H_2SO_4
HNO_3
H_2CO_3

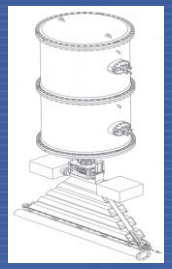
Acid rain

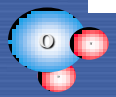
- Removal of SOx and NOx oxides
- By-product - useful fertilizer
- No secondary waste
- Complementary to the CO_2 sequestration
- Fully developed proven technology
- Commercial units now available

IAEA

Radiation Treatment of Waste Water for Cleaner Environment & Reuse if Possible







e_{aq}
OH*
H*
H_2O_2

Water Molecule

Active Radicals

Harmful Organic in Waste water

- Complete Decomposition → H_2O, CO_2
- Partial Decomposition
- Suspended solid
- Monomer to Polymerization

Partial Decomposition, Suspended solid → Coagulation

- Removal of Toxic group → Bio-Treat
- Removal of Color, Odor

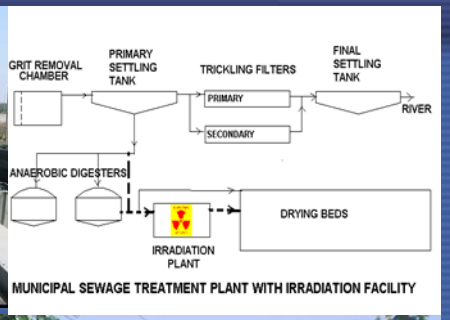
- *EB facility* in Rep. of Korea
- Max. flow rate 10,000m³/day
- In combination with the existing Biological Treatment Facility

- Decrease in the chem. Reagents up to 50%
- Efficiency of Biological Treatment improved by 30%
- Decrease in the retention time in Biological Treatment Facility

IAEA

Hygienization through Radiation

- **Treatment of sewage waste** –
  - Disinfection of Microorganisms
  - Bio-fertilizer –valuable product
  - increased yields & soil quality improvement
  - Fully Developed and Demonstrated

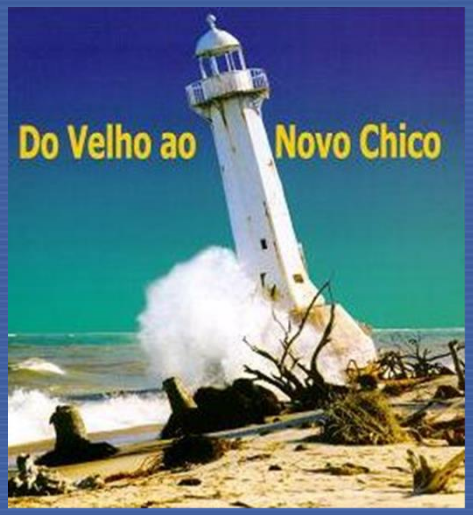


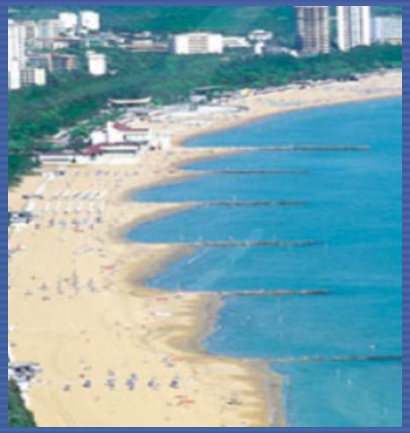
- Treatment of materials in unforeseen situations
- Example – Anthrax through post
- Possible uses in emergencies; natural calamities etc. to treat contaminated water/food etc.

Sanitization of postal mail – Anthrax threat 2001!

IAEA

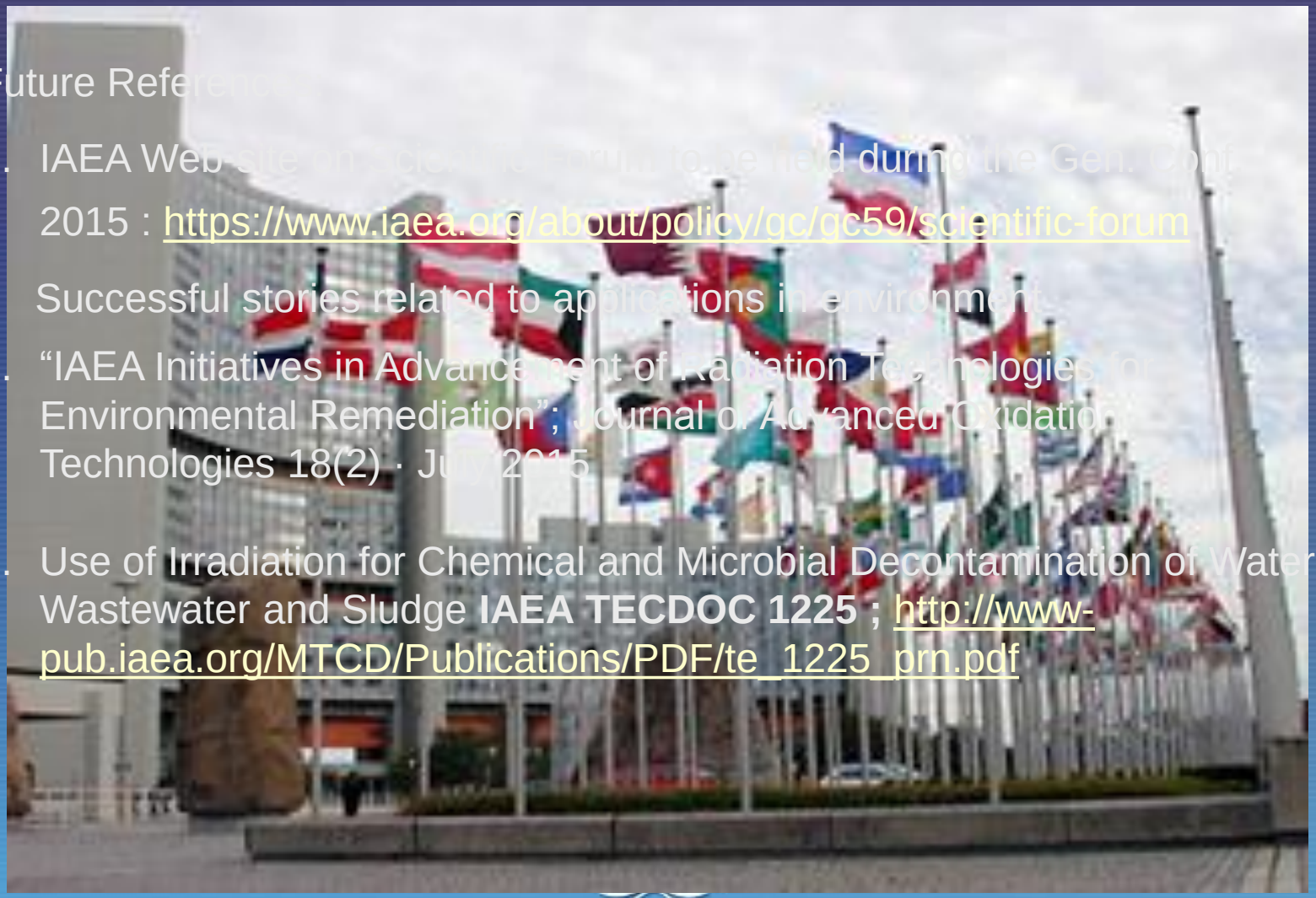
Radiotracers and Non-destructive Tests : protection of coasts and trees





IAEA

THANK YOU!



Future Reference

1. IAEA Web site on Scientific Forum to be held during the Gen. Conf. 2015 : https://www.iaea.org/about/policy/gc/gc59/scientific-forum

   Successful stories related to applications in environment

2. "IAEA Initiatives in Advancement of Radiation Technologies for Environmental Remediation"; Journal of Advanced Oxidation Technologies 18(2) · July 2015

3. Use of Irradiation for Chemical and Microbial Decontamination of Water, Wastewater and Sludge **IAEA TECDOC 1225** ; http://www-pub.iaea.org/MTCD/Publications/PDF/te_1225_prn.pdf

IAEA
International Atomic Energy Agency