

# **The Environment**

# **Cost Effectiveness of Radiation Processing**

## **Depends On**

- **Uniqueness of the desired change**
- **Efficiency (chain length) of the radical reactions**
- **Large volumes, use of high power electron accelerators**
- **Use of the lowest electrons appropriate for a process**
- **Combination treatment (synergistic effect)**

# **Radiation Processing Technology for the Environment**

- **Areas of interest**
  - **Natural and polluted waters**
  - **Industrial chemical wastes**
  - **Sewage**
  - **Flue gases**

# **Contaminated Natural Drinking Water**

- **Pathogenic microorganisms**
- **Colouration (humic acids)**
- **Fertilizers**
- **Pesticides**
- **Fungicides**
- **Chloro-organic compounds**

# **Treatment of Contaminated Water**

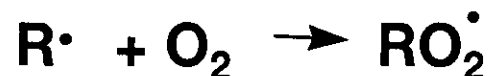
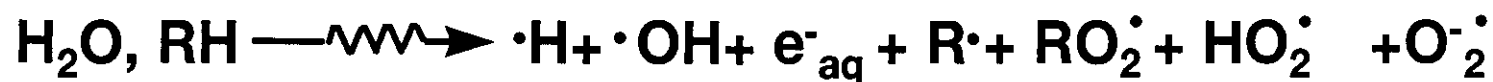
- **Filtration - partially effective**
- **Chemical treatment - partially effective**
- **Chlorine treatment - fairly effective against microorganisms, chloro-organic compounds produced**
- **UV photolysis, ozone treatment - partly effective, expensive**
- **Irradiation - with or without ozone treatment, effective**
  - **Pilot plant in Austria, and now a commercial plant under construction**
  - **Extensive work in several countries**

# **Irradiation of Contaminated Waters**

- **Quite effective in reducing microorganisms and chemical pollutants**
- **Synergistic effect with ozone treatment**
- **Drinking water, 0.5 to 1 kGy dose enough in most cases**

# Synergistic Effect with Ozone Treatment

- The presence of  $O_3$  during irradiation
  - Increases the yield of  $\cdot OH$ , and thus of oxidative degradation
  - Oxidizes  $NO_2^-$  to  $NO_3^-$  ( $NO_2^-$  is toxic)
- Key reactions are



# **Industrial Polluted Waters**

- **Irradiation (with ozone treatment) also applicable to treating municipal wastewater and waste waters from pulp and paper mills, textile industry**
  - **Pilot plants in USA, Germany and Russia**
  - **Purification of wastewater from a rubber plant in Russia**

**Woods and Pikaev (1994)**