

## Physics & Chemistry - Applications of Radioactivity

### WHAT THEY HAD DISCOVERED:

We now have the essentials to utilize radioactive elements. Roentgen gave us x-rays, Becquerel discovered radioactivity, the Curies were able to discover which elements were radioactive, and Rutherford brought about transmutation and the "splitting of the atom." All of these discoveries and curiosity came with a price. Time showed the damaging effects of radiation exposure and the incredible destruction that could be harnessed from these elements.

### APPLICATIONS

Radioactive isotopes are presently used in many aspects of human life today. Most people recognize radioactivity's contributions to industry, research and war, but it is even used within many people homes. Here are a few examples of how radioactive isotopes are utilized today.

### AT HOME

Most people have radioactive material in their very own homes, or at least we would hope so. Why? Because in most every smoke detector unit today there is a very small amount of Americium-241. How does it work? Well Americium-241 is present in the detector in oxide form and it emits alpha particles and very low energy gamma rays. The alpha rays are absorbed in the detector, while the non-harmful gamma rays are able to escape. The alpha particles collide with oxygen and nitrogen in the air of the detector's ionization chamber producing charged particles, or ions. A small electric voltage runs across the chamber which is used to collect these ions and operate a small electric current between two electrodes. When smoke enters the chamber it absorbs the alpha particles disrupting the rate of ionization in the chamber, thereby turning off the electrical current, which sets off the alarm.

For more information go to: <http://home.howstuffworks.com/smoke2.htm>

### NUCLEAR POWER

On June 7th 1954 the the USSR produced the world's very first nuclear power plant. These plants, though clean burning, produce a great deal of toxic nuclear waste which is difficult to eliminate. To date, approximately 15% of the worlds electricity and 6% of the worlds power is produced in nuclear power plants. With the rise in gas prices many countries around the world considered increasing their use nuclear energy.

The problem with nuclear energy is that although it is "clean" in the sense that only water vapor is emitted into the atmosphere, it has its share of problems. It must be kept constantly regulated, and is extremely hard to dispose of. In the past, poor regulation of nuclear power has caused major problems, such as the Chernobyl incident in 1986. Even when regulated properly, the waste can cause contamination which lasts for many years and destroys natural resources.

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For more information and a specific example go to:  
<http://www.world-nuclear.org/info/chernobyl/inf07.html>

**INDUSTRY****Gamma sterilization**

Large scale gamma irradiation is used to sterilize disposable medical supplies such as syringes, gloves and other instruments that would be damaged by heat sterilization. Large scale gamma irradiation is also used for killing parasites found in wool, wood and other widely distributed products. In the 1960's the irradiation of meat was allowed by the US, and it is now a commonly used food sterilization method. Small scale irradiates are also used for blood transfusions and other medical sterilization procedures.

**Gamma ray analysis**

Gamma Rays can be used to determine the ash content of coal. By bombarding stable elements with radioactive rays one can cause a fluorescence, the energy of fluorescent x-rays can help identify if any elements are represented in a material. The intensity of the rays can indicate the quantity of that material. This process is commonly used in element processing plants.

**MEDICINE**

Radioisotopes are used as tracers in medical research. People ingest these isotopes which allow researchers to study processes like digestion and locate medical problems like cancers and obstructions within an individual's digestive tract.

Radioactive elements are also used in clearing angioplasty obstructions and eliminating cancer.

A good resource on the industrial and medical uses of radioactive isotopes:  
<http://www.world-nuclear.org/info/inf56.htm>

**WAR**

On August 6th and 9th 1945, the US dropped nuclear weapons on Nagasaki and Hiroshima, Japan. These weapons were a part of a top secret project known today as the Manhattan project. Though those within the blast zone were instantly killed, the effects of these weapons would be felt for many years to come. Many more people died in the months following the bombing due to radiation

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poisoning, and years later, birth defects would prove the effects of radioactive bombardment upon DNA.