Basic Knowledge of Radioactive Substances

Differences between Radiation, Radioactivity, and Radioactive Substances

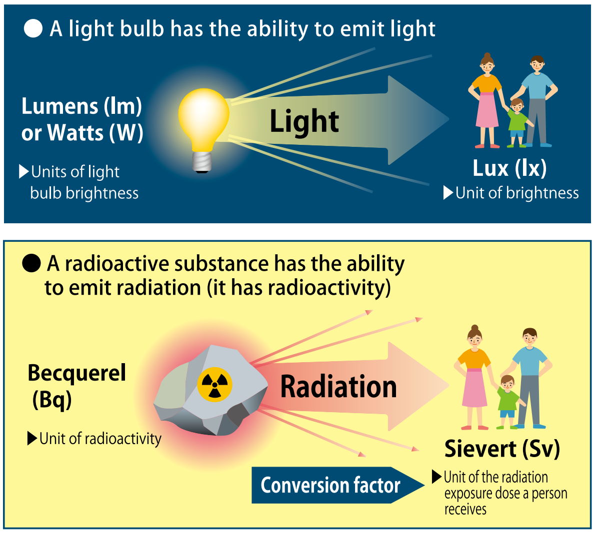
"Radiation" is like light that can pass through objects. The ability to emit radiation is called "radioactivity" (the unit for the amount of radioactivity is the Becquerel (Bq)), and substances which have that ability are called "radioactive substances".

The unit of Sievert (Sv) is used for the radiation exposure dose how much human body is affected by radiation.

If a radioactive substance is placed in a sealed container, radiation is emitted from the container, but the radioactive substance itself is not.

If we look at the example of a light bulb, the light is like radiation, the bulb is like the radioactive substance, and the ability to emit light is like radioactivity. The greater the radioactivity, the more radiation the radioactive substance emits.

The radiation exposure dose varies with distance between the radioactive substance and the exposed person. The strength of radiation increases with proximity to the source, and decreases with distance. That is like the way even a bright light bulb looks dim from a distance.



※Sieverts are related to the impact of radiation

[Figure] What Are Radiation, Radioactivity, and Radioactive Substances?

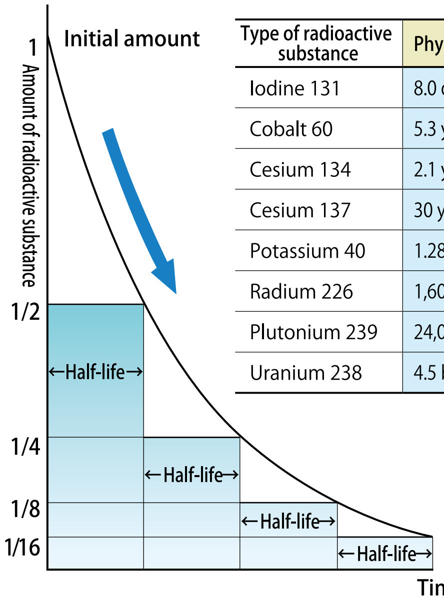
Reference : Ministry of the Environment "Unified Basic Reference on the Health Impacts of Radiation, FY2017 Edition"; Consumer Affairs Agency "Food and Radiation Q&A, 12th edition", March 8, 2018; Ministry of the Environment "Unified Basic Reference on the Health Impacts of Radiation, FY2017 edition"

Half-life of Radioactive Substances

As radioactive substances emit radiation, they transform into stable substances which do not emit radiation. Therefore, the radioactive substances dispersed from a reactor accident do not remain in the natural environment eternally, because their quantity decreases over time. The time required for that radiation decay is determined for each type of radioactive substance, and the time it takes for the amount of radioactive substance to halve is called the physical half-life. For example, the half-life of iodine 131 is around 8 days, while that for cesium 134 is around two years, and for cesium 137 is around 30 years (Figure).

Radioactive substances taken into the bodies of organisms are expelled from the body through metabolism and the excretory effects of defecation, urination, perspiration, respiration, etc. The time required for those processes to halve the amount of radioactive substance is called the biological half-life. The biological half-life of cesium 137 in humans is around 9 days in people aged up to one year, around 38 days in those aged up to nine, around 70 days in those aged up to 30, and around 90 days in those aged up to 50. Biological half-life is shorter in children because of their faster metabolism. For example, if cesium 137, which has a long physical half-life of 30 years, enters the body of a person aged 50, half of the cesium has been expelled from the body after around three months.

(Reference) Physical half-life



Type of radioactive substance	Physical half-life
Iodine 131	8.0 days
Cobalt 60	5.3 years
Cesium 134	2.1 years
Cesium 137	30 years
Potassium 40	1.28 billion years
Radium 226	1,600 years
Plutonium 239	24,000 years
Uranium 238	4.5 billion years

[Figure] Physical Half-life

Reference : Ministry of Agriculture Forestry and Fisheries (2012) "Basics of Radioactive Substances"; Consumer Affairs Agency "Food and Radiation Q&A, 12th edition", March 8, 2018; Ministry of the Environment "Unified Basic Reference on the Health Impacts of Radiation, FY2017 edition"