

# Units of Radiation Dosimetry

For a complete characterization of the biological effect of ionizing radiation, it is necessary to know the quantities defining the degree of effect.

## Units of radiation dosimetry

### Emission

Emissions are among the basic quantities that characterize a radiation source. The emission value indicates the **number of radiation particles** emitted by the source **per unit of time**. The size of the emission is  $s^{-1}$ .

### Activity

If the radiation source is radioactive, the content of the emission is related to the quantity of **activity A** of the source. The activity of the source is defined as **the number of radioactive transformations** in a given amount of radionuclide **per unit of time**. The unit of activity is  $1 \text{ Bq}$  (becquerel).  $1 \text{ Bq}$  represents one radioactive transformation per 1 s. The measure of activity is  $s^{-1}$ .

### Volumetric activity

**The volume activity  $av$**  expresses the ratio between the activity of the source  $A$  and the volume  $V$  of a certain substance. The unit is  $\text{Bq.m}^3$ . The volume activity dimension is  $s^{-1} \cdot m^{-3}$ .

### Exposure

**Exposure X** (*irradiation*) is a characteristic of the X-ray and  $\gamma$  radiation field. This quantity is defined using the ionizing effect of radiation in a given environment (air by default). The exposure is given by the ratio of the **electric charge  $\Delta Q$**  of the ions, which were created by the braking of electrons or positrons, and a certain **mass  $\Delta m$**  of the volume element of air.

$$X = \Delta Q / \Delta m$$

The main unit is  $1 \text{ C.kg}^{-1}$ . The size of the exposure is  $\text{Askg}^{-1}$ .

### Exposure speed

**Exposure speed** (*exposure power*)  $dX/dt$  is characterized as an increase in exposure in a given time interval.

$$dX/dt = \Delta X / \Delta t$$

The unit is  $\text{A.kg}^{-1}$ . The dimension of exposure speed is  $\text{Am}^2 \cdot s^{-2}$ .

### Absorbed dose

**The absorbed dose D** is defined as **the ratio of the average energy  $\Delta E$**  of ionizing radiation absorbed by a volume element of air of a certain **mass  $\Delta m$** .

$$D = \Delta E / \Delta m$$

The unit is  $1 \text{ Gy (grey)} = 1 \text{ J.kg}^{-1}$ . The dimension of the absorbed dose D is  $\text{m}^2 \cdot s^{-2}$ .

### Dose rate

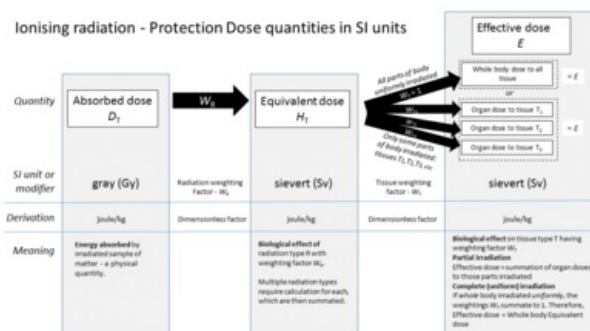
**The dose rate** (*dose rate*)  $dD/dt$  is expressed by the **dose increment ratio  $\Delta D$**  in the time interval  $\Delta t$ .

$$dD/dt = \Delta D / \Delta t$$

The unit is  $\text{Gy.s}^{-1}$ .

### Dose equivalent

**The dose equivalent H** correlates with the magnitude of the biological effects of various types of ionizing radiation. It is used for radiation hygiene purposes and has the meaning of a **modified dose  $H = DQN$** , where  $Q$  is a **quality factor** (so-called quality factor) that expresses the quality of radiation in terms of biological effects.  $N$  represents the **product of other factors** that describe the irradiation conditions. The unit of dose equivalent is  $1 \text{ Sv}$  (*sievert*). The dimension of the quantity is  $\text{m}^2 \cdot s^{-2}$ .



Graphic showing ICRU protection dose quantities in SI units.

# Links

## Related articles

- Ionizing radiation
- Deterministic effects of ionizing radiation
- Dosimetry

## References

- JIŘÍ, Beneš – JAROSLAVA, Kyplová – FRANTIŠEK, Vítek. *Základy fyziky pro lékařské a zdravotnické obory : pro studium i praxi.* - edition. Grada Publishing, a.s., 2015. 236 pp. ISBN 9788024747125.
- BENEŠ, Jiří. *Základy lékařské biofyziky.* - edition. Karolinum, 2007. 201 pp. ISBN 9788024613864.