

# Non-ionizing Radiation

Certain types of electromagnetic radiation are a natural component of environment and man is almost adapted to them. Their effects on human health are not yet sufficiently known. Sudden changes in the intensity and character of the radiation can cause negative effects on living organisms. Unfortunately man cannot detect/warned by his senses if he is in a radiation zone (unless in extremely high dose).

## Sources

Typical sources of electromagnetic radiation:

- Broadcasting and television
- Computers
- Mobile phones
- Warming ovens
- High temperature plasma
- Various generators of microwaves
- Radio locators

3 categories:

1. Radio waves (broadcasting, television): 3.104 – 3.108 Hz
2. Microwaves (generators, warming ovens): 3.108 – 3.1012 Hz
3. Radar waves (radio locators): 3.1010 – 3.1212

Radio waves radiation occurs in nature as electromagnetic pulsing waves at the head of cold fronts and during storms, sometimes with significant intensity. Radio waves occur in various technological procedures in the industry such as certain warming procedures, high temperature plasma, various generators of microwaves, in computers etc.

## Physical substance of non-ionising radiation

- Electricity fields: a non-moving electric charge creates around itself an electrostatic field
- Magnetic fields: a moving electric charge creates around itself a magnetic field in addition to the electrodynamic field
- Electromagnetic fields: not bound to electric charges, arises due to time change of electric and magnetic fields
- Unidirectional current: in this case only magnetic field arises
- Alternative currents: for example, 380/220V, 50Hz distribution network generates in time changes of current, a magnetic field and an electric field.

## Biological effects

The electric and magnetic components of non-ionising radiation may produce in general non-specific neuropsychic disturbances in man. Types:

- Thermal phenomena
- Non-thermal phenomena

Plants and small animals die near strong transmitters where there is a high density of cm-long waves. The changes induced by this radiation are mostly reversible in man. Women are usually more sensitive than men. At high intensities even thermal phenomena are possible but non-thermal phenomena occur more frequently. High frequency radiation can produce changes in:

- Growth and virulence of bacteria
- Inactivation of viruses
- Changes of chromosomes in the process of cell division.

In general, biological effects are the bigger the greater the field intensity, and therefore induced tension. Factors that modify biological effects:

- Time course: the fields of pulsating character are biologically more effective than non-pulsating fields, rectangular shape of the impulse is more effective than the sinus one.
- Length of waves:
  - cm and dm waves can penetrate deeper into the tissue and strike the essential-to-life organs (area of frequency to 500 MHz)
  - mm waves are practically fully absorbed by the skin (frequency area >3000 MHz).
  - Magnetic field with pulses identical to alpha waves of man (8-14 Hz) provokes resonance phenomena causing changes of Ca<sup>2+</sup> flow in the brain, blood etc.
- Absorbed energy: the quantity of the energy of magnetic components' absorbed by human body, grows with the size of the body.

- Gradient and localization: non-homogeneous fields are more effective than homogenous fields.
- Exposure: no correlation exists between the length of exposure and the effect. Even negative reaction to disappearance of the magnetic field has been found!

Affecting intensities can produce three responses of the exposed organism:

1. Indifferent response: functional changes do not exceed physiological norms
2. Active adaptation: non-specific but observable effects
3. Extreme effect: cumulative, of various types effects

## Mechanisms of effects

It is so far not exactly known but a number of theories exist. When changes strike the nervous cell, they secondarily influence also other functions of the organism. Changes of tension provoked by electromagnetic induction can spread along the nerves to places where they primarily could not have occurred and this way biological effects can be further strengthened.

## Principles of health prevention

1. Time protection
2. Protection by distance
3. Protection by screening - Faradays cage (screening HF field)

## Links

### Related articles

- Biological Effects of UV Radiation

### Bibliography

- BENCKO CHARLES UNIVERSITY, PRAGUE 2004, 270 P, V, et al. *Hygiene and epidemiology. Selected Chapters*. 2nd edition. Prague. 2008. ISBN 9788024607931.
- RAMES, . *Physical factors of environment* [lecture for subject Hygiene and Epidemiology, specialization Hygiene and Epidemiology, 1st Faculty of Medicine Charles University]. Prague. 2011.