Vibration, Pressure and Ionizing Radiation

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Vibration

a. Whole body vibration

caused by poorly designed or poorly maintained vehicles, platforms or machinery as in uneven roads, Fork lift and Quarrying.

Acute effects cause discomfort: nausea, vomiting, loss of balance may appear after work.

Fatigue, dizziness, headache, sleep disorders also might develop.

Oscillation of organs due to vibration has an effect on body functioning.

Vibration around 1 Hz affects the sense of balance.

Vibration in the range of 3-6 Hz affects organs in the thorax and abdomen.

Vibration in the range of 20-30 Hz targets the head, neck and shoulders.

Whole body vibration of higher frequencies can lead to gynaecological complaints among women

Long term exposure to WBV may lead to:

Lower back pain (Degeneration of the intervertebral discs is more common, more severe and its onset is earlier in workers exposed to whole-body vibration than in the non-exposed population, ligaments loosened from shaking), also it can cause:

Motion sickness

Bone damage

The longer a worker is exposed to WBV, the greater the risk of health effects and muscular disorders.

Prevention:
i _ Education of workers about vibration transmission and to take breaks , posture changes , reduce exposure time

ii_ preference for buying machines and vehicles designed to reduce transmission of vibration

iii_ suspension seats

2- Local body vibration
****hand-arm vibration

Occurs in the arms , hands and fingers when working with a vibration tool or machinery as in drill hammering

It affects tendons, muscles, bones and joints, and can affect the nervous system

Vibration induced health conditions progress slowly.

In the beginning it usually starts as a pain.

As the vibration exposure continues, the pain may develop into a condition called Hand Arm Vibration Syndrom (HAVS)

The development of HAVS is gradual and increases in severity over time.

It may take a few months to several years for the symptoms of HAVS to become clinically noticeable

Symptoms include:

attacks of whitening (blanching) of one or more fingers when exposed to cold

tingling and loss of sensation in the fingers

loss of light touch

pain and cold sensations between periodic white finger attacks, especially upon cold exposure

loss of grip strength

bone cysts in fingers and wrists

Risk factors

1. Frequency and acceleration of Vibration.
2. Duration of exposure and years of involvement in Vibration work.
3. Protective practices and equipment including gloves, boots, work-rest periods.
4. Skill, operator control and grip forces - how hard the worker grasps the vibrating equipment.
5. Position of the hand and arm relative to the body.
6. Medical history of injury to fingers and hands, particularly frostbite.
7. Smoking and use of drugs and exposure to other physical and chemical agents.
8. State of tool maintenance
9. Hardness of the material being contacted by the machine (for example metal in grinding and chipping)

Prevention

1- Use of anti vibration gloves

Reduce the vibration from handheld machines

2. Take regular breaks of at least 10 minutes away from the tool

3. Use tools correctly and use the right tool for the job.

4. Avoid use of excessive grip, nor to use a tool for longer than necessary.

Pressure

Decompression sickness is a disease results from exposure to high or low atmospheric pressure.

Also called Bends or Caisson disease.

It occurs in scuba divers, tunnel workers or high altitude or aerospace events when dissolved gases (mainly nitrogen) come out of solution in bubbles.

Under increased atmospheric pressure (such as that experienced by deep-sea divers or tunnel workers), fat-soluble nitrogen gas dissolves in the body fluids and tissues.

During decompression the gas comes out of solution and, if decompression is rapid, it forms bubbles in the tissues.

Similarly, the gases in solution in the body tissues under normal atmospheric pressure form bubbles when pressure rapidly decreases, as when aviators in unpressurized aircraft ascend to high altitudes too quickly.

affect any body area including joints, lung, heart, skin and brain.

Bubbles cause pains in the limbs (known as the bends) and mild cutaneous symptoms.

Also breathlessness, angina, headache, dizziness, collapse, coma, and in some cases death.

Emergency treatment of decompression sickness consists of rapid recompression in a compression chamber with gradual subsequent decompression.

The condition can be prevented by allowing sufficient decompression time for the excess nitrogen gas to be expelled naturally.

Ionizing Radiation

Ionising radiation

Ionising radiation can be described as the transfer of energy in the form of particles (such as alpha and beta particles) or electromagnetic waves (such as X-rays and gamma rays) capable of producing ions directly or indirectly.

Ionising radiation can occur naturally (e.g. from the radioactive decay of natural radioactive substances such as radon gas and its decay products) or it can be generated artificially (e.g. man-made radioactive substances or the operation of certain electrical equipment, such as X-ray sets, which emit ionising radiations).

The effect on body tissues will depend on:

1. the type of radiation,
2. the dose and duration of exposure
3. whether the source is internal or external to the body.

There are three types of nuclear radiation: alpha, beta and gamma.

Alpha is the least penetrating, while gamma is the most penetrating.

Nonetheless, all three are ionising radiation: they can knock electrons out of atoms and form charged particles.

Types of Ionising Radiation

Alpha radiation represents the nucleus of helium atoms that are often called alpha particles (α).

They are positively charged particles

These particles are big.

If an alpha source is outside the body, the alpha radiation will not cause any harm to the human body since radiation will not pentrate the skin.

Types of Ionising Radiation: cont.

Beta radiation consists of small, high-energy, and high-speed electrons emitted by certain types of radioactive nuclei.

They are actually an ejected electron.

If beta radiation reaches the human body, it can cause skin burn or blindness if the eyes are exposed.

Internal organs will not be damaged (unless ß-radiation emitters are deposited internally e.g. by ingestion) since beta radiation stops in 1 to 2 cm of tissue.

Types of Ionising Radiation: cont.

Gamma particles have no mass and no electric charge called photons.

They are the same particles as those that represent visible light but have much higher energy.

Since they have no mass and no electric charge, it is difficult to stop.

X-rays also ionise atoms. They behave the same as gamma rays, except that their energy is lower

Sources

Ionising radiation sources are used in medicine (for diagnosis and treatment in oncology

Industry (for measurement and other purposes as well as for producing energy)

Research and teaching.

Effects

Ionising radiation ionises atoms in all matter including the human body.

Cause cell damage and death.

OR radiation damages cell DNA

If the damaged cell survives, it can mutate and reproduce and cancer can occur.

Dose Limit

The most important dose limit is the annual dose limit of 20 mSv. It means that a worker can receive a dose of 20 mSv per year from ionising sources they are working with.

Natural background radiation due to radioactivity in soil, water, air, food, on average the annual dose is around 2 mSv

So a worker using ionising radiation sources can receive ten times the dose of the natural background at the workplace.

Pregnant and Nursing Mothers

For women, there are special limitations during pregnancy or breast feeding.

Pregnant woman can work in a radiation area but the dose to the foetus must be below 1 mSv during pregnancy.

Breast feeding woman can work in a radiation area when only exposure to external radiation is possible (X-ray devices or encapsulated radioactivity sources). In that case, the limit of 20 mSv per year applies.

A breastfeeding mother is not allowed to work in an area where contamination and intake of radioactivity is possible.

Protection

To keep radiation doses low, three methods are used: time, distance and shielding.

The dose is proportional to the time of exposure The more time one is exposed to ionising radiation, the larger the dose that will be received and the more harmful the radiation will be.

The radiation reduces with the distance from the source.

Protection: Cont.

Shielding: There are activities that require workers to be close to the source and in a high radiation field.

In that case, we minimise the doses by using shielding and protective clothing.

When working with X-ray devices in medicine, the most common personal protective clothing is lead aprons. Led aprons made of 0.25 mm thick lead attenuate X-rays more than 100 times.

In some cases when eyes are exposed, spectacles made of lead glass are used as protection. Also, lead gloves can be used, however such gloves are quite thick and not appropriate for detailed work.