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ASPECTS OF FOOD INDUSTRY MACHINES PRODUCING VIBRATIONS

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Abstract: *The work refers at the facilities in the milling and baking industry, part of the food industry, producing vibrations maintained range of common into and acting directly upon the human operator, which operates production in vibrating medium, throughout the day. Search for explanations as to how these vibrations can be reduced, or to protect a human operator during the production process.*

Key words*: food industry, milling and baking industry, vibrations action on the human operator*

1. GENERAL CONSIDERATIONS

In the food industry still do not have the good informations concerning the study on the produsedof vibrations, or the exposure of the human body to direct vibrations, therefore in this paper tries to detect and investigate with accurately how is the situation of the opperators the work at the colloid mills or at the mills with hammers.

Short-term exposure to vibrations of 2-20 Hz, resulting in the appearance of symptoms, such as abdominal pain, general state of discomfort, headaches, chest pain, nausea, loss of balance, contractions of the muscles and decrease accuracy while performing maneuvers, breathing slow, cluttered speech. The different types of discomfort are given in the Table 1.

Table 1.

Symptoms caused by vibration frequency

Symptoms	**f** [Hz]
General state of discomfort	4-9
Headache	13-20
Mandible pain	6-8
Speech deficiencies	13-20
Breathing more difficult	12-16
Chest pains	5-7
Abdominal pain	4-10
Muscle contractions	13-20

Long-term exposure can lead to health problems, especially problems of nervous system, diseases of the gastrointestinal system.

2. THE VIBRATIONAL FIELD OF FOOD INDUSTRY

The vibrations act on the body through the surface of contact between humans and vibrant system. Vibrational field may act on the entire body (WBV – Whole Body Vibration) (if the person sits up or stands placed), or a part of the body, for example on the hand (HAV – Hand Arm Vibration). Negative effects of vibration on the human body leading to decreased capacity for work, thus reducing its performance.

Excessive exposure to vibration may cause hand disorders of blood circulation to the fingers, neurological functions and disorders of the hands and arms.

For food industry workers can bring out the fact that the action by the vibrations of the human hand-arm system is quite common so it is particularly important to determine the severity of the factors presented in exposure to

vibrations. The severity of biological effects depend on:

- The exposure time and the method of work: the duration, frequency and succession work periods and break;
- Duration of exposure per day;
- Cumulative duration of working day;
- Direction of vibration transmitted to hand;
- The size and direction of the force applied by the operator through his hands on the gear-driven devices;
- The type and status of the vibrating mechanisms.

3. CRITERIA FOR ASSESSING THE STATE OF DISCOMFORT DUE TO VIBRATIONS

The vibrations are perceived differently, depending on the sensitivity of the person that is acting, so they can not make an exact quantification of the way in which the body perceives them.

Human response to vibration depends on: the parameters of vibration (amplitude, frequency), the mode of transmission, body position and duration of exposure.

Established three criteria for assessing the discomfort state: the threshold of perception, a feeling of pleasantness and insuportabilitate (Fig. 1). The one who was busy establishing how the human body reacts to vibrations, was Dieckman [Dar 83].

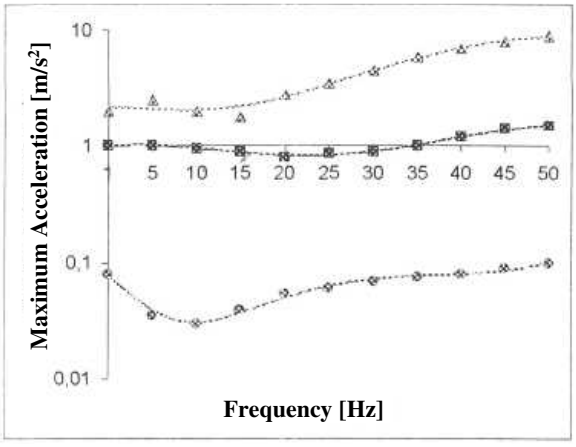

Fig. 1. Assessing the discomfort state: (*) the threshold of perception; (▪) the sensation of pleasantness: (Δ) insupportability state

In order to assess the degree of vibration perception by humans, the level of vibrations is defined by:

$$P = 10 \lg \frac{Z}{Z_1} \text{ [Pal]} \qquad (1)$$

[Pal] is the unit of measurement of the vibrations level, noted „P". In the relation (1) the notetion „Z" is the intensity of vibration [Dar 83] and has the unit measure [cm^2/s^3]. It has the expresion:

$$Z = \frac{a_0^2}{f} = 16\pi^4 x_0^2 f^3 \qquad (2)$$

In thees relations, the notations are:

- a_0 is acceleration amplitude;
- f is the frequency;
- x_0 is the amplitude of the movement;
- Z is the intensity of the vibration;
- Z1=0,5 cm^2/s^3 is the reference value for the intensity of vibrations.

In the figure 2 is given the perception degree of vibrations for the human.

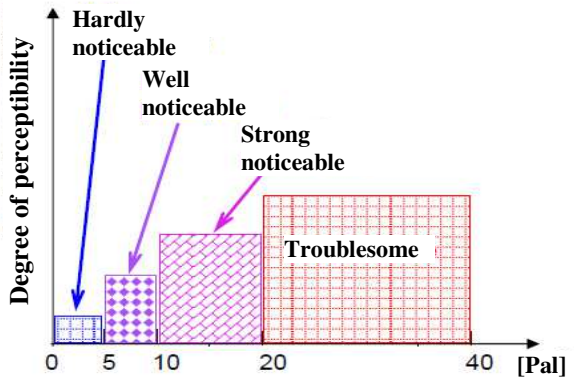

Fig. 2. The degree of perceptibility [Tru 09]

The degree of perceptibility is thus classified:

- ✓ Hardly noticeable <5Pal;
- ✓ Well noticeable 5 – 10 Pal;
- ✓ Strong noticeable 10 – 20 Pal;
- ✓ Troublesome 20 – 40 Pal.

3.1. Vibration-producing machinery in food industry

An important source of vibrations in the food industry is the hammer mill. In the figure 3 there is the scheme of hammer mill component. Hammer mill section you can see:

- ➢ shredding disc, and hammers attached to tree;
- ➢ a barbecue outsider;
- ➢ escape chute.

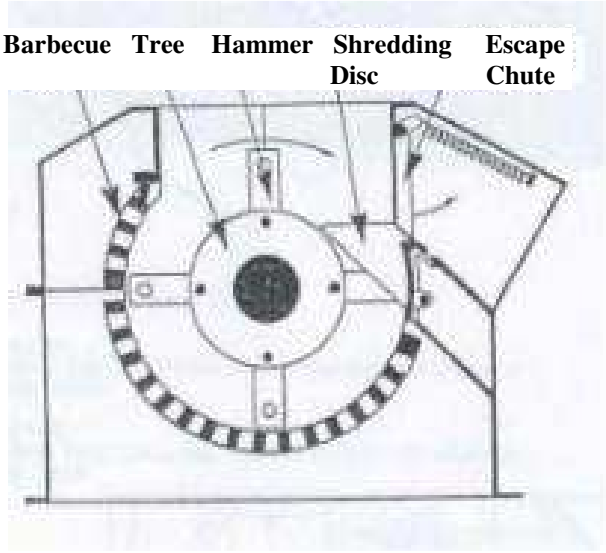

Fig. 3. Hammer mill components

4. ALLOWABLE LIMIT OF VIBRATION THAT ACTS ON THE HUMAN BODY

Various types of machinery and equipment exposed the man to mechanical vibration and that can harm its comfort, quality of labour, health and safety of its operations. Given the complexity of the factors that determines the behaviour of the human body to vibration and bearing in mind the variety of quantitative data regarding their perception of the man and his reactions to this, Directive 2002/44/EC, lays down minimum requirements for the protection of workers against risks to health and safety that may be generated by exposure to vibration [2002/44/EC].

For the purposes of this directive, the following terms shall mean:

(a) „vibraţie transmisă sistemului mână-braţ": vibraţia mecanică care, în cazul în care este transmisă sistemului uman mână-braţ, generează riscuri pentru sănătatea şi securitatea lucrătorilor, în special tulburări vasculare, leziuni ale oaselor, articulaţiilor sau tulburări neurologice sau musculare;

- "vibration transmitted to the hand-arm system": the mechanical vibration that, when transmitted to the human hand-arm system, entails risks to the health and safety of workers, in particular vascular disorders, injuries of the bones, joints or neurological disorders or muscle;
- "vibration transmitted to the whole body": the mechanical vibration that, when transmitted to the whole body, entails risks to the health and safety of workers, in particular-back morbidity and trauma of the spine of the other.

4.1. For vibration hand-arm system

(a) the daily exposure limit value standardised, to a reference period of eight hours, must be 5 m/s^2;

(b) the amount of daily exposure, which triggers the action, standardised to a reference period of eight hours, shall be 2.5 m/s^2.

Exposure of workers to vibration transmitted to the hand-arm system shall be assessed or measured on the basis of the provisions of [2002/44/EC].

4.2. For whole-body vibration

(a) the daily exposure limit value standardised to a reference period of eight hours, shall be 1.15 m/s^2 or, at the option of the system concerned, a value of vibration dose ca be 21 $m/s^{1,75}$;

(b) the amount of daily exposure, which triggers the action, standardised to a reference period of eight hours, shall be 0.5 m/s^2, or, at the option of the system concerned, a value of vibration dose can be 9.1 $m/s^{1,75}$.

The level of exposure to mechanical vibration may be assessed by the observance of specific working practices and reference to relevant information about the expected value of the vibration corresponding to the equipment or the types of equipment used in specific conditions of use, including such information provided by the manufacturer of the equipment. This operation must be distinguished from measurement, which requires the use of specific apparatus and appropriate methodology.

Because the vibration limits refer to the vibrations in the place of their penetration into the body and have, for example, the keel of a Chair, which can attenuate or amplify the vibration measurements should be made, as close as possible to the point or area through which they are transmitted to the body.

5. STATISTICS FOR EXPOSURE TO VIBRATION IN FOOD INDUSTRY

According to some studies and estimates made in several European countries, a rate of 4-7% of the population, through daily activities they carry out food industry, the global action on the human body vibration (WBV whole –body vibration) [Net 02].

This aspect is particularly worrisome, because a very large mass of the population is affected by vibrations what occur in food industry, due to expansion and diversity of this industry.

In this paper it shows a small example of vibration equipment manufacturer (hammer mill), which affects the health of the human operator, working directly in the production process, but also workers who supply the raw materials and the junta with the finished product packaging.

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Aspecte privind utilajele din industria alimentară producătoare de vibraţii

Rezumat: *Lucrarea se referă la utilajele din industria de morarit si panificatie, parte componenta a industriei alimentare, care produc vibratii intretinute intro gama larga de frecvente si care actioneaza nemijlocit asupra operatorului uman, ce isi desfasoara activitatea de productie in mediul vibrational, pe toata durata zilei de munca. Se cauta explicatii asupra modului in care aceste vibratii pot fi diminuate, sau sa se protejeze operatorul uman in timpul procesului de productie.*

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