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Identyfikacja zagrożeń i ocena ryzyka zawodowego hałasem ultradźwiękowym w wybranych gałęziach przemysłu

Hazard identification and occupational risk assessment of ultrasonic noise in the selected branches of industry.

Resilience oscillation in the frequency range from 20 kHz to 10 GHz which propagation takes the form of acoustic waves in the gas, liquid and solid are called ultrasounds. The issues concerning the occurrence and propagation of ultrasounds could be examined in two ways. On the one hand ultrasounds are produced on purpose e.g. to streamline technological process or the useful information carrier in the purpose of medical diagnostics. On the other hand ultrasonic components occur as not desired sounds which means that ultrasonic noise in many cases is emitted in the machines and devices in the work environment.

Ultrasonic noise is the sound or noise of the spectrum within high audible frequency band (10-20 kHz) and low ultrasonic frequencies (20 - 40 kHz). This noise may cause hearing loss related to negative effects on the human body. For this reason this noise was placed on the list of factors harmful to health. It can also cause annoyance for health. Therefore in order to prevent the effects of workers' exposure to this factor it is necessary to identify the machines and other devices generating ultrasonic noise.

The aim of the doctoral thesis was to diagnose and characterize (identify) industrial sources of ultrasonic noise and to assess the risks occurring in industrial plants in Poland. A thesis, that ultrasonic noise occurring at workstations in the industry is annoying, irritating and harmful factor was adopted. Moreover the identification and characterization of ultrasonic noise sources as well as make the criterion for determining risk limit levels more specific, should contribute to more effective control of workers' exposure to this type of noise.

Identification process of ultrasonic noise sources in the work environment and risk assessment at workstations as effect of exposure to this factor included: diagnosis of hazard factor (literature review and questionnaire study), measurement of quantities characterizing ultrasonic noise and their analysis, expert evaluation - determination of quantities characterizing occupational risk at workstations as effect of ultrasonic noise – the number of times that MAI (Maximum Admissible Intensity) was exceeded.

The research on the risk of ultrasonic noise was carried out in three directions: subjective questionnaire study at workstations and in the laboratory, laboratory testing of the annoyance of ultrasonic noise and measurement at workstations in industry factory. The study of the

annoyance of ultrasonic noise occurring at industry workstations and in the laboratory was carried with the use of the developed questionnaire and a survey. The measurements of quantities characterizing ultrasonic noise at workstations were performed using the measurement methods adapted to the types of workstations and technological processes.

The measurements were carried out at about 200 workstations located in the metallurgical and textile factories and small service units (e.g. in the garages). The tests included technological workstations (e.g. ultrasonic drills and welding machines) as well as non-technological ultrasonic sources (e.g. hand pneumatic tools, machines with compressed air and others).

The excess of the quantities characterizing ultrasonic noise in the technological ultrasonic machines occurs mainly in the one third frequency band with center frequency of 20 kHz, that is the working frequency for devices (produced by ultrasonic generator). The highest excess of ultrasonic noise at workstations of non-technological ultrasonic devices occurs in the one third frequencies bands with center frequencies: 10 kHz, 12,5 kHz and 16 kHz. The risk of hearing loss is estimated as high because these frequency bands cover the high range of audible frequency noise.

On the basis of results of the measurement of quantities characterizing ultrasonic noise at workstations an expert evaluation was prepared to determine occupational risk at these workstations by setting its measure i.e. the number of times MAI of ultrasonic noise was exceeded. The operation of some devices which emit ultrasonic noise requires from workers to focus attention as they perform activities which demand high quality performance and precision in joining the elements (e.g. during welding under gas) or included detailed elements of complicated form and high precision of processing (e.g. ultrasonic drills).

Therefore the influence of this type of noise on psycho-physical efficiency of workers, which was determined at test stand in the laboratory at definite acoustics conditions, is important. The tests that were carried out made it possible to determine preliminary proposal for annoyance criterion of ultrasonic noise for activities which require the focus of attention for third octave bands with center frequency from 10 to 40 kHz.

The summary results and the recommendation for further studies are presented in the last section of the PhD thesis.