ANALYSIS OF THE NOISE EXPOSURE OF MILKING PARLOUR OPERATORS DURING WORKING SHIFT AT DIFFERENT TECHNOLOGICAL SOLUTIONS

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Abstract: Generally, working environment means all tangible and intangible factors that act directly on the employee and his work. Employees working in conditions of farms are exposed to different unnatural influences. These factors may include also noise. Noise always arises with a certain energy conversion. In cattle farms, the sources of noise are represented by various mechanical equipment and machines that are used for enabling the operations of the farm. The aim of the paper was to analyze the exposure of operators in milking parlours, during their day routine. The measurement took place at three different farms with different technological solution of milking system. In this article, automatic milking system, herringbone milking parlour and rotary milking parlour was evaluated. Values were processed statistically, showed in graphs and compared with values under the Directive of the European Parliament and the Council Nr. 2003/10/EC, which gives the exposure limit values $L_{AEX, 8h}$ (noise exposure with weighting filter “A”) and upper and lower action value of exposure $L_{AEX, 8h}$, but also the values of $L_{CPL}$.

Key Words: working environment, milker, cattle.

INTRODUCTION

Currently, high demands are given on environmental protection. The environmental protection must be part of person’s life in twenty-first century (Gálik et al. 2014). Each production process is characterized by certain conditions in which it is performed (Opáth and Kažimírová, 2013). Into production process of milk is entering various means of mechanization. Cattle bred in farm buildings are exposed to noise, which can come either from outside or from inside of the building. Several published studies demonstrate different sounds that can occur inside the building for animal husbandry (Castelhano-Carlos and Baumans 2009). Noise sources on farms can be, in addition to ordinary activities (opening and closing doors, washing, speech of employees, dispensing feed, etc.), also machinery, basal levels of noise caused by mechanical ventilation, animal activity (climbing to barriers, chewing on barriers) and their own vocalization (Mihina et al. 2012). Other sources of noise can also be mechanization used on farms, because of the noise either of the engine or hydraulic systems (Janoško et al. 2010). Besides noise from technical and mechanized equipment, in animal...
production there are also noise emissions caused by biological noise of animals. This noise is by dairy cows in the range of 73.7 dB to 83.8 dB (Šístková et al. 2010).

A great deal of research has been done on the effects of noise on performance (Kjellberg and Landström 1994). Algers et al. (1978) detected noise levels in the milking parlours and states values from 75 to 90 dB. According to Kauke (2007) is the noise intensity in most cases unacceptable for dairy cows and also for operator (milker).

Therefore, careful planning should be made before construction of animal buildings, in order to avoid stressful environmental sounds both for the animal and personnel (Brouček 2014).

MATERIAL AND METHODS

Research place

The experiment was conducted in three cattle farms in the Czech Republic. First measurements were performed in the farm with 840 production dairy cows, with rotary milking parlour (year of manufacture 2007) with 36 parlour places. This parlour is equipped with oil-vane vacuum pump Fullwood Ambassador. Dairy cows are milked 2 times per day and they and the milking lasted 407 minutes. This parlour is served by three workers (milkers).

Second measurements were performed in the farm with capacity for 205 dairy cows, milked with three identical automatic milking systems (AMS) (year of manufacture 2006). Every AMS unit is equipped with claw vacuum pump Mink MM 1104 A VM. Cows are milked according to their needs, in some cases up to 3 times a day. This system of milking is served and controlled by one worker (zootechnician). The working shift lasted 640 minutes.

Third measurements were performed in the farm with 536 production dairy cows, with herringbone milking parlour 2 x 12 with quick exit (year of manufacture 2009). This parlour is equipped with oil-vane vacuum pump Fullwood Q4. Dairy cows are milked 2 times per day and the milking lasted 348 minutes. Parlour is served by two workers (milkers).

Measuring device

Personal Noise Dosimeter 3M eg4 Edge Dosimeter was used for measuring of noise exposure. For calibration, before the measurement was used Acoustic Calibrator 3M AC–300. Conditions during measurement were recorded by digital meteorological station WS–1600.

Data acquisition

During measurement, the operators of milking parlours were exposed to normal, everyday conditions, when the milking system was running. The noise pressure levels were measured in area, where the employees are located during the working shift and where their work tasks are performed. The measuring device was located on workers right shoulder, so that his work tasks were not obstructed by wearing this device (Figure 1). Duration of each measurement was equal to the duration of the work shift in a given milking parlour.

\[
L_{AEX,8h} = L_{Aeq} + 10 \log \left( T_e / T_0 \right), \text{dB}
\] (1)
where:
\[ L_{Aeq,Te} \] - equivalent sound pressure level during the period of \( T_e \);
\[ T_0 \] - nominal duration of working day – 8 hours

Software package SAS ver. 9.2 (SAS, 2009) was used to carry out given statistical procedures.

RESULTS AND DISCUSSION

The measurements were conducted under the conditions specified in Table 1.

Table 1 Climatic conditions during measurement

<table>
<thead>
<tr>
<th>Location of measurement</th>
<th>Air temperature [°C]</th>
<th>Relative humidity of air [%]</th>
<th>Atmospheric pressure [hPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary milking parlour</td>
<td>19.1</td>
<td>64</td>
<td>943</td>
</tr>
<tr>
<td>AMS</td>
<td>18.1</td>
<td>42</td>
<td>959</td>
</tr>
<tr>
<td>Herringbone milking parlour</td>
<td>20.1</td>
<td>54</td>
<td>991</td>
</tr>
</tbody>
</table>

When analyzing the summary statistics of basic noise measures, we found out, that the highest \( L_{AFeq} \) was found in rotary milking parlour (79.75±5.04 dB) while the lowest value was measured in AMS (71.11±9.13 dB). The same situation was observed in \( L_{AFmax} \) values. The highest peak value (\( L_{Cpk} \)) was found in AMS (114.16±5.20 dB). Graphical overview of mean \( L_{AFmax} \) and \( L_{AFeq} \) in various milking parlour types is presented in graph (Figure 2).

Figure 2 Average values of noise in milking parlours

As can be seen in the graph (Figure 2), the average maximum sound pressure levels are quite high. This is due to the fact, that during milking are occurring different noises, caused by various noise sources, such as hitting metal parts to each other (metal barriers, namely chains, locking mechanisms of barriers and so on), or other adverse sounds. In reality, these values were in the range of 59 dB to 121 dB.

Equivalent levels were in rotary milking parlour in range of 62.4 dB to 100.2 dB, in AMS in range of 59.2 dB to 96.9 dB, and in herringbone milking parlour in range of 59.8 dB to 97.2 dB. Arithmetic averages of measured values showed in graph (Figure 2) indicate, that in rotary milking parlour and in herringbone milking parlour the values were higher than in AMS, where the levels were around 71 dB.

The differences within mean \( L_{AFeq} \) values between various milking parlours types were highly statistically significant (P<0.001***). The same result was observed in case of \( L_{AFmax} \) and \( L_{Cpk} \) values as well.

The differences of correlation coefficients within the individual types of milking parlours were not important, therefore correlations were calculated from common database of all measured values in all types of milking parlours toghether. As expected, the most important correlation was found between \( L_{AFeq} \) and \( L_{AFmax} \) (\( r = 0.9115^{***} \)). Moderate relations were found between \( L_{AFmax} \) and \( L_{Cpk} \) (\( r = \))
0.39161*** and $L_{Aeq}$ and $L_{CPk}$ ($r = 0.29874***$). Measured values of $L_{CPk}$ include especially sudden noises and these values did not significantly affect $L_{Aeq}$ and $L_{AEmax}$.

Table 2 Calculated $L_{AEX,8h}$, and maximum values of $L_{CPk}$

<table>
<thead>
<tr>
<th>Type of milking parlour</th>
<th>Average $L_{Aeq}$</th>
<th>Total milking time (duration of the work shift)</th>
<th>$L_{AEX,8h}$</th>
<th>Maximum Value of $L_{CPk}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary milking parlour</td>
<td>79.75</td>
<td>407</td>
<td>79.03</td>
<td>132.8</td>
</tr>
<tr>
<td>AMS</td>
<td>71.11</td>
<td>640</td>
<td>71.11</td>
<td>109.6</td>
</tr>
<tr>
<td>Herringbone milking parlour</td>
<td>76.57</td>
<td>348</td>
<td>75.17</td>
<td>109.5</td>
</tr>
</tbody>
</table>

In the table (Table 2) are shown calculated noise exposure values of operators $L_{AEX,8h}$ weighted with weighting filter “A” (dB) and maximum values of $L_{CPk}$.

According to Directive of the European Parliament and the Council Nr. 2003/10/EC, exposure limit value $L_{AEX,8h}$ has a value $L = 87$ dB (resp. $L_{CPk} = 140$ dB by single impulses) and with this value, the worker can’t be exposed under any circumstances, therefore after use of methods for reducing noise. The upper exposure action value $L_{AEX,8h}$ has a value $a = 85$ dB (resp. $L_{CPk} = 137$ dB by single impulses), and the lower exposure action value $L_{AEX,8h}$ has a value $a = 80$ dB (resp. $L_{CPk} = 135$ dB by single impulses). These action values are noise values in working place, beyond which is the employer obliged to carry out actions (shares) to reduce noise.

As can be seen from the values in the table (Table 2), the noise level did not exceed even the value of the lower exposure action value of 80 dB in any of parlours.

CONCLUSION

Noise generated during the milking process depends not only on technological equipment of parlours and their age. Important factors are also the number of animals milked at the same time, and thus the number of parlour places.

The noise exposure directly depends on the way of working of operators, especially on the speed of work (more noise is produced in haste), precision and accuracy of teat cups application (if improper application, unpleasant noise can occur), the volume of mutual communication of operators and by chasing the dairy cows into the parlour, or other activities (flushing water during milking).

In our experiment, noise exposure levels didn’t exceed the values given in The Directive of the European Parliament and the Council Nr. 2003/10/EC. In terms of noise, most favorable working environment was in case of automatic milking system.

ACKNOWLEDGEMENTS

This study was supported within the project "CZ.1.02/5.1.00/09.06271 BAT centrum JU". Petr Bartos thanks for the financial support provided by the Grant Agency of the University of South Bohemia in České Budějovice, grant project GAJU 094/2016/Z.

This paper was supported by the project VEGA no. 1/0575/14 of the Slovak Scientific Grant Agency.

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