INDUSTRIAL WASTEWATER TREATMENT PLANT SOUND IMPACT

Sebastian MUSTAȚĂ, Dragoș DRĂCEA, Augustina TRONAC

University of Agronomic Sciences and Veterinary Medicine, Faculty of Land Reclamation and Environmental Engineering, 59 Marasti Blvd., 011464, District 1, Bucharest, Romania, Phone: (+40)213182266, Fax: (+40)213182888, E-mail: smustata@gmail.com, dragosdrac@yahoo.com, augustina.tronac@yahoo.com

Corresponding author email: smustata@gmail.com

Abstract

Interlocking residential, administrative and production areas in urban development is accompanied by a decrease in population comfort caused by industry sound pollution. Verification of compliance of acoustic pressure and noise limits is done by direct measurements. This approach is used for assessing the noise level of a treatment plant of industrial wastewater resulting from a meat processing factory, having a technological chain comprising mechanical, chemical and biological phases. The interpretation of recorded values leads to a solution proposal aimed to preserve the operation staff health and to improve the acoustic conditions of the surrounding areas.

Keywords: sound, compressor, impact, pollution diminishing.

INTRODUCTION

Romania is under a complex process of social rules changing in the context of historical and cultural traditionalism. During the 1950s, economic development was based on the construction of large industrial sites that, after 1990, kept no longer their cost-effectiveness and were dismantled. Some of these were converted into industrial parks, others into residential areas. Urban development in the post-revolution era in Romania led to intertwined residential, administrative and production areas, as no relocation techniques were applied to industries depending on urban evolution. Therefore, no natural territorial reorganizations of circular type were obtained. Relocation would have the advantage of facilitating access, diminishing the amount of local taxes, obtaining profit through land sales. The decision of no relocation has the disadvantage of discomfort resulting from noise pollution in the vicinity. Noise limits are set by authorities based on the effects on human health and comfort, taking into account social and economic factors and varying according to day time, protected activities, source type, etc. Compliance checking with normative frameworks includes noise descriptors, relevant time, measurement points, area type and characteristics, descriptions and operating conditions of the source, the environment, propagation conditions from source to receiver (ASRO, 2008, 1).

We analyzed a treatment plant of industrial wastewater (Figure 1) corresponding to a meat processing factory, having mechanical, chemical and biological phases on the technological chain.

![Figure 1. Wastewater treatment plant scheme: 1, 9, 10 - screw volumetric pumps (wastewater, sludge, polyelectrolyte); 2, 7, 11 - centrifugal pumps (chemically treated water, flotation, washing water releases); 3, 4, 8 - blowers and compressors (mixing tank, biological reactor, compressed air command, flotation unit); 5, 6 - mechanical gearbox engines (flotation scraper, press); 12 - electric panels and automations (submerged equipments - pumps and mixers not shown)](image-url)
MATERIALS AND METHODS

We chose to determine sound pressure levels by direct measurement and then extrapolating the results for isolines plotting. Measurements were carried out in real conditions, meeting the appropriate standards (ASRO, 2008, 2). The measurement interval was 10 seconds and only one set of measurements was performed.

Measurements were made inside and outside the plant, between 10.00 o’clock and 12.00 o’clock, in a winter month; weather conditions were characterized by: 4°C temperature, 2.1 m/s wind speed, 3/4 overcast, no sun shining, no precipitation.

The outer street surface was dry concrete, uncovered with ice or snow, and was representative for the usual noise exposure situation. All measurements were performed on the wind direction, in order to minimise the related uncertainty (ASRO, 2008).

The measurement device was Chauvin Arnoux type, indicative CA 834, with measuring ranges of: 30-80 dB, 50-100 dB, 80-130 dB and an extended range of 30-130 dB.

The operating conditions were representative for the ambient noise analysed, all equipment was in continuous operation. Measurements were avoided during the compressor operation (its operation was discontinuous). The main noise source was the compressor corresponding to the biological reactor.

Measurements were performed at a distance far enough, in order to include noise contributions from all major sources and small enough in order to minimize weather influence.

The maximum sound pressure level coming from the wastewater treatment plant was measured, with the equipment in working conditions corresponding to the highest noise emission.

Inside the plant (var. 1), the microphone was located in the area where the affected staff members spent their working time. The measurement points were chosen at 0.5 m distance from any surface, walls, ceiling or floor, and at least 1 m distance from significant acoustic transmission elements (windows, vents, doors). The distance between two neighbouring positions of the microphone was at least 0.7 m. Outside the plant (var. 2) we chose specific positions of the microphone in areas of interest to analyze the effects of equipments in the neighbourhood areas (Figure 2).

RESULTS AND DISCUSSIONS

Results are presented in Table 1 and through isolines (Figures 3 and 4).

![Figure 2. Reception points](image)

![Figure 3. Inner isolines (door closed)](image)

<table>
<thead>
<tr>
<th>Point</th>
<th>Acoustic pressure (dB)</th>
<th>Point</th>
<th>Acoustic pressure (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Var. 1</td>
<td>Var. 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>75.3</td>
<td>75.5</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>75.4</td>
<td>73.8</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>64.3</td>
<td>65.2</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>64.5</td>
<td>63.0</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>67.7</td>
<td>67.3</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>75.3/77.1</td>
<td>75.1/76.9</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>75.2/75.9</td>
<td>74/74.7</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>74.7/75.8</td>
<td>75.3/75</td>
<td>28</td>
</tr>
<tr>
<td>9</td>
<td>74.3</td>
<td>74.0</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>75.2/78.2</td>
<td>74.9/76.9</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>67.7</td>
<td>69.4</td>
<td>31</td>
</tr>
<tr>
<td>12</td>
<td>75.6</td>
<td>73.2</td>
<td>32</td>
</tr>
<tr>
<td>13</td>
<td>55.7</td>
<td>54.8</td>
<td>33</td>
</tr>
<tr>
<td>14</td>
<td>53.3</td>
<td>56.3</td>
<td>34</td>
</tr>
<tr>
<td>15</td>
<td>54.4</td>
<td>53.1</td>
<td>35</td>
</tr>
<tr>
<td>16</td>
<td>54.5</td>
<td>53.3</td>
<td>36</td>
</tr>
<tr>
<td>17</td>
<td>55.9</td>
<td>55.6</td>
<td>37</td>
</tr>
<tr>
<td>18</td>
<td>55.9</td>
<td>54.0</td>
<td>38</td>
</tr>
<tr>
<td>19</td>
<td>56.6</td>
<td>56.1</td>
<td>39</td>
</tr>
<tr>
<td>20</td>
<td>56.6</td>
<td>57.9</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 1. Values recorded
Analyzing the obtained acoustic pressure values, we could distinguish these trends:

a) var. 1 - door closed
- the outer wall had a noise reduction effect of (17-24)% and the partition wall (site-scale) of (10-14)%
- the recorded values were amplified at +3.4 m (inside) with (1-4)%
- between the blower corners there was a gap of 18 dB(A), representing 22.4%
- a noise decrease was recorded at a distance of 2.5 m measured from the front wall of about 8% on the access zone and an amplification of 5% at the same distance on the back wall

b) var. 2 - open door
- the outer wall had a noise reduction effect of (1-23)% and the partition wall (site-scale) of (8-13) %
- the recorded acoustic pressure values were amplified at +3.4 m (inside) with (0.4-2.7)%
- between the blower corners there was a gap of 5.1 dB(A), representing 6.2%
- a noise decrease was recorded at a distance of 2.5 m measured from the front wall of about 12% on the access zone and an amplification of 1.5% at the same distance on the back wall

c) comparing the two analyzed variants, we found that:
- when door was open, the outer wall had diminished efficiency of soundproofing with 16% and the partition wall (site-scale) with 2%
- the recorded values at the tank corners, floor level, were substantially the same regardless the variants
- the recorded acoustic pressure values at the tank corners (+3.4 m level) were (0.3-1.7)% higher when door was closed
- when door was closed, registered acoustic pressure values at the blower were (10-12%) larger near the wall and (1.6-4.0%) smaller near the door
- outside, in the access area, a local noise pressure increase of 18% was recorded when the door was open; in the rear area, a local noise pressure decrease of 1.6% was recorded under the same condition
- when the door was open in the access area, 2.5 m from the front wall, there was a 1.4% increase of noise pressure and a 3.4% decrease in the rear area under the same condition.

**CONCLUSIONS**

All reaction/treatment basins and electromechanical equipment are located inside the technological hall of the industrial wastewater treatment plant analyzed. For the operating personnel and the equipment, the working and functioning environment is highly aggressive, combining physical, chemical, and biological pollution factors. The noise level exceeds 50 dB in any circumstance.

In order to increase the inner acoustic comfort, it is recommended to make a separation and to enclose all equipment individually (depending on the needed noise protection - Figure 5), as follows:
- a ventilated hall, equipped with air pollution control devices; wastewater and sludge collection basins, flotation unit, sludge dewatering unit, biological reactors will be installed;
- a climatic hall, acoustic insulated; electromechanical equipment will be installed.

![Figure 5. Proposed scheme: A. Ventilated hall, B. Climatic hall](image)

Professional insulation or equipment placing in insulated boxes is estimated to reduce the noise level by 18%, having the same effect with the front wall.

Moreover, the proposed solution could be improved by placing the equipment vertically, which will:
- reduce the plant surface;
- simplify the hydraulic scheme;
- facilitate the plant operation;
- eliminate the floating water and sludge pumps.

The mentioned equipment has large wear and tear, induces significant operating costs and high phonic pollution; its removal results in diminishing the potential sound impact of the industrial wastewater treatment plants.

REFERENCES
