Noise Control Action Plan Implementation at BorsodChem 2/2
András MUNTAG\textsuperscript{1}; Miklós MÁRKUS\textsuperscript{2}
\textsuperscript{1} EnviroPlus Ltd., Hungary
\textsuperscript{2} FONOR Ltd., Hungary

ABSTRACT
This presentation is the second in a two-part series, reporting on the noise control action plan of Hungary's largest chemical factory. Few details of the noise control action planning at BorsodChem Ltd. outlined in the previous paper will be shown in this presentation.

The first task was the installation of two monitoring stations for the observation of the noise. The monitoring stations are placed in the plant area in the direction the sound waves propagating towards the residential area. We are demonstrating some observation results of the project.

The exhaust hood of a boiler exchange has been chosen for noise mitigation from the dominant noise sources. We are expounding the method of the noise mitigation and the noise measurement results for before and after conditions.

For each sources and technologies, studies have been prepared before the start of implementation works regarding the detection of possible causes of the noise emission. Such studies have been made in the case of numerous cooling towers and a 2 m diameter fresh air supplying pipe. The tenders for the noise mitigation implementation works have been made based on these.

The noise mitigation often have to be carried out in high noise level conditions. The control measurements was carried out by noise intensity measurements.

Keywords: Industrial Noise, Noise Control, Action Plan, Noise Model
I-INCE Classification of Subjects Number(s): 04.1, 14.1.8, 52.5, 56.1, 76.1.4

1. INTRODUCTION

Controlling the level of noise sources in industrial plants requires planning in scheduled form what measures are to be taken and what costs are to be expected during implementation. This can be well done for sites with no more than 50 sources. In our case the noise comes from a huge area (2.5 sqkm) from more than 500 sources. These sources are spread across not only in space but in time also. The large distances make impossible not only identifying the changes in individual sources, but also high grade of meteorological effects are to be taken in account.

Action planning has the task to rank dominant sources and calculate the effect and costs of reducing their level. Expert’s role is not only to make technical statements, but to explain the background of that, to prove the importance of making such decisions, and to prognosticate things that are not possible to see in advance.

This paper has the goal to give some examples of that work.

2. ACTION PLAN AND IMPLEMENTATION TASKS

2.1 Composing of Action Plan

In the previous paper we made some impressions how to manage the Action Planning work. With

\textsuperscript{1} muntaga@enviroplus.hu
\textsuperscript{2} markusmiklos@fonor.hu
our ears, measuring instruments, knowledges in physics, calculation ability and engineering sense we were able to pick out noise sources from the huge conglomerate that could have dominant level in immission points in urban and rural areas.

We made noise measurements near the noise sources, calculated their effects outside the plant, listened to the noise during exploration in- and outside the plant, and tried to compose in our calculation model the noise that we heard. If our engineering opinion about noise immission was confirmed from more aspects, we could rank the sources. We made theoretical suggestions for noise reduction measures, and estimated their costs. We had consultations with decision-makers of the plant to explain the ‘whats’, ‘whys’ and ‘whens’.

So we composed a plan that was able to form a 10 years program for the plant. The local environmental authority – after consultation – accepted our conception, so the plant could start with implementing the Action Plan.

2.2 Monitoring

The first step was to install two monitoring stations near the populated areas at the border of the plant. The first is located on the roof of a 4 storey building at the urban end of the plant. The second was fixed on a public lightning pylon in the height of 6 m at the other settlement. Both site has the feature that it is in the direction to the dwelling area for most noise sources. After installation we made some measurements to find out the typical differences of the important noise parameters.

![Figure 1 – Noise Monitoring of BorsodChem](image)

Since installation both monitoring stations work properly. The collection and storage of the data goes automatically. We are able to control the instrument and investigate the results with remote control from distant terminal. We make reports of results quarterly.

2.3 Consultancy, Studying

The management of the plant decided to implement this 10 year’s program. The Department for Environmental Protection of the plant steers the noise control work.

In that program we have a lot of consultancy tasks. We have to interpret measurement results, to explain acoustical phenomena, to find out solution for noise control measure, to consult with
applicants or contractors for noise control implementation.

In BorsodChem there are more than 20 individual producer sections that are discrete parts of the plant. It does not mean that they work independently. If we think of prescribed noise emission values, we have to share out this value for the discrete sections. This should be done not only for the present situation, but for the future as well. This problem is not evident to solve.

Furthermore there are some special noise sources that need a further thinking and research. There are a lot of cooling towers there, so we have to think about common reducing process for them. There are lot of pipes, where we have to find out, which process is the main cause of generating noise.

2.4 Tender Specification

When it is known what extent of reduction need is to be required, the object of the work can be specified. The aim of the task was to prepare technical specification to several tenders, which were announced for getting ready noise reduction.

2.5 Controlling Measurements

For noise reduction measures it is worth to know if it was efficient. Before and after noise control activity we have a task to make measurements to show, in what extent the reduction was successful. In such environment as in BorsodChem it is not easy: firstly: reduction of a noise source is hardly to detect outside the plant among a lot of sources with similar noise level, secondly: in near field are also a lot of noise sources at the same frequency band and noise level.

3. ACTION PLAN

3.1 Investigating of Noise Sources

As we first entered the plant, it was terrifying to feel the size of the task. We walked along the large plant area, and were listening in the huge amount of impacts. After weeks we were able to separate the sources having effect on outside immission from that of local significance. Two main parameter to indentify noise sources in greater distances were characteristic frequency or frequency band and noise events restricted in time. Nevertheless we made consistent measurement at all sources that were potencially dominant (see Fig.2.).

![Figure 2 – Noise Source Measuring Sites (500 Points)](image)
3.2 Preparing Noise Model

With data of terrain, buildings and noise sources we composed a noise propagation model of the plant (with the aid of IMMI noise mapping software). After calibration of noise emissions we were able to prepare a noise map of the plant and surroundings.

3.3 Classification of Sources

The noise model of the plant gave us a chance to see which sources are dominant in living area, and in what extent they take part in forming resultant noise level. After making these calculations we portioned sources into three classes: (1) primary noise sources, that have dominant noise level by dwellings near the plant; (2) secondary noise sources, that may become dominant after reducing first class noises; (3) noise sources, that have a little influence in forming noise immission level.

3.4 Proposing Theoretical Solutions

When we find out which sources are dominant, we have to deal with a limited number of problems. So we had a list of 40-50 sources that had to be handled.

As we think of noise reduction, we don’t deal with real plans. An action plan is not the field for experiments or detailed calculations. We have to have our eye on immission level and dominant sources: what extent is needed to have acceptable noise level in populated area, and what size of reduction at dominant sources makes it possible to reach. A second approach is: is this level of reduction technically possible to realize?

Our list of dominant sources widened with informations of necessary level of reduction and possible technical solutions – for each sources of the list.

3.5 Planning and Cost Budget

The information of possible technical solutions is usable to rate the costs of reduction activities. too. This information forms a new ranking of noise sources: the schedule of implementation of actions. The order of this list is influenced primarily by budget power of BorsodChem, secondarily by the...

![Figure 3 – Noise Source Ranking](image-url)

INTER-NOISE 2016

Noise Control Action Plan Implementation at BorsodChem 2/2

Muntag – Márkus
spectacularity of the reduction. We made 3 milestones in the schedule, and so we formed a plan for 10 years of noise reduction work with a budget of more than 6 million euros.

3.6 Introducing of AP

The most challenging side of this project was the consultancy with representatives of the plant. Among the representatives are the staff of the Department for Environmental Protection (DEP), the leader of individual parts of the plant, and the decision-maker (management). They were not informed enough of acoustics, noise control and logarithms. They have different (and selective) hearing as an acoustician. They have a priority of technology and budget. It was a long and interesting process, till we had begun to speak in common language. But we considered this task as one of the most important, because the success of introducing Action Plan to the authority was dependent mostly on it.

4. EXAMPLES OF IMPLEMENTATION WORK

After accepting Action Plan by the local environmental authority, the implementation could start. Hereinafter we would show some examples to illustrate the wide variety of our activity during AP-project.

4.1 Monitoring

First of all we installed two noise monitoring stations to follow the noise level running. The stations were installed in the plant area, but we choose the sites carefully. They were placed in the direction of propagation of sound from most sources to the populated area near the border of the plant. They are situated far enough from sources, so no local noises affect them. One is on the roof of a building, other is on a public lightning pylon. Both sites are not visited by people accidentally.

Noise levels are recorded in every hours with a resolution of 1 sec. We collect broad-band parameters and spectrums as well. We calculate from 1 sec data averages for 30 min and for 3 sections of day (day-evening-night).

![Figure 4 – Example of Monitoring Results](image)

These data are difficult to analyse, because of the huge amount of sources, event and large distances. We get meteorological data from the plant meteo service. The filtered data are compared against dispatcher reports, so some changes in operational status can be identified in noise levels. For example
after finishing the first reduction works, the effect could be slightly detected.
Reports are prepared quarterly.

4.2 Noise Controlling Solutions

Noise reduction works were started with one of the main sources. It is an outlet vent of a boiler in the TDI (toluol-diizocianate)-2-plant.
The reduction was conceived by two thoughts: first the outlet vent was turned away from the direction from the town towards unhabited direction (cca 135°); then the flow in the pipe was laminared and its noise was lowered by a large damper.

4.3 Study of Noise Generation Phenomena

One of the studies that had to be prepared before announcing tender for noise reduction was about physical properties of fresh air supplying system. At the inlet of the system the pipe itself is 2 m of diameter, and it’s noise level in a distance of 3 m was 98 dBA.
After measurements it was seen, that flow-generated noise is of minor importance because of the low flow speed of air, but above 200 Hz ventilator’s noise and vibration is radiating by the pipe’s wall. Solution of noise reduction in more steps (vibration isolating; drone-insulation; damping element; noise enclosure of pipe) was suggested. (tender announcement currently in progress).

4.4 Control Measurement

The noise sources operate with open technology on the entire production area. This technology, which has a typically sound permeable structure, but still dampens the propagation of sound to some extent, affects the volume of the task in such a way that - in the absence of noise sources which are isolated inside the buildings - every noise source of the industrial area takes part in the development of noise. That is the reason of difficulty controlling the efficiency of noise reduction measures.

One of the noisiest place in BorsodChem is the PVC (polyvinyl chloride)-plant. Noise can be heard everywhere 95-105 dB of level, 200-1500 Hz in frequency and some tonal components at 300 and 370 Hz.

Under such conditions a logical choice was to measure sound intensity. It’s easier to rate how efficient our noise reduction was when we not only know the frequency and level of the noise in such complex sound-field, but direction as well.

We constructed a frame with surface of 1 x 2 m, and a measuring mesh was shaped in it. We measured the intensity through this frame and evaluated the accuracy parameters according ISO 9614. We reached a sizeable accuracy in the range of 160-4000 Hz.

This measurement will be repeated after noise reduction. The difference will tell us how effective noise reduction was.

Figure 7 – Sound Intensity Measurement

5. CONCLUSION

There is not easy to paint a comprehensive picture of such a complicated project. We could only show some mosaics of it.

We hope, our project – which is one of the biggest in it’s kind – will show a lot of experiences and, of course, success too.