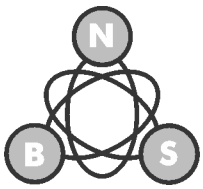
2020 55th International Scientific Conference on Information, Communication and Energy Systems and Technologies (ICEST)



ICEST 2020

Proceedings of Papers

Serbia, Niš, September 10 - 12, 2020

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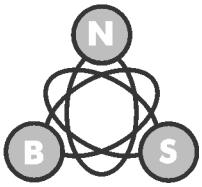

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Regular papers:

Impact of Microclimate Changes and Noise to Workers as a part of an Implemented Health and Safety System

Ivo Kuzmanov[1] and Roberto Pasic[2]

Abstract – **Impact of microclimate changes to workers has always been a special health and safety issue to each business entity who obligatory fulfil the national laws regarding health and safety. Especially if the microclimate changes are related to worker circulations among processes where they have to do business activities in cold and hot chambers as a part of a daily routine several times a day. On the other hand if the daily routine has production activities in a room where the noise is a special problem as well then we have a special situation. These two main concerns are "must do" problems to solve by themselves, but combined with a situation where some accidents happened, we certainly have a situation to show and to deal with. This paper presents only a small part from the research (real activity in real business entity) and some of the equipment and measures (especially made for the purpose) used to deal with the same one.**

Keywords – **Health and Safety, Production system, Measurement, Negative impact to workers, Noise.**

I. INTRODUCTION

The paper presents only a part from an extensive research, as still ongoing applicative activity, with several key activities such as: creating a measurement unit (specially made and even improved one) [1-8] as one of the equipments used during the processes, measurements on different parameters (temperature, humidity, noise) into production capacity in Republic North Macedonia, but also dealing with the occurred problems one by one in short notice and finally continuous monitoring on defined measurement spots. In addition to results published in [9], in this research we are presenting only the situation at first – specially created unit and some of the additional measurements regarding temperature and humidity [9], and we are focusing on some problems which occurred during the process. Also we are presenting some of the solutions made which are in a stage of so called real applicative testing mode or approved mode (used on a daily base) into the business entity previously mentioned. Also, we are presenting some additional problems on the spot which occurred during the processes of dealing with the first defined problem.

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But first of all some small things about the entity – it's a production company with several capacities (work stations) in different parts of Republic North Macedonia, and considering the year fluctuation of workers, with more than 100 up to 300 employees. The focus during the first contact with the company was on several key problems regarding health and safety issues on different micro locations and different spots into the capacities. But one of the main problems was the health and safety issue regarding the workers which during day activities had the mentioned problems – transition from cold to hot rooms and vice versa.

From all of the presented problems by the company, the one presented here is the most interesting because starts with one problem – circulation from cold to hot chambers and then to normal work conditions several times a day (even in one stage in every 15 minutes).

This problem during the process of observation evolved with multiple problems regarding health and safety. At first the real problem was the circulation of workers who were exposed to so called 'temperature shocks' from -3°C or in some cases even -5°C to normal conditions (19 - 23°C) and then to extremely hot conditions where temperatures were even +45°C. Also one of the problems was the circulation directly from hot to cold or otherwise several times during the daily period of work 8 and even more working hours per day.

This problem occurred and concerned 8-12 people at any time, or in some cases 15-25 people during shifts. Other thing that was a real concern was the HTZ equipment (HTZ is a short notice used in Macedonia, given for health and safety equipment) given to the workers and the conditions that they work in – wet floors, wet surfaces, lot of equipment into the room and finally lot and lot of electricity wires (although all of them were in a good condition, even some of them brand new instalation).

At that stage, that was the starting point why we created also a portable unit (2 units) presented in detail in the previous publication [9], so we could conduct multiple measurements in several occasions and even during the hole day. As starting point even we conducted a real calibration with equipment which is quite expensive, so we could get precise measurement data from a portable unit. That was the maybe the only way to get a real picture during various measurements in multiple days (even is some cases 8 hours per day), about what is happening and things could be seen from a different angle.

But during the processes and monitoring of the whole thing, other problems occurred: noise at one of the spots with a daily activity with 4-8 people at spot (with circulation into hot and cold chambers of the same ones), and a thing that was not said at first (documents were there) – previous injuries and

multiple and common illnesses. Especially injuries and the noise (86-89 dB) was a new thing at that stage, even for the company. And finally the paper presents only a small part from the processes of monitoring, processes of creating solutions on spot (by fulfilling legal obligations) and finally the process of monitoring the created solutions in practice and setting them as a daily routine (must do thing).

II. The Measurement Unit and the Results

The measurement unit used as a portable one was in-house created [1-8] and tested in various different cases. We are using 8 additional pieces of the same one – not only here, but also in different locations. During the processes of comparison to other equipment we have concluded that the measurement unit brought us real and secure results.

The same one during the process of creation till now, was compared to several other equipments (more than 7 producers) even in real measurements on spot and gave us results with a slight variation (in some cases ± 0.1 to maximum variation of ± 0.2).The equipment is in detail presented into [9], using previous knowledge from [1-8], and real knowledge, but here inside of the same one given in Figs. 1 and 2 is presented. Additionally, the measurements (temperature and humidity) from the same one – measured in different time and data relative to [9] – are given in Table I.

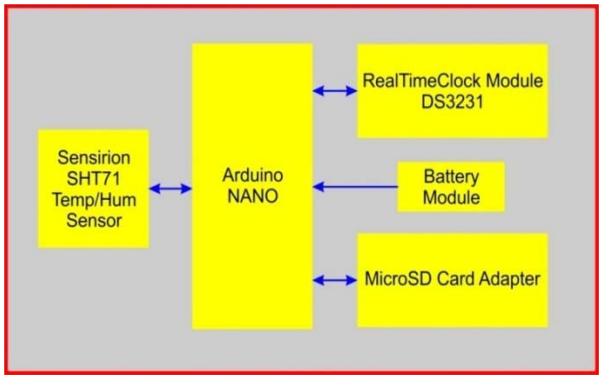

Fig.1.Sensor node structure – Arduino NANO

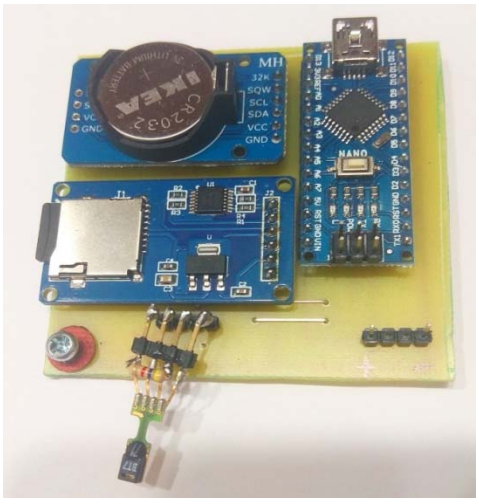

Fig. 2. Temperature and humiditysensor – inside the box

TABLE I
PRESENTING SMALL PART FROM A 60 MINUTE MEASUREMENT IN ONE DAY

	Temperature (°C)	Humidity (%RH)
1	17.2	47
2	16.3	51.2
3	16.7	51.3
4	23.1	56.3
5	25.7	57.8
6	10.0	61.1
7	6.9	70.1
8	3.2	67.8
9	1.8	48.5
10	-2.0	54.7
11	-2.1	57.7
12	-2.8	68.0
13	7.8	51.8
14	9.5	51.2
15	13.5	51.6
16	28.7	52.3
17	34.5	50.8
18	36.9	47.8
19	41.3	46.7
20	16.7	51.8

The data presented into Table I, are in one day in a time frame since 9.05 till 10.00 o'clock by local time. At this stage we only get a segment from the whole picture in what kind of conditions workers do their everyday routine activities. That day, the outside measurements (as key factor for comparison) during the processes of inside measurements were 10.1 till 15.3 Celsius degrees and humidity of 40.7% at the starting point at 9.00 o'clock. That was a starting point which brought us to another problem at that stage. The problem was that in Republic North Macedonia although there is a health and safety law and multiple regulations regarding the same one, there are only some recommendations considering the temperatures and humidity (not obligatory - only recommendations). And considering all of the recommendations, they brought us to data about the temperature in work conditions for winter from 18 to 21 Celsius degree and for summer from 22 till 25 Celsius degrees, once more as a recommendation.

At this stage, we have workers in hot and cold chambers with variations of temperatures. So considering the data and the regulations, we started a survey and considering the facts available on web, we found several information's regarding this thing from Balkan countries and some even from EU, but the most real ones were the Slovenian regulations and the Serbian ones [10-11].

According to the same ones, the Serbian regulations and the Slovenian ones, regarding preventive measures for health and safe work were quite good ones and quite similar. During the process of research we found tabulated results into the spot 6.4 from the Serbian regulations [11] that were one of our leads in which way should we go. That was a good lead because the given results show even the outside temperature and the defined way of working. Regarding the outside

conditions (about + 15 Celsius degrees) the humidity maximum value should be 75 (we were even better) and the temperature at maximum + 28 Celsius degrees.

Another thing which was interesting was the situation that we used quite a large period of time reconsidering and re-reading the Macedonian law and regulations and we found that the work conditions should not harm or in any case influence the workers (still not regulated the temperatures or humidity with numbers). During this process we had also some communication with health and safety inspectors as well.

Seeing the real situation and being on spot, as previously said that this is only a part of extensive research we found two other problems. The first one, were the documents about previous injuries (business entity secret – so this will not be a thing to mention into this or other papers) and illness (colds, frequent flues, sneezing as a frequent thing among workers on spot etc.). But the second one considering previous measurement and actions to deal with the problem (temperature shocks) was a real surprise. It was the noise in a room where most of the time spends several workers at any time of the day. It even seems weird because it was spotted after some inventory change and maintainer activities. This was unexpected because all of the activities were done to reduce even more the noise and to create a better production process. We got the same notice from the workers as well – the noise was larger since the new equipment was installed and since preventive maintain activities on the actual equipment were done.

Having in mind the previously mentioned things, a series of measurements of the noise were conducted using Testo equipment (quite professional one) in order to get a better overview of the main problem that occurred.

Table II presents only a small part of the measurements in a room of 200 meters with more than 15 machines inside. But, we focus on only 5 of them.

TABLE II
PRESENTING SMALL PART FROM NOISE MEASUREMENTS

	NOISE (dB)
1	80
2	79.9
3	86.8
4	87.1
5	89.0
6	88.7
7	78
8	78.1
9	76.7
10	76.5

Table II presents 10 measurements on 5 different spots, taking the principle 2 measurements on spot. Especially surprising where the data conducted regarding spot 2 (measurements 3 and 4) and 3 (measurements 5 and 6) which had some different measurement data after some changes to the equipment and after maintainer activities. That was maybe the bigger surprise, but that will be discussed in the future work (we had conducted a whole monitoring what happened using FMEA). And FMEA is abbreviation for Failure Mode Effects Analysis.

It's quite important to notice that the Macedonian regulations [12] regarding noise – defined in special regulation, defines the low and upper limits of noise which are from 80 – 87 dB. Considering this fact we had a situation with the spots really on upper limit or even more, and a different problem to solve. Finally, we are still solving problems in the process that occurs. Also, the handy transportation of weight is a problem which has to be solved.

III. THE SOLUTIONS AND FUTURE STEPS

Seeing the previous presented, some steps were made and some still are in a move so we could get a better environment for the workers. Several conducted activities made it possible to create better conditions for workers. First regarding the situation with the HTZ equipment – although there was quite a good one when we came the same one was not appropriate for the situation. So dealing whit the fact that there were some comes and goes from workers to hot or cold chambers, first of all we solve the thing by using a line in which most of the products are transported not by human hand. But for the processes where we have to have a human hand we created a cycle activity in which each worker is on spot only using the cold chamber but no more than 15 minutes a day with a special HTZ equipment for cold conditions on it. Hot chambers are not used by humans at this stage – the transport is on track. This is specially solved also by the real focus from the management. So, as previously said the HTZ equipment (updated version of the same one with some significant efficiency to health and safety but also with some financial savings for the company) now is only appropriate for the room where the noise was in some parts. The situation with the noise is also a thing that is solved with some changes but it will be presented in the future work. Now, we are only dealing with a new thing in two spots where a hand weight is transported, but on small distances. We would like to solve it as well.

Further, Table III presents the momentarily measured values of the noise, from which one could get a real picture what happened. The problem solution will be presented in some other publication.

TABLE III
PRESENTING SMALL PART FROM NOISE MEASUREMENTS AT THE MOMENT ON THE SAME SPOTS AS PREVIOUS

	NOISE (dB)
1	73.2
2	73.1
3	78.8
4	78.7
5	83.8
6	83.8
7	77.9
8	78.0
9	76.4
10	76.5

IV. CONCLUSION

Finally, we could conclude that this paper presents not only previously created measurement unit, shown in detail in [9] and based on Arduino NANO MCU, but also whole problem on spot in a real business entity. The same one presents the starting point – daily routine in humidity and hot and cold chambers, but also the process of monitoring in which several new problems occurred. Occurred problems as new ones were the noise after the maintainer activity and the new equipment installed which brought us to additional measurements and additional activities, and also the illnesses and injuries which were a part of that process as well. So from one problem we got several different ones. Some of the activities and measurements done are presented into the paper. The important thing to mention is that the created unit is used in more than 8 different spots at this stage, even in different business entity at the moment so we could get a real data, but we are also considering to improve the same one with adding a noise sensor to the same one (small one – we are in a search for appropriate and good one at the moment).

Finally seeing the data aimed and the amount of the same ones at this stage we could say that some future publications will be made as well.

At the end we are also considering to create a sensor node with web based application for online collection of data in real time as soon as we solve the ad – in to the measurement units with a noise sensor, but with some financial support from sponsors.

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