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ISSN 0543-5846
METABK 51(4) 494-496 (2012)
UDC – UDK 621.73.042:669.1=111

RISK ESTIMATION OF AIR POLLUTION PRODUCED BY A WELDED CONSTRUCTIONS COMPANY

Received – Prispjelo: 2012-02-08
Accepted – Prihvaćeno: 2012-04-25
Preliminary Note – Prethodno priopćenje

The study refers to the air pollution produced by a welded constructions company that achieves a production of 1 000 t of products/month. Air quality monitoring was conducted in the area of influence of the welded construction company that is 200 m radius around the company and the monitoring period was May to September, 2008-2011. Air quality monitoring was performed in seven different monitoring stations denoted by A, B, C, D, E, F, G. For air quality monitoring we have measured the concentrations of various pollutants (NH_3, NO_2, SO_2, CO, H_2CO, HCl, phenols), and for each hazard the hazard ratio was calculated.

Key words: welded construction company; air pollution; risk estimation; hazard coefficient

INTRODUCTION

Air pollution is one of the most important global issues which involves conducting research to improve air quality. Thus, in 2009 in the EU were vented large amounts of pollutants, and Romania produced air pollution by fumes specific to the welding processes, namely: 187 741 tons NH_3, 432 178 tons MMVOC, 247 262 tons NO_x, 459 168 tons SO_x [1-2]. Also, if an analysis is performed of the amount of emissions per capita, Romania exceeds the EU average for the three pollutants, namely: NH_3, MMVOC, SO_x.

Under these conditions appropriate measures must be taken to reduce air pollution through continuous improvement of manufacturing technologies, and in this category fall the welded construction companies [3-4]. The main issues concerning the hazardous welding fumes resulted from the process are related to the melting of materials subjected to welded joints, because the melting of any material generates pollutants [5].

MATERIALS

Since the main objective of the work is the determination of the environmental impact, particularly on air quality, of a industrial organization for welded construction manufacturing and how to turn it into an eco technological organization, investigations were made in an industrial organization, whose object of activity is the development of welded steel constructions in a production of 1 000 t/month. Production takes place in two enclosed spaces of 60 x 40 ml, each divided in two tracks 20 m wide, with one 5-ft crane and appropriate deployment of technology flow that includes activities needed to produce 1 000 t/month of welded steel constructions.

Also, the measurements were made using the same measuring equipment in the same situations, but in different areas, thus seven different points were considered, located within a radius of 200 m of the welded construction industrial organization the area in which we assume that all pollutants end, substances extracted from the working environment through the exhaust process.

In terms of CO_2 emissions in several welding procedures, they are presented in Table 1.

Table 1 **CO_2 emissions, in several welding procedures /tCO_2/t seam**

Welding process	CO_2 emissions/ t CO_2/t seam	
	min.	max.
Manual arc welding	0,280	0,50
Submerged automatic arc welding	0,175	0,21
Welding in protective gas environment	0,205	0,24
Oxyfuel torch welding	0,312	0,55

The values of NO_x and SO_2 emission for each tonne of welded seam are shown in Table 2.

Table 2 **Values of SO_2 and NO_x emissions, / Kg/t seam**

Department	SO_2 emission /kg SO_2/t seam	NO_x emission /kg NO_x/t seam
Welding	0,64	0,154

The equipment used to detect gas resulting from the operations of welding is a differential analysis equipment. This equipment is a multifunctional gas analyzer that is based on a series of electrochemical sensors and

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allows the determination and measurement of gas concentration.

Thus it has 3 sensors that can determine the following gases: O_2, CO, NO, CO_2, NO_x, H_2S, except that the first three are determined directly and the other three are directly calculated by the analyzer. At the same time the device is controlled by a microprocessor, has an LCD display and a keyboard that facilitates its use as a memory storage that allows large volumes of information to be stored, and all this also allows real-time retrieval of information.

Depending on the type of welding process and welded structures welding equipment is necessary, sometimes totally different. The welded construction enterprise subject to our study is a company that does a wide range of sizes made of welded structures using mainly the following welding processes: manual metal arc welding (MMA), automatic submerged arc welding (SAW), metal inert gas welding (MIG), plasma arc welding.

To assess the impact on air pollution there are several evaluation methods such as Leopold's matrix, the Large Dams matrix or the Columbus Batel method by which you can make an inventory or even a systemic analysis, based on detailed studies [6].

For the research contained this paper we have used the Leopold matrix, which is presented as an array of double entry, on the vertical axis appearing the environmental factors and/or their functions and environmental processes, and on the horizontal axis, the actions that might possibly generate impact.

RESULTS AND DISCUSSION

Knowing the general characteristics of the influence of air pollution on plants we have monitored air quality during the warm season in the area of influence of the industrial activity of welded constructions.

For this, air samples were collected during May - September, 2008 - 2011, from 7 points- namely stations: A, B, C, D, F, E, G.

From the multitude of possible air pollutants, with major negative effects on plant development, only those with synergy action were selected, present simultaneously in the air and which could have as emissary the industrial processing activity of welded constructions of the company, namely carbon monoxide, sulfur dioxides and nitrogen, hydrochloric acid, phenols and aldehydes, and their determinations were made according to current standards. The spread of gaseous and solid pollutants in the atmosphere is done through the wind vector, the expression of the movement of air masses on a specific area egret. Chemical-analytical data obtained and summarized in Table 3 for May, June, July, August and September highlight the following aspects:

- changes in concentrations are presented as the range for: hydrochloric acid, ammonia, nitrogen oxides, sulfur dioxide, aldehydes, phenols, carbon monoxide;
- dispersion of the reviewed pollutants in the air follows, at different levels, that of the wind vector;
- concentrations of pollutants take different values, but the highest value a carbon monoxide present in August 2008 was in Station A;
- sulfur dioxide closely egret wind vector. The highest concentration of this Hazard was recorded in May 2008 at station B;
- the ranges of ammonia and hydrochloric acid, indicating the existence and activity of other generators of pollution than the activity of industrial processing of welded constructions, the highest concentration is not correlated with wind direction;
- relatively high content of nitrogen oxides in 2008, with highest values at station B and a sharp decline in 2011;
- although not a hazard specific to the activity of welded industrial processing, ammonia in the atmosphere can react with specific compounds which are among the constituents of smog. There was a sharp downward trend in 2011 compared to 2008 due to measures to reduce the quantity of exhaust gases;
- hydrochloric acid content present in the atmosphere, fairly uniform in the tested area throughout the monitoring period, but at large enough values;
- aldehydes tended to increase in Station A in the summer, indicating, apparently, an influence of air temperature. Concentrations recorded in time and space ranges from rather large values;
- the quantities of phenols present in the atmosphere were at very low levels, well below the maximum allowed by standards. The highest concentration was determined in July 2008 in Station A.

In this context, we have detailed in Table 4 some particular aspects related to air quality of the points-stations.

From the data presented, it is clear that the industrial activity to achieve welded constructions can be considered an environmental pollutant, especially of the atmosphere, and this is shown by air quality monitoring during this time (Table 5).

CONCLUSION

- the presence of various pollutants in the atmosphere directly influences plant development mainly as follows: $SO_2 > HCl > NO_2 > CO_2 > NO_x > CO$;
- air quality at each point - station has a certain well-defined feature, which provides a ranking of the effect of each welded manufacturing activity on the natural environment;
- the results of the measurement have showed that the industrial activity of manufacturing welded constructions can be considered as a major environmental pollutant, especially of the atmosphere;
- the main objectives of an industrial organization which manufactures welded constructions must

Table 3 **Values measured at the A, B, C, D, E, F, G stations (excerpt)/ mg/dm³**

Pollutant	Average concentration / mg/dm³	Maximum concentration/ mg/dm³	Hazard coefficient
1	2	3	4
A STATION			
HCl	0,004 - 0,0097	0,002 - 0,02	0,04 - 0,0971
H_2CO	0,0012 - 0,0036	0,0020 - 0,0060	0,1008 - 0,2975
NH_3	0,0122 - 0,0186	0,0100 - 0,0200	0,1200 - 0,1857
NO_2	0,0040 - 0,0297	0,0100 - 0,0500	0,040 - 0,2973
SO_2	0,0314 - 0,0611	0,0400 - 0,1300	0,1257 - 0,2444
CO	1,3048 - 1,5861	1,8000 - 2,0500	0,6524 - 0,7931
Phenol	0,0008	0,0010	0,0260
B STATION			
HCl	0,0113 - 0,0140	0,0200 - 0,0300	0,1125 - 0,1400
H_2CO	0,0010 - 0,0044	0,0020 - 0,0070	0,080 - 0,3650
NH_3	0,0300 - 0,0400	0,0300 - 0,0600	0,2002 - 0,4000
NO_2	0,0100 - 0,0106	0,0100 - 0,0200	0,1000 - 0,1063
SO_2	0,0300 - 0,0506	0,0700 - 0,1000	0,1200 - 0,2025
Phenol	0,0011	0,0030	0,0353
C STATION			
HCl	0,0053 - 0,0139	0,0100 - 0,0300	0,0529 - 0,1388
H_2CO	0,0012 - 0,0049	0,0180 - 0,0300	0,1033 - 0,4067
NH_3	0,0277 - 0,0461	0,0500 - 0,0900	0,2765 - 0,4611
NO_2	0,0355 - 0,0389	0,0800 - 0,0900	0,3353 - 0,3888
SO_2	0,0347 - 0,0972	0,0800 - 0,2200	0,1388 - 0,3889
Phenol	0,0010	0,0010	0,0333
D STATION			
HCl	0,0090 - 0,0123	0,0200 - 0,0300	0,0900 - 0,1235
H_2CO	0,0012 - 0,0016	0,0040 - 0,0300	0,1000 - 0,1325
NH_3	0,0040 - 0,0320	0,0700 - 0,1000	0,0400 - 0,3200
NO_2	0,0100 - 0,0135	0,0200 - 0,0300	0,1000 - 0,1353
SO_2	0,0653 - 0,0670	0,1000 - 0,1200	0,2612 - 0,0653
Phenol	0,0010	0,0011	0,047
E STATION			
HCl	0,0080 - 0,0177	0,0100 - 0,0800	0,0800 - 0,1765
H_2CO	0,0007 - 0,0008	0,0020	0,0600 - 0,0683
NH_3	0,0147 - 0,0240	0,0300 - 0,0400	0,1471 - 0,2400
NO_2	0,0090 - 0,0112	0,0200 - 0,0300	0,0900 - 0,1118
SO_2	0,0440 - 0,0541	0,0900 - 0,1100	0,1800 - 0,2165
Phenol	0,0010	0,0020	0,0333
F STATION			
HCl	0,0133	0,0200 - 0,0300	0,1300
H_2CO	0,0009 - 0,0017	0,0010 - 0,0030	0,0775 - 0,1400
NH_3	0,0160 - 0,0213	0,0300 - 0,0500	0,1600 - 0,2133
NO_2	0,0127 - 0,0170	0,0400 - 0,0500	0,1267 - 0,1700
SO_2	0,0360 - 0,0500	0,1000	0,1440 - 0,2002
Phenol	0,0013	0,0030	0,0443
G STATION			
HCl	0,0090 - 0,0120	0,0200	0,0900 - 0,1200
H_2CO	0,0005 - 0,0017	0,0010 - 0,0060	0,040 - 0,1442
NH_3	0,0300 - 0,0313	0,0500 - 0,0700	0,3000 - 0,3133
NO_2	0,0100 - 0,0140	0,0100 - 0,0200	0,1000 - 0,1400
SO_2	0,0367 - 0,0500	0,0900 - 0,1500	0,1467 - 0,2002
Phenol	0,0013	0,0020	0,0443

Table 4 **Some particular aspects related to air quality measuring stations**

Point - Station	Particular aspects
1	2
A	- maximum permissible concentration was not exceeded, except CO, content in May 2008; - SO_2 content shows a downward trend.
B	- high content of NO_2 and NH_3; - phenols present in very small quantities.
C	- the highest concentrations of pollutants recorded during the warm season.
D	- the largest amount of SO_2 and aldehydes; - the majority of chemical compounds are greatly diminished in the last year of analysis; - the ranges are quite large.
E	- in May 2008, the sum of concentrations (NH_3 + NO_2 + SO_2 was very high above the standard; - the highest concentrations of SO_2; - air quality has improved at the end of the normalization period.
F	- phenols at very low values.
G	- SO_2 concentration is quite high, but generally below the limit.

Table 5 **Areas of possible change in the concentrations of pollutants in the period 2008-2011**

No.	Quality indicators	Range of variation
1	Hydrochloric acid (Pollutants)	0,0040 - 0,0220
2	Ammonia	0,0120 - 0,0481
3	Nitrogen oxides	0,0040 - 0,0468
4	Sulfur dioxide	0,0045 - 0,0972
5	Phenol	0,0008 - 0,0030
6	Carbon oxide	1,2167 - 2,1877
7	Sediment particles	0,041 - 13,40

be: reduction of environmental pollution, a considerable reduction of waste, transforming the organization into an eco-technological organization.

REFERENCES

[1] EEA, also available at Eurostat, (env_air_emis), 2011.

[2] Data on air polluants from EEA, also available at Eurostat (env_air_emis); polution Eurostat (tps00001), 2011.

[3] ANSI Z49.1, Section E5.4 pp. 12. American Welding Society, 550 NW LeJeune Road, Miami, FL. 2005.

[4] Y. Wang et al., , Materials Environ. Sci. Technol. 45 (2011) 15, 6539-6544.

[5] T. Karkoszka et al., Metalurgija, 51 (2012) 2, 145 – 288.

[6] Gh. Amza et al., Theoretical and Experimental Research on the Environmental Impact of Certain Welding Process, of the 4th, IASME/WSEAS, Cambridge, 24-26 February, 2009, 60-66.

Note: The responsible translator for English language is S.C. PURTRAD S.R.L., Targu Jiu, Romania