Monitoring of air Pollution on the Premises of the Factory Sharrcem – L.L.C

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Summary
In these proceedings, we will address the problem of air pollution on the premises of the Cement factory SHARRCEM L.L.C. in Hani Elezit in the Republic of Kosovo respectively around the clinker cooler, rotary kiln, and raw material mill. By air pollution, we mean the introduction of chemicals, particles, or other harmful materials into the atmosphere which in one way or another causing damage to the development of plants and organisms. Air pollution occurs when certain substances are released into the air, which depending on the quantitative level, can be harmful to human health, animals, and the environment in general. The analysis of air shows the influence of the extractive and processing industry on the chemical composition of air. Parameters analyzed though under control such as the case of carbon dioxide, due to the increasing production capacity of cement, the production of hundreds of thousands of cubic meters of CO_2 gas made CO_2 production a concern. With the purchase of the latest technology by the SHARCEM Factory in Hani Elezit, the amount of air pollution has been reduced and the allowed parameters of environmental pollution have been kept under control. Air pollutants are introduced into the atmosphere from various sources which change the composition of the atmosphere and affect the biotic environment.The concentration of air pollutants depends not only on the quantities that are emitted from the sources of air pollution but also on the ability of the atmosphere to absorb or disperse these emissions. Sources of air pollutants include vehicles, industry, indoor sources, and natural resources. There are some natural pollutants, such as natural fog, particles from volcanic eruptions, pollen grains, bacteria, and so on.
Keywords: *Air pollution, Clinker, Furnace, Mill, Dust, Sulfur dioxide, Nitrogen Oxides*

1. Introduction

In the ecosystem where we live, the air is one of the most important elements for human health and in general for the environment that surrounds us and which is constantly under the influence of pollution. Although air pollution comes from human activities, it can also be affected by natural phenomena. By air pollution, we mean when substances are released into the air in quantities that can harm the health of humans, animals, and plants or can cause material damage. Some air pollutants may also have global impacts such as increasing the effect of greenhouse gases or damaging the ozone layer. Air pollutants can be classified as follows.

1.1 Aerosol

Aerosols can be defined as solid particles or liquid droplets in the composition of air in microscopic size derived from smoke, dust, ash, and gaseous condensed substances that can be found in atmospheric air. Some of these particles are so large that if they are bright, they can be seen as a mist or cloud, or if they are dark, they can be seen as soot or smoke. Aerosols are most often created in nature by industrial processes, landfills, combustion of fossil fuels (coal, oil), dust, internal combustion engine gases (cars, trucks, industrial machinery), at work construction, volcanic eruptions, forest fires, etc. [3]

1.2 Dust

The powder is composed of solid particles created by the crushing and grinding processes. Their size can be from 0.01 μ to 100 μ. Mostly dust particles 5 μ or smaller in size tend to form air-stable suspensions. [4]

1.3 Fumes

Smoke is composed of a small number of particles of solid or liquid substances dispersed in the air, which are created by the incomplete combustion of fuels. Inhalation of smoke is the leading cause of death for indoor fire victims. Generally, the particle size is less than 1 μ. [5]

Manuscript received October 5, 2022
Manuscript revised October 20, 2022
https://doi.org/10.22937/IJCSNS.2022.22.10.28

Photo 1. View of the Cement factory chimney

1.4 Chlorine and hydrogen chlorides

Chlorine is found in polluted air like chlorine and hydrogen chloride, chlorine is made up of organic compounds and is very toxic. The main sources of air pollutants such as chlorine and its components are the chemical industry, water purification process, sewage plants, swimming pools, etc. These pollutants irritate the human respiratory tract. [9]

1.5 Nitrogen oxides

Viewed from a pollution perspective, the most important nitrogen gases are ammonia (NH_3), nitric oxide (NO), nitrogen dioxide (NO_2), and nitrogen suboxide (N_2O). Together NO and NO_2 often appear as NOx. Nitrogen oxides are mainly present due to emissions from the chemical industry where nitric acid is produced and their products. Other sources of air pollution with nitrogen oxides are automobile combustion gases, power plants, furnaces, heating boilers, etc. in addition to nitrogen dioxide obtained from human activities. [10]

1.6 Carbon monoxide (CO)

It is an odorless and colorless gas and benefits from the incomplete combustion of carbonaceous matter. It is a very poisonous gas. A major source of carbon monoxide is the incomplete combustion of fuels by car engines. Also, furnaces, oil refining operations, gas production plants, etc. release large amounts of carbon monoxide. [11]

1.7 Carbon dioxide (CO_2)

Carbon dioxide is a chemical compound composed of two oxygen atoms and one carbon atom which under normal conditions is in the gaseous state. Carbon dioxide in the atmosphere is in the amount of 0.039% (400 ppm). It is obtained by burning carbon-containing fuels. It is also emitted from volcanoes, geysers, and water sources where the earth's crust is thin. CO_2 can be found in the depths of lakes and the depths below sea level mixed with oil and natural gas. Carbon dioxide is one of the most important greenhouse gases which keeps the earth's temperature constant and prevents heat from escaping into space. Atmospheric carbon dioxide is the main source of carbon for life on Earth. Its concentration in the earth's atmosphere since before the industrial revolution was regulated through the process of photosynthesis in organisms. [12]

However, from the Industrial, Revolution until today, the concentration of CO_2 has increased rapidly from the burning of fuels of fossil origin (coal, oil, and natural gas), etc. The consequence of the increasing concentration of CO_2 in the atmosphere is global warming and climate change.

1.8 Ozone (O_3)

Ozone is an inorganic molecule with the chemical formula O_3, it is a pale blue gas with a strong distinctive odor. Ozone is an allotropic modification of oxygen much less stable than the modification of oxygen O_2. Ozone is obtained from O_2 by the action of ultraviolet light or even by electrical discharges into the atmosphere, and is present in low concentrations throughout the Earth's atmosphere. In total ozone makes up only 0.6 ppm of the atmosphere. Ozone smells bad and is very poisonous.

1.9 Organic vapors

Sources of air pollutants such as organic vapors include a large number of chemical compounds, such as aromatic hydrocarbons, acetylene, olefins and chlorine hydrocarbons, etc. Produced during the combustion process of the aforementioned compounds. They are the basic ingredients of smog.

2. Location of sample collection

The part that we will deal with in this proceeding is the part of the premises of the Cement factory in Hani Elezit, respectively the spaces around the clinker cooler, the rotary kiln, and the raw material mill.

Photo 2. SHARRCEM, Hani Elezit

Photo 3. Rotary furnace

2.1 Sampling

Sampling was performed based on ISO standards and sampling was performed during 2018: March, April, May and Jun.

3.0 Results and discussion

Air quality monitoring in the Republic of Kosovo is done remotely by the Institute of Hydrometeorology with a state-of-the-art gas analyzer with an accuracy of 0-50 ppb to 0-20 ppm. Measurements of gas concentration and environmental parameters are done every minute.

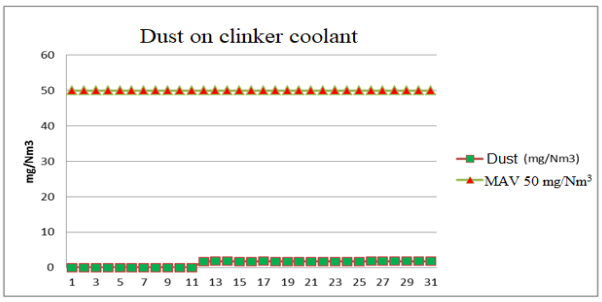
Photo 4. Gas analyzer

In our case we dealt with the sampling of gases in the premises of the Cement factory in Hani i Elezit, respectively the areas around the clinker cooler, rotary kiln, and raw material mill and that:

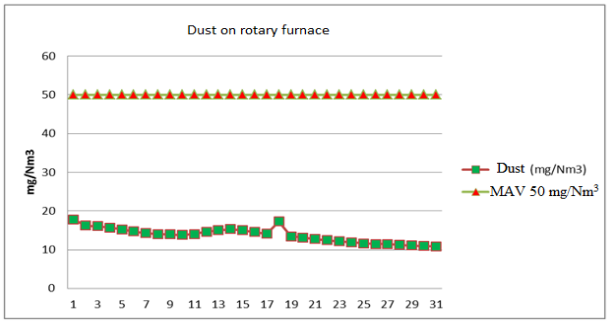
1. Dust in clinker coolant spaces
2. Dust in the rotary kiln spaces
3. Dust on the premises of the raw material mill
4. Sulfur dioxide (SO_2) in the factory chimney
5. Nitrogen Oxides (NO_x) in the factory chimney

	Clinker coolant	Furnace		Chimney		Chimney	
March 2022	Dust (mg/Nm^3)	Dust (mg/Nm^3)	MAV 50 (mg/Nm^3)	SO_2 (mg/Nm^3)	MAV 400 (mg/Nm^3)	NOx (mg/Nm^3)	MAV 800 (mg/Nm^3)
1	0	17.85	50	4.12	400	574.00	800
2	0	16.23	50	3.14	400	554.15	800
3	0	16.05	50	3.06	400	584.73	800
4	0	15.68	50	3.48	400	588.88	800
5	0	15.26	50	3.24	400	586.12	800
6	0	14.71	50	3.12	400	582.84	800
7	0	14.30	50	3.22	400	577.73	800
8	0	14.02	50	3.16	400	563.47	800
9	0	13.94	50	3.19	400	570.56	800
10	0	13.84	50	3.32	400	565.02	800
11	0	14.07	50	3.65	400	553.64	800
12	1.73	14.61	50	3.82	400	553.87	800
13	1.83	15.03	50	3.83	400	519.01	800
14	1.77	15.34	50	3.88	400	522.76	800
15	1.74	15.00	50	3.64	400	521.31	800
16	1.73	14.60	50	3.52	400	518.84	800
17	1.77	14.15	50	3.61	400	516.73	800
18	1.75	17.30	50	3.66	400	513.34	800
19	1.72	13.42	50	5.27	400	496.18	800
20	1.71	13.10	50	5.31	400	498.01	800
21	1.69	12.77	50	6.23	400	487.71	800
22	1.70	12.44	50	6.62	400	484.91	800
23	1.72	12.16	50	6.90	400	490.97	800
24	1.73	11.91	50	6.98	400	495.61	800
25	1.73	11.66	50	7.62	400	499.79	800
26	1.76	11.44	50	8.22	400	498.23	800
27	1.76	11.44	50	8.22	400	498.23	800
28	1.77	11.25	50	8.21	400	500.11	800
29	1.77	11.10	50	8.18	400	502.38	800
30	1.78	10.95	50	8.20	400	503.06	800
31	1.79	10.87	50	8.15	400	501.81	800

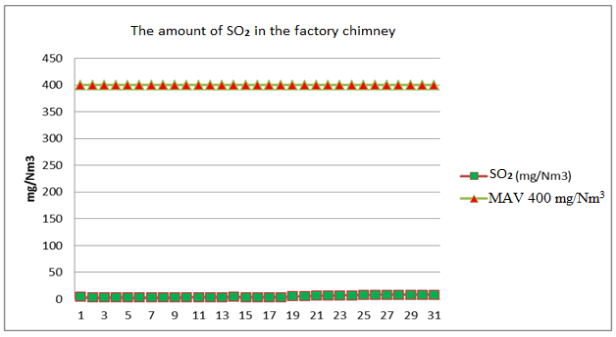
3.1 Graphic presentation of the obtained results



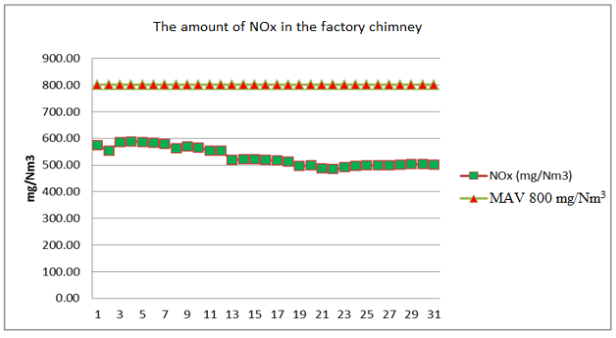
Graph 1. Dust on clinker coolant



Graph 2. Dust on rotary furnace



Graph 3. The amount of SO_2 in the factory chimney



Graph 4. The amount of NOx in the factory chimney

Table No. = 2. Monitoring of dust in clinker coolant, rotary kilns as well as sulfur dioxide (SO_2) and nitrogen oxides (NOx) in the chimney of the Cement Plant during April 2022.

	Clinker coolant	Furnace		Chimney		Chimney	
April 2022	Dust (mg/ Nm^3)	Dust (mg/ Nm^3)	MAV 50 (mg/ Nm^3)	SO_2 (mg/ Nm^3)	MAV 400 (mg/ Nm^3)	NOx (mg /Nm^3)	MAV 800 (mg/ Nm^3)
1	2.13	6.95	50	6.16	400	513.77	800
2	2.20	6.62	50	6.88	400	529.92	800
3	2.11	6.33	50	5.64	400	461.96	800
4	2.07	6.29	50	5.75	400	440.51	800
5	2.09	6.32	50	6.06	400	450.75	800
6	2.18	6.19	50	7.91	400	444.23	800
7	2.09	6.19	50	7.58	400	466.70	800
8	2.19	6.14	50	9.90	400	475.72	800
9	2.20	6.16	50	11.36	400	485.47	800
10	2.18	6.15	50	11.71	400	493.59	800
11	2.19	6.12	50	12.14	400	493.94	800
12	2.17	6.07	50	11.87	400	500.39	800
13	2.22	5.98	50	11.95	400	500.06	800
14	2.19	5.92	50	11.99	400	499.12	800
15	2.16	5.87	50	11.39	400	502.00	800
16	2.15	5.82	50	11.09	400	50.13	800
17	2.13	5.77	50	11.14	400	508.64	800
18	2.13	5.76	50	11.79	400	506.22	800
19	2.13	5.71	50	12.73	400	499.21	800
20	2.14	5.66	50	12.37	400	496.83	800
21	2.16	5.62	50	12.97	400	490.47	800
22	2.15	5.59	50	13.41	400	489.95	800
23	2.08	5.4	50	13.3	400	490.1	800
24	2.11	5.56	50	13.07	400	491.63	800
25	2.09	5.49	50	13.33	400	495.69	800
26	2.10	5.41	50	12.99	400	495.41	800
27	2.13	5.33	50	12.66	400	493.89	800
28	2.18	5.26	50	12.49	400	492.66	800
29	2.23	5.21	50	12.28	400	492.63	800
30	2.27	5.15	50	12.17	400	491.81	800

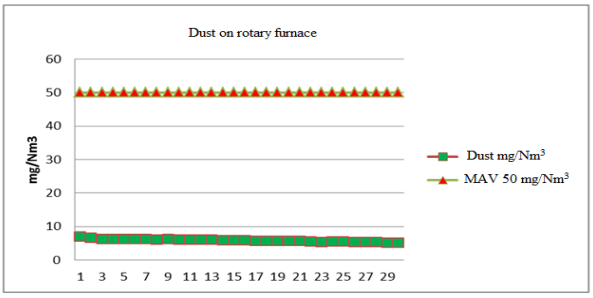


Figure 8. Dust on rotary furnace

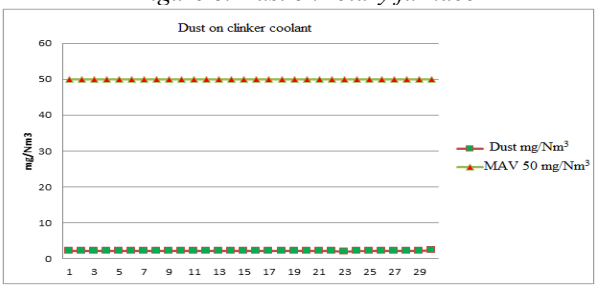


Figure 9. Dust on clinker coolant

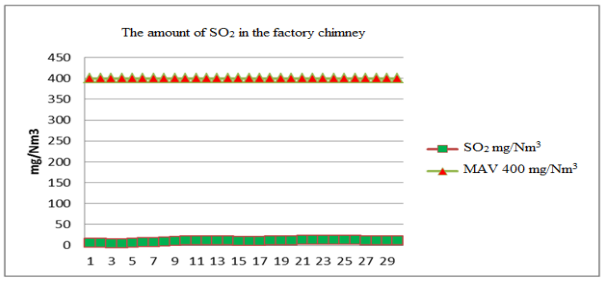


Figure 10. The amount of SO_2 in the factory chimney

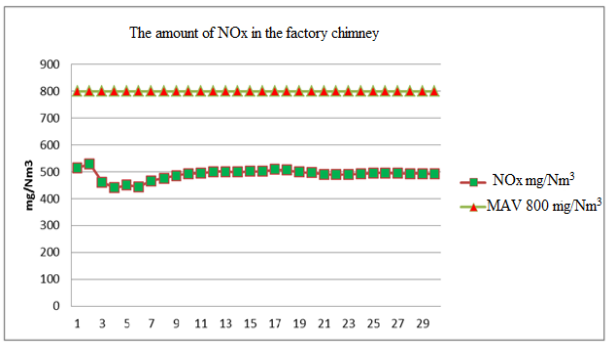


Figure 11. The amount of NOx in the factory chimney

	Clinker coolant	Furnace		Chimney		Chimney	
May 2022	Dust (mg/ Nm^3)	Dust (mg/ Nm^3)	MAV 50(mg / Nm^3)	SO_2 (mg/ Nm^3)	MAV 400(mg/ Nm^3)	NOx (mg/ Nm^3)	MAV 800(mg/ Nm^3)
1	3.57	3.45	50	4.44	400	572.67	800
2	3.66	3.40	50	4.48	400	563.40	800
3	3.69	3.45	50	4.41	400	562.37	800
4	3.72	3.40	50	4.51	400	527.25	800
5	3.79	3.37	50	7.53	400	502.93	800
6	3.85	3.35	50	6.92	400	475.79	800
7	3.88	3.35	50	6.47	400	461.35	800
8	4.01	3.41	50	6.31	400	464.45	800
9	4.30	3.43	50	6.01	400	470.02	800
10	4.59	3.44	50	5.84	400	478.47	800
11	4.96	3.44	50	5.76	400	478.99	800
12	5.30	3.44	50	5.62	400	478.79	800
13	6.02	3.43	50	5.47	400	486.25	800
14	6.81	3.45	50	5.37	400	494.64	800
15	7.59	3.45	50	5.36	400	497.14	800
16	8.18	3.44	50	5.15	400	494.14	800
17	8.75	3.42	50	5.05	400	490.06	800
18	9.44	3.40	50	4.98	400	484.64	800
19	10.55	3.38	50	5.05	400	480.65	800
20	11.32	3.37	50	5.17	400	476.10	800
21	11.75	3.37	50	5.11	400	474.58	800
22	11.47	3.37	50	5.08	400	472.93	800
23	11.49	3.36	50	5.06	400	473.45	800
24	10.85	3.33	50	4.91	400	472.73	800
25	10.68	3.32	50	4.86	400	472.21	800
26	10.57	3.31	50	4.80	400	473.58	800
27	10.62	3.30	50	4.76	400	474.64	800
28	10.58	3.30	50	4.72	400	478.25	800
29	10.51	3.29	50	4.69	400	480.59	800
30	10.59	3.29	50	4.59	400	485.26	800
31	10.57	3.28	50	4.55	400	486.74	800

Table No. 3. Monitoring of dust in clinker coolant, rotary kilns as well as sulfur dioxide (SO_2) and nitrogen oxides (NOx) in the chimney of the Cement Plant during May 2022.

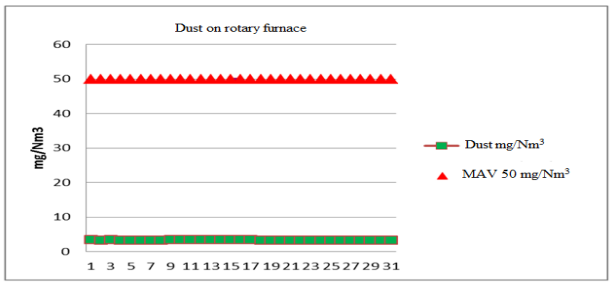


Figure 12. Dust on rotary furnace

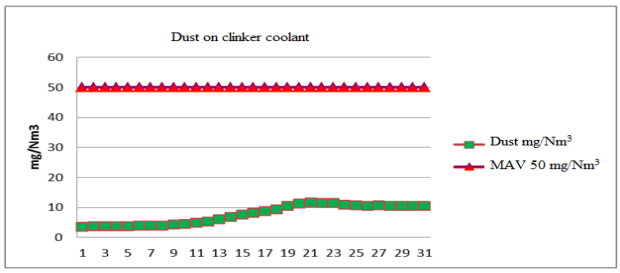


Figure 13. Dust on clinker coolant

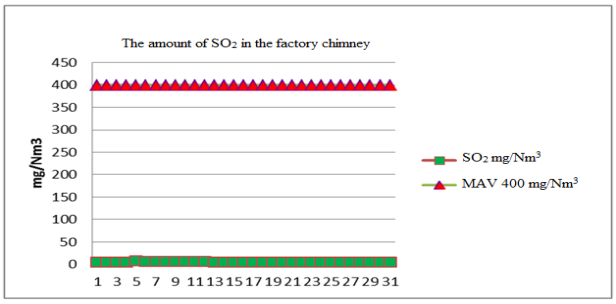


Figure 14. The amount of SO_2 in the factory chimney

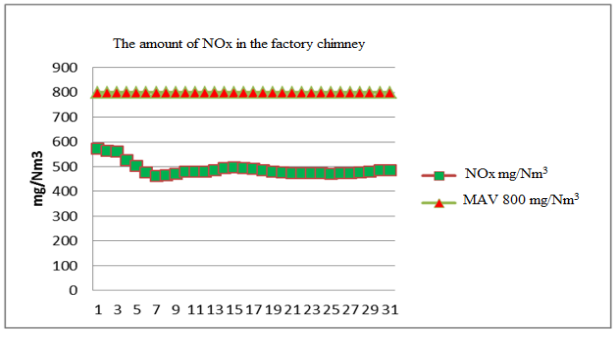


Figure 15. The amount of NOx in the factory chimney

Table No. = 4. Monitoring of dust in clinker coolant, rotary kilns as well as sulfur dioxide (SO_2) and nitrogen oxides (NOx) in the chimney of the Cement Plant during Jun 2022.

	Clinker coolant	Furnace		Chimney		Chimney	
Jun 2022	Dust (mg/ Nm^3)	Dust (mg/ Nm^3)	MAV 50(mg/ Nm^3)	SO_2 (mg/ Nm^3)	MAV 400(mg/ Nm^3)	NOx (mg/ Nm^3)	MAV 800(mg/ Nm^3)
1	11.36	2.97	50	3.69	400	494.20	800
2	11.65	2.93	50	3.92	400	455.13	800
3	12.40	2.91	50	5.02	400	415.30	800
4	12.63	2.98	50	5.56	400	413.78	800
5	13.11	2.99	50	6.91	400	402.61	800
6	13.53	3.00	50	6.62	400	392.50	800
7	13.62	2.99	50	6.97	400	378.56	800
8	14.58	2.98	50	8.19	400	362.93	800
9	15.04	2.97	50	8.37	400	352.47	800
10	15.97	2.96	50	8.76	400	343.69	800
11	17.09	2.93	50	9.54	400	346.06	800
12	19.60	2.89	50	9.91	400	348.84	800
13	20.07	2.87	50	9.68	400	356.82	800
14	18.74	2.83	50	9.14	400	365.27	800
15	17.60	2.79	50	8.76	400	368.47	800
16	16.60	2.77	50	8.44	400	371.27	800
17	15.72	2.74	50	8.21	400	375.36	800
18	14.95	2.71	50	7.91	400	380.92	800
19	14.28	2.69	50	7.67	400	379.25	800
20	13.67	2.67	50	7.44	400	377.50	800
21	13.12	2.65	50	7.25	400	375.72	800
22	12.61	2.64	50	7.09	400	380.91	800
23	12.14	2.64	50	6.93	400	387.05	800
24	11.72	2.63	50	6.80	400	391.06	800
25	11.31	2.63	50	6.61	400	395.59	800
26	10.93	2.61	50	6.47	400	405.08	800
27	10.59	2.59	50	6.31	400	417.18	800
28	10.27	2.58	50	6.22	400	423.97	800
29	9.97	2.58	50	6.13	400	430.20	800
30	9.69	2.58	50	6.05	400	432.66	800

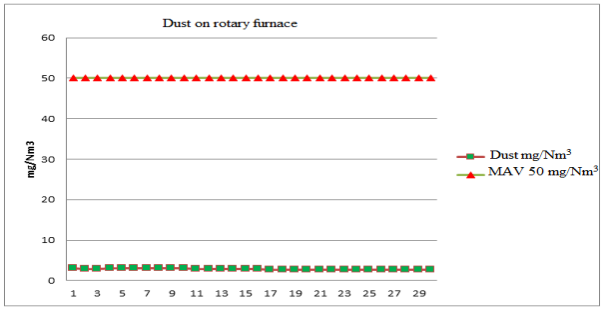


Figure 16. Dust on rotary furnace

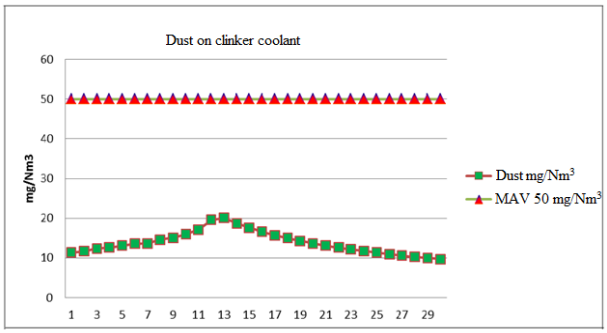


Figure 17. Dust on clinker coolant

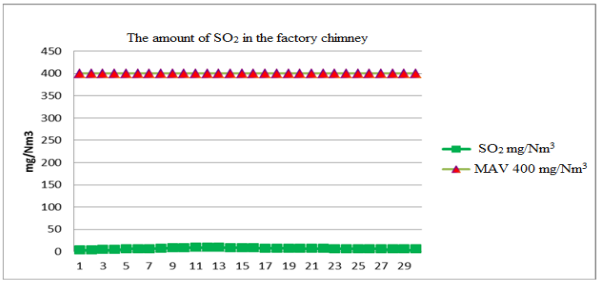


Figure 18. The amount of SO_2 in the factory chimney

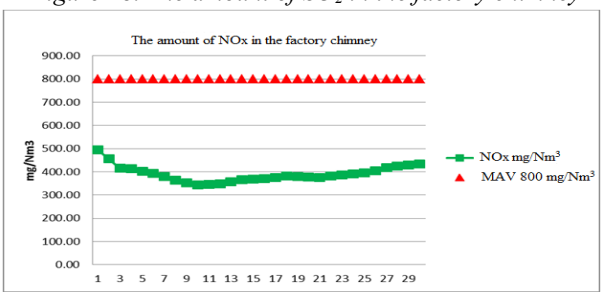


Figure 19. The amount of NOx in the factory chimney

From the monthly reports that are given for the pollution inside the premises of the cement factory from March 2022 to June 2022 and from the graphic presentation above it is seen that in general the amount of dust in the clinker cooler and the milling of raw material and gases SO_2 and NO_x do not exceed the maximum allowable value (MAV).

From the monthly reports that are given for the pollution inside the space of the cement factory from March 2022 to June 2022 and from the graphic presentation above it is seen that in general the amount of dust in the clinker cooler and the milling of raw material and gases SO_2 and NO_x do not exceed the maximum allowable value and is in conformity with legislation for air pollution in the Republic of Kosovo.

Conclusion

SHARRCEM aims to serve customers in the region with high-quality products and services while creating long-term and sustainable profitability for the business. SHARRCEM offers a working environment that creates development opportunities based on performance, attitude, and skills.

SHARRCEM treats each other with mutual respect and trust, sharing information and knowledge, as well as the benefits of company success, throughout all levels. SHARRCEM is committed to building a better future together with the people of Kosovo therefore SHARRCEM also strives to operate as a responsible corporate citizen, contributing to the development of our business as well as the community. SHARRCEM creates sustainable long-term profitability for shareholders in the context of social responsibility and prosperity.

The process of cement production affects the environment. SHARRCEM operations are heavily dependent on the use of natural resources. SHARRCEM is aware of its impact on nature and that is the reason why environmental care is one of the priorities in all aspects of conduct.

Dust, noise, safety risks, landscape alternation by using raw materials, air emissions, and energy and water consumption are issues related to our day-to-day performance. For this reason, SHARRCEM is committed to actions that reduce the operational impact on the environment. SHARRCEM complies with all national regulations on environmental protection in the Republic of Kosovo. Some conclusions made us are:

- → To treat the discharge water of the extraction and processing industry, even though the industrial water in SHARRCEM SH.P.K. recirculated in addition to water for sanitary needs
- → Identification of polluted areas above the maximum allowed values and drafting programs for their rehabilitation
- → Continue to implement standards on maximum permissible values of pollutants
- → Continuous improvement of the technological process
- → Full functioning of the national system for air quality monitoring and
- → Taking legal measures and sanctioning these activities following the law on environmental protection.

ACKNOWLEDGEMENTS

We have to thank the "Hydro meteorological Institute of Kosovo" and "National Institute of Public Health", Pristine, Kosovo, for the excellent corporation in the time monitoring of air pollution on the premises of the factory SHARRCEM SH.P.K. We also, have to thank representatives of cementer factory SHARRCEM Joint Stock Company for allowing us to be present at the time of sampling dust and air in the premises of the factory SHARRCEM Joint Stock Company.

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