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Air Dispersion Study for Lafarge Ciment (Moldova) S.A. plant in Raionul Rezina

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1. Introduction

1.1 Scope of the study

Lafarge Ciment (Moldova) S.A. has commissioned Envirometrics S.A. to carry out an air dispersion modeling study based on air pollutant concentrations measured at the main stack of the plant in Raionul Rezina, Republic of Moldova, on March 19, 2024. The study aims to identify the area affected by the plant's operations and to detect any exceedances of air quality guidelines and legislative standards.

The air dispersion modeling was conducted using the globally recognized AERMOD model and three years of local meteorological data, following the US EPA guidelines for air dispersion modeling (https://www.epa.gov/sites/default/files/2020-09/documents/appw_17.pdf. The study covered the following pollutants: NO2, SO2, CO, PM, TOC, Metals (As, Cd, Ni, Pb, Hg, Mn, V, Tl), other inorganic gaseous pollutants (HCl, HF, NH3), and dioxins/furans. For these pollutants, the EU air quality standards, which are also incorporated into Moldova's national legislation under Law No. LP98/2022 on Atmospheric Air Quality, were used to identify any exceedances (https://environment.ec.europa.eu/topics/air/air-quality/eu-air-quality-standards_en. For pollutants not included in the EU air quality standards, the WHO guideline values and OSHA standards (https://www.who.int/publications/i/item/9789289013581 and https://www.osha.gov/laws-regs, respectively) were used.

Two scenarios of air emissions from the plant were examined. The first scenario corresponds to the current normal operation of the cement plant, while the second scenario assesses the potential impact of using different types of waste materials to replace primary raw materials and fossil fuels in the cement kiln. Emissions for the first scenario were calculated based on measurements at the main stack of the plant, while emissions for the second scenario were based on the total emission limit values of Directive 2010/75/EU, Annex VI, Part 4.

1.2 The AERMOD modelling system

Air dispersion models are computational tools that are used to predict the concentration of air pollutants at selected downwind receptor locations during various timesteps. The models use mathematical formulations to simulate the atmospheric processes involved in air pollutants dispersion by using meteorological and topographical inputs. The air dispersion models are divided into two big categories:

- *Screening models that produce estimates of "worst-case" concentrations without the need for hourly meteorological and detailed topographical data and which are usually applied before the refined air quality model to determine if refined modeling is needed.*
- *Refined models that use complex algorithms and detailed hourly meteorological records and high-resolution topographical data to assess one or multiple sources' impacts on ambient air quality.*

The AERMOD modeling system, developed by the U.S. Environmental Protection Agency (EPA) and the American Meteorological Society (AMS), is a state-of-the-art air dispersion model used for regulatory purposes. It is a steady-state Gaussian plume model designed for predicting the dispersion of air pollutants from point, area, and volume sources in the atmosphere. It integrates several advanced algorithms to account for the influence of terrain and complex meteorological conditions. AERMOD uses a planetary boundary layer (PBL) theory to simulate how air pollutants disperse in different stability conditions, and it includes both a terrain preprocessor (AERMAP) and a meteorological preprocessor (AERMET). The AERMAP component processes terrain data to define the influence of topography on plume behavior, while AERMET processes meteorological data to provide detailed, site-specific atmospheric profiles. These features enable AERMOD to accurately represent the dispersion *characteristics of pollutants under a wide range of environmental conditions, making it an essential tool for air quality management and regulatory compliance.*

AERMOD requires several key types of input data to accurately model the dispersion of air pollutants. These inputs include:

- *meteorological data, which typically involves hourly surface and upper air observations processed through AERMET to provide wind speed, wind direction, temperature, and stability class profiles.*
- *geophysical data including terrain data, which is processed through AERMAP to account for the influence of local topography on plume dispersion, and land use data that may be required to characterize the surface roughness, albedo, and Bowen ratio of the modeling area; and*
- *source data, such as emission rates, stack heights, flow gas exit temperature and speed (or flowrate).*

These comprehensive inputs allow AERMOD to simulate real-world conditions with high precision, making it a robust tool for environmental impact assessments.

2. Dispersion Modelling

2.1 Geophysical data and modelling grids

For terrain elevations, data from the Shuttle Radar Topography Mission (SRTM3) were used, with a grid resolution of 3 arc-seconds (approximately 90 meters). The terrain elevations for the project's greater area are presented in Figure 2.1. Land use data were obtained from the Global Land Cover Characteristics database of the U.S. Geological Survey, with a data resolution of 30 arc-seconds (approximately 1 kilometer).

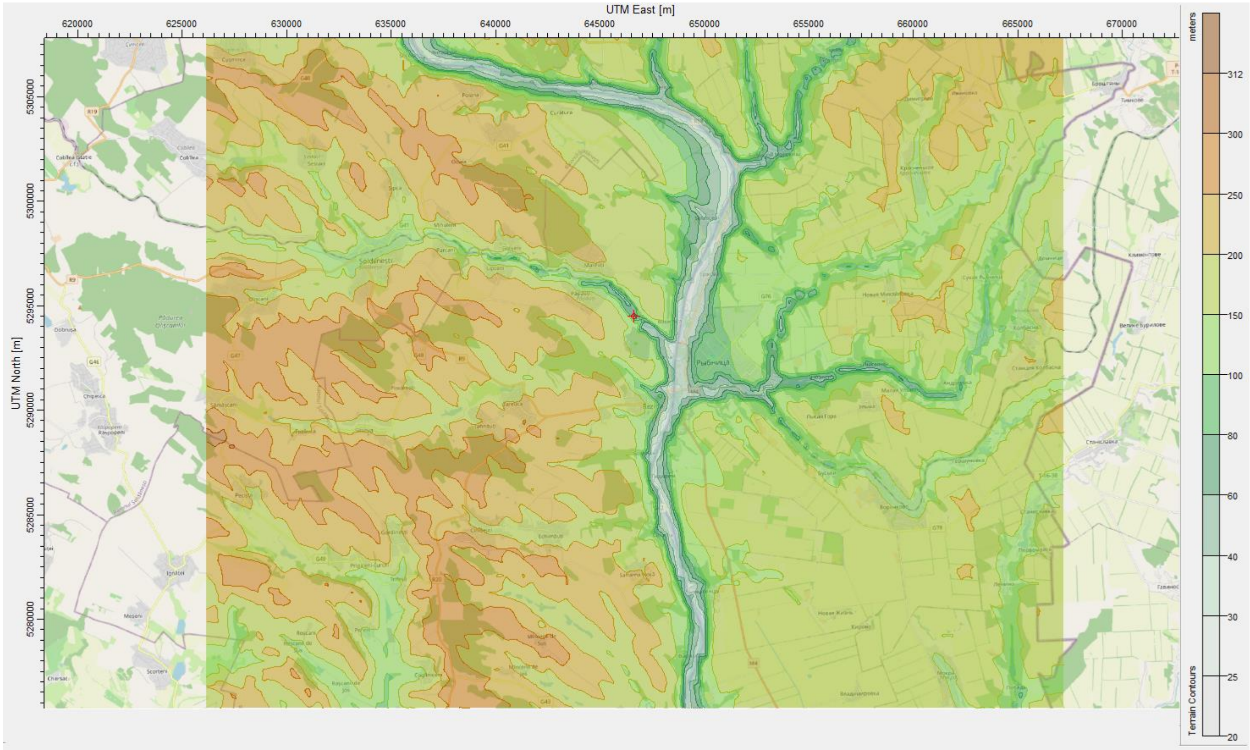

***Figure 2.1**: Terrain elevations of the area around the plant. The main stack location is annotated with a red point.*

In AERMOD, defining a grid of receptors is essential for accurately modeling the spatial distribution of air pollutant concentrations. This grid consists of specific locations where the model calculates pollutant levels, allowing for a detailed analysis of dispersion patterns and hotspot identification. The placement and density of receptors can be adjusted based on the study's requirements, enabling finer resolution in areas of particular interest or concern (e.g., residential areas near the stack). This flexibility in receptor placement ensures that AERMOD can provide detailed and site-specific air quality assessments, which are crucial for regulatory compliance and health risk evaluations.

For this study, a multi-tier grid centered on the stack location with a grid size of 40 km x 40 km has been defined. The horizontal resolution of the grid is as follows:

- *50m for distances 0 – 4.000 m from the point source*
- *100m for distances 4.000m to 8.000m from the point source*
- *200m for distances 8.000m to 12.000m from the point source*
- *400m for distances 12.000m to 20.000m from the point source*

*A denser grid is used at locations near the source, where emissions are expected to have the most significant impact (**Figure 2.2**).*

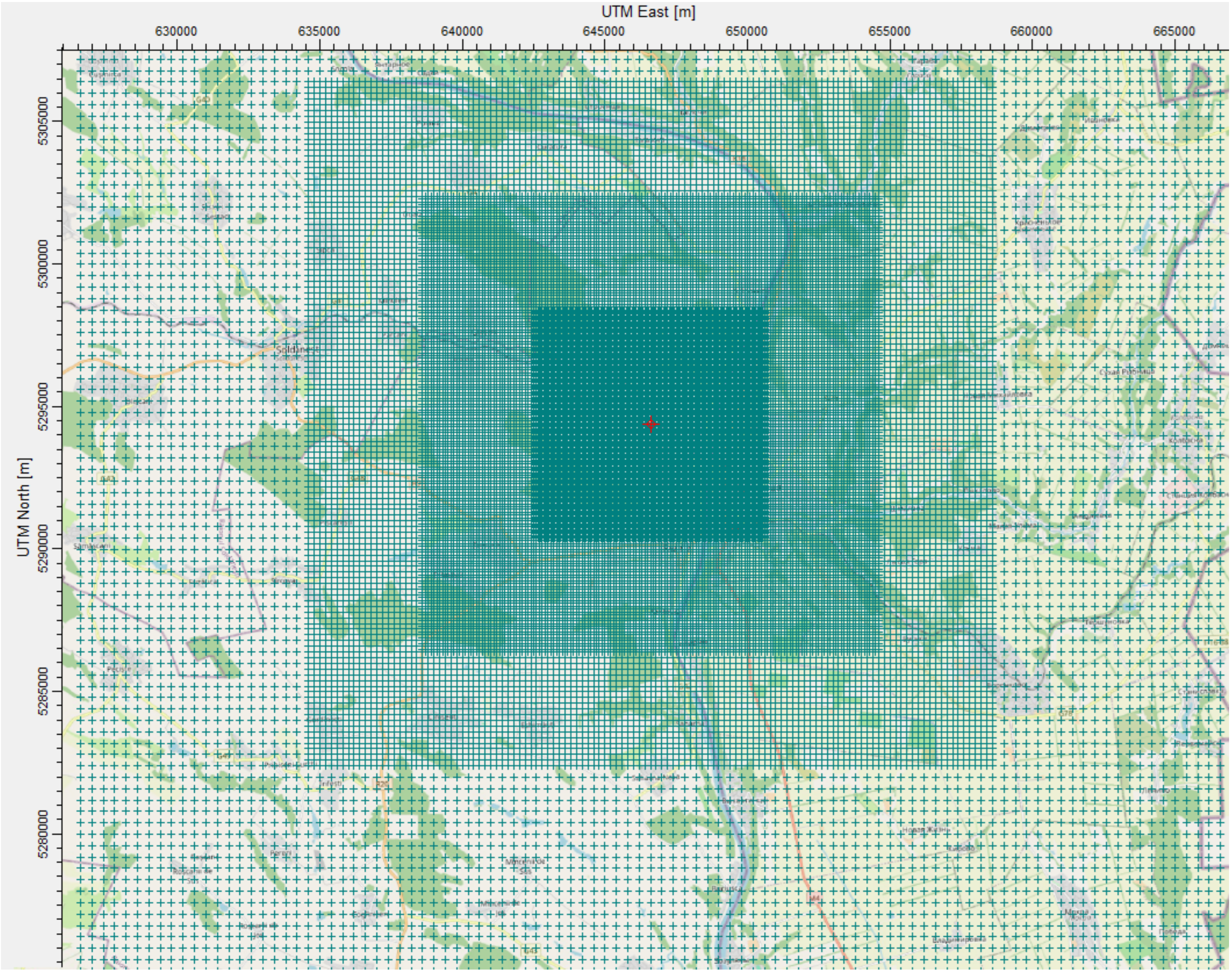

***Figure 2.2**: Multi-tier receptor grid used in the study. Grid resolution 50m, 100m, 200m and 400m*

2.2 Meteorological data

AERMOD requires hourly data of the following parameters from surface based meteorological stations:

- *wind speed*
- *wind direction*
- *temperature*
- *cloud cover*
- *ceiling height*
- *surface pressure*
- *relative humidity and*
- *precipitation (for wet processes modeling)*

According to the U.S. EPA Guideline on Air Quality Models - Appendix W, high-quality meteorological data is essential, typically requiring a minimum of one year, but preferably three years of data to account for annual variability. The closest meteorological station to the *installation is in Rîbnița town (WMO Code 337540, 47.767°N, 029.017°E, altitude 119.0m), about 5 km southeast of the installation. However, the available meteorological data from the Rîbnița station are in daily and 3-hourly timesteps, and therefore cannot be used in the AERMET/AERMOD system.*

Prognostic meteorological data from Numerical Weather Prediction models, such as the Weather Research and Forecasting (WRF) model, can be used as input to the AERMET-AERMOD modeling system, offering detailed and spatially resolved weather information. Thus, within the scope of this study, three years of WRF data (01.01.2021-31.12.2023) are used, ensuring a robust representation of various meteorological conditions and enhancing the reliability of dispersion and deposition predictions in AERMOD. Observation data are used for quality assessment and validation of the prognostic data.

*As presented in **Figure 2.3**, the prognostic data are representative of the region, as monthly average values of temperature, relative humidity, pressure, and cloud cover are similar to those measured at the Rîbnița station. Regarding wind speed, prognostic data are 2-3 times higher than the measurements, likely because those values refer to a height of 10 meters above ground level, whereas Rîbnița station measurements are probably taken at a lower height. In both datasets, higher wind speeds are observed during the winter months (December, January, and February) and the early spring months (March and April). In both cases, the dominant wind directions are northwest-north, followed by south-southeast. The frequencies of wind direction and speeds in the plant area are presented in the wind rose in **Figure 2.4**.*

***Figure 2.3**: Comparison of the monthly values of the main meteorological parameters based on measurements at Rîbnița station and the results of the WRF prognostic model at the location of the cement plant. Data covers period 01/01.2021-31/12/2023.*

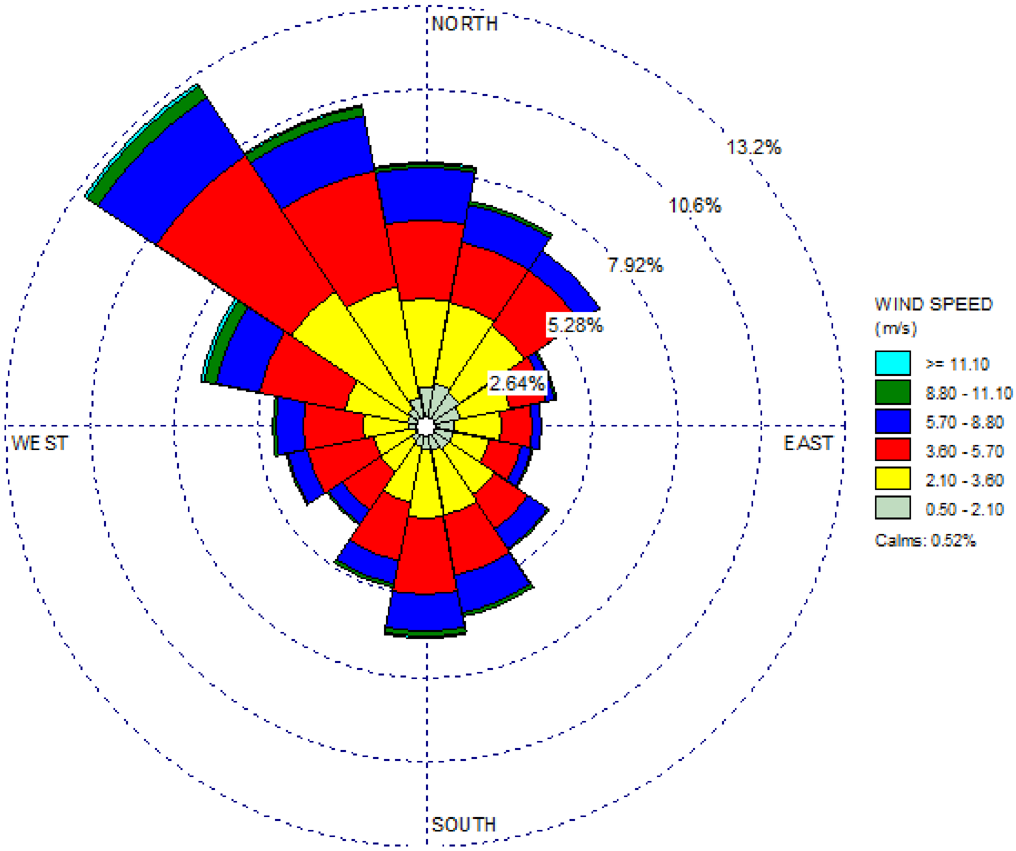

***Figure 2.4**: Windrose at the location of the cement plant according to AERMET Results at 10m above ground level and for period 01/01/2021-31/12/2023 based on the results of the prognostic NWP model WRF.*

2.3 Emissions

2.3.1 Stack data

The parameters that are important in the physical mechanisms of pollutant dispersion and which they are also necessary inputs to the dispersion model, are:

- *the location of the source and its geometrical characteristics (stack height and diameter),*
- *the air pollutants emission rates expressed in mass per time units, and*
- *the exit parameters (temperature and volumetric flowrate) of the exhasut gas.*

In addition the daily, weekly and seasonal operational schedules may be used as input.

The examined source is the main stack of the cement plant with the following characteristics:

Height (m)	*185.0*
Diameter (m)	*3.334*
X (UTM m)	*646596.58*
Y (UTM m)	*5294506.2*

2.3.2 Emissions under current normal operation (Scenario 1)

The emission rates of air pollutants (in g/s) under the normal operation scenario have been calculated using the results of air pollutant concentration measurements (in mg/Nm³) and the volumetric flow rate (Nm³/s) of the exhaust gas at the main stack by applying the following equation:

$$ER_i = \frac{C_i \times F}{(3600 \times 1000)}$$

where ER the emission rate in g/s of the pollutant i, C the concentration of the pollutant in exhaust gases expressed in mg/Nm3 and F the flowrate in Nm3/h.

The measurements of air pollutant concentrations, exit temperature, and volumetric flow rate were conducted on March 19, 2024. The results of the measurements are presented in Tables 2.1 and 2.2.

***Table 2.1**: Air pollutants concentrations measurements at the main stack of the Lafarge Ciment (Moldova) S.A. plant in Raionul Rezina, Republica Moldova compared to emission limits.*

<table>
<tr><th>Concentrations</th><th>C1 [mg/Nm3]</th><th>C2 [mg/Nm3] at reference oxygen 10%</th><th>Emission Limit [mg/Nm3]</th></tr>
<tr><td>HF</td><td>0.1696</td><td>0.254</td><td>1</td></tr>
<tr><td>NH3</td><td>1.067</td><td>1.595</td><td></td></tr>
<tr><td>CO</td><td>459</td><td></td><td></td></tr>
<tr><td>NOx</td><td>914</td><td></td><td>800</td></tr>
<tr><td>SO2</td><td>2.86</td><td></td><td>50</td></tr>
<tr><td>TSP</td><td>3.73</td><td>6.480</td><td>30</td></tr>
<tr><td>HCl</td><td>0.059</td><td>0.104</td><td>10</td></tr>
<tr><td>TOC</td><td>1.71</td><td>2.540</td><td>10</td></tr>
<tr><td>Mercur (Hg)</td><td>0.001661</td><td>0.004834</td><td>0.05</td></tr>
<tr><td>Cadmiu (Cd)</td><td>0.000027</td><td>0.000079</td><td rowspan="2">0.05</td></tr>
<tr><td>Taliu (Tl)</td><td>0.000108</td><td>0.000314</td></tr>
<tr><td>Arsen (As)</td><td>0.000108</td><td>0.000314</td><td rowspan="8">0.5</td></tr>
<tr><td>Cobalt (Co)</td><td>0.000027</td><td>0.000079</td></tr>
<tr><td>Cupru (Cu)</td><td>0.000108</td><td>0.000314</td></tr>
<tr><td>Mangan (Mn)</td><td>0.000697</td><td>0.002027</td></tr>
<tr><td>Nichel (Ni)</td><td>0.000108</td><td>0.000314</td></tr>
<tr><td>Plumb (Pb)</td><td>0.000108</td><td>0.000314</td></tr>
<tr><td>Stibiu (Sb)</td><td>0.000108</td><td>0.000314</td></tr>
<tr><td>Vanadiu (V)</td><td>0.000113</td><td>0.00033</td></tr>
<tr><td>Total Echivalent Toxic I-TEQ cu LOQ ng/Nm3</td><td>0.0045</td><td></td><td>0.1</td></tr>
</table>

***Table 2.2**: Measurements of exit temperature and flowrate at the main stack of the Lafarge Ciment (Moldova) S.A. plant in Raionul Rezina, Republica Moldova.*

Flow rates	***Measurement 1***	***Measurement 2***	***Measurement 3***
Flow rate at m^3/h	*792,261*	*847,965*	*782,023*
Flow rate at Nm^3/h	*578,954*	*603,747*	*577,901*
Exit Temperature °C	*96.63*	*106.015*	*93.652*

2.3.3 Emissions under co-incineration of waste (Scenario 2)

The BREF entitled 'Production of Cement, Lime and Magnesium Oxide' forms part of a series presenting the results of an exchange of information between EU Member States, the industries concerned, non-governmental organisations promoting environmental protection and the Commission, to draw up, review, and where necessary, update BAT reference documents as required by Article 13(1) of the Directive. This document is published by the European Commission pursuant to Article 13(6) of the Directive.

This BREF for the production of cement, lime and magnesium oxide covers the following specified in Annex I to Directive 2010/75/EU, namely:

3.1. Production of cement, lime and magnesium oxide:

(a) production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other kilns with a production capacity exceeding 50 tonnes per day;

(b) production of lime in kilns with a production capacity exceeding 50 tonnes per day;

(c) production of magnesium oxide in kilns with a production capacity exceeding 50 tonnes per day.

The document also covers some activities that may be directly associated to these activities on the same site. Important issues for the implementation of Directive 2010/75/EU in the production of cement, lime and magnesium oxide are the reduction of emissions to air; efficient energy and raw material usage; minimisation, recovery and the recycling of process residues; as well as effective environmental and energy management systems.

In accordance with Best Available Techniques (BAT) Reference Document for the Production of Cement, Lime and Magnesium Oxide, different types of waste materials can replace primary raw materials and/or fossil fuels in cement manufacturing and will contribute to saving natural resources. Basically, characteristics of the clinker burning process itself allow environmentally beneficial waste-to-energy and material recycling applications. The essential process characteristics for the use of waste can be summarised as follows:

- *maximum temperatures of approx. 2000°C (main firing system, flame temperature) in rotary kilns*
- *gas retention times of about 8 seconds at temperatures above 1200°C in rotary kilns*
- *material temperatures of about 1450°C in the sintering zone of the rotary kiln*
- *oxidising gas atmosphere in the rotary kiln*
- *gas retention time in the secondary firing system of more than 2 seconds at temperatures of above 850°C; in the precalciner, the retention times are correspondingly longer and temperatures are higher*
- *solids temperatures of 850°C in the secondary firing system and/or the calciner*

- *uniform burnout conditions for load fluctuations due to the high temperatures at sufficiently long retention times*
- *destruction of organic pollutants due to the high temperatures at sufficiently long retention times*
- *sorption of gaseous components like HF, HCl, SO2 on alkaline reactants*
- *high retention capacity for particle-bound heavy metals*
- *short retention times of exhaust gases in the temperature range known to lead to 'denovo-synthesis' of PCDD/F*
- *complete utilisation of fuel ashes as clinker components and hence, simultaneous material*
- *recycling (e.g. also as a component of the raw material) and energy recovery*
- *product-specific wastes are not generated due to a complete material utilisation into the*
- *clinker matrix; however, some cement plants in Europe dispose of bypass dust*
- *chemical-mineralogical incorporation of non-volatile heavy metals into the clinker matrix [60, VDI 2094 Germany, 2003], [76, Germany, 2006], [168, TWG CLM, 2007].*

The types of waste frequently used as raw materials in the European cement industry include inter alia:

- *Fly ash*
- *Blast furnace slag*
- *Silica fume*
- *Iron slag*
- *Paper sludge*
- *Pyrite ash*
- *Spent foundry sand*
- *Soil containing oil*

Other waste materials are supplied as so-called 'inter-ground' additions to the grinding plants. Fly ash can be used both as raw material in the production of clinker (mainly for its content of alumina) and as an inter-ground addition for cement. Fly ash can replace up to 50% of the Portland cement clinker; however, it may contain mercury. Furthermore, suitable industrial gypsum lends itself for use as a sulphate component.

In the selection and use of waste as raw material the following requirements shall be included:

- *the waste consists primarily of the clinker components*
- *low volatile heavy metal concentration, i.e. mercury, thallium and other types of metals*
- *regular monitoring of inputs, e.g. used waste materials by sampling and analysis.*

The clinker-burning process offers good conditions for using different types of waste materials replacing parts of conventional fuels. As listed in Table 1.14 of the BAT Reference Document for the Production of Cement, Lime and Magnesium Oxide, different types of wastes are used as fuels in European cement kilns, categorised as hazardous and nonhazardous wastes. As these calorific waste materials can replace primary fuel in cement kilns, a consistent waste quality is essential (e.g. adequate calorific value, metal, halogen (e.g. chlorine) and ash content, the waste has to be suitable for the burners). There is a constant increase in the use of waste fuels in clinker production; however, the increase in the use of non-hazardous waste is more significant than the use of hazardous waste. Non-hazardous waste are listed in group numbers 1–10 and the hazardous waste are listed in group numbers 11–13.

Different types of wastes used as fuels in EU-27 cement kilns

Group Nr	Types of waste fuels (hazardous and non-hazardous)
1	Wood, paper, cardboard
2	Textiles
3	Plastics
4	Processed fractions (e.g. RDF)
5	Rubber/tyres
6	Industrial sludge
7	Municipal sewage sludge
8	Animal meal, fats
9	Coal/carbon waste
10	Agricultural waste
11	Solid waste (impregnated sawdust)
12	Solvents and related waste
13	Oil and oily waste
14	Others

Waste, like mixed municipal waste, mixed commercial waste or mixed construction, demolition waste and some solid hazardous waste has to be pretreated in waste management facilities before being used as fuels. The extent of the waste treatment operation, such as sorting, crushing, and pelletising, depends on the waste fuel application.

Examples of pretreated waste mixtures used in cement plants include:

- *hazardous waste impregnated sawdust*
- *waste fuel based on paper, textiles both pre and post consumer which is manufactured from polythene film, photographic film, paper, polypropylene, packaging materials and plastics*
- *waste fuel consisting of household waste, screened paper, cardboard, wood, carpet, textiles and plastics which is a solid, clean and non-hazardous fuel.*

The Directive on Integrated Pollution Prevention and Control (IPPC) was adopted in 1996.

The aim of this key law on industrial emissions is to achieve a high level of environmental protection through integrated prevention and control of the pollution arising from a wide range of industrial and agricultural activities, such as production of metals, minerals, chemicals, paper, textiles, leather, processed foods, poultry and pig farming, combustion plants, oil refineries, waste management, etc. This will help resolve environmental problems, such as pollution of air and water, climate change, soil contamination and negative impacts of waste and move the EU closer to sustainable patterns of production.

Integrated pollution prevention and control is based on a permit system for installations. The permits for the concerned industrial processes - which installations must obtain and comply with to be allowed to operate - include emission limit values based on Best Available Techniques.

The IPPC Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) lays down rules on integrated prevention and control of pollution arising from industrial activities. It also lays down rules designed to prevent or, where that is not practicable, to reduce emissions into air, water and land and to prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole.

ANNEX VI, Part 4 of the Directive defines the rules for determination of air emission limit values for the co-incineration of waste. Special provisions are laid down for waste co-incineration cement kilns (point 2).

2.1 The emission limit values set out in points 2.2 and 2.3 apply as daily average values for total dust, HCl, HF, NOx, SO2 and TOC (for continuous measurements), as average values over the sampling period of a minimum of 30 minutes and a maximum of 8 hours for heavy metals and as average values over the sampling period of a minimum of 6 hours and a maximum of 8 hours for dioxins and furans.

All values are standardised at 10 % oxygen.

Half-hourly average values shall only be needed in view of calculating the daily average values.

2.2 C – total emission limit values (mg/Nm3 except for dioxins and furans) for the following –polluting substances

Polluting substance	*C*
Total dust	*30*
HCl	*10*
HF	*1*
NOx	*500*
Cd + Tl	*0,05*
Hg	*0,05*
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V	*0,5*
Dioxins and furans (ng/Nm3)	*0,1*

2.3 C – total emission limit values (mg/Nm^3) for SO_2 and TOC

Pollutant	*C*
SO_2	*50*
TOC	*10*

The competent authority may grant derogations for emission limit values set out in this point in cases where TOC and SO_2 do not result from the co-incineration of waste

2.4. C- total emission limit values for CO

The competent authority may set emission limit values for CO.

The emission rates of the air pollutants (in g/s) under the co-incineration scenario has been calculated by using the same equation as in the scenario of the normal operation and the emission limits of the IPPC Directive 2010/75/EU. For the rest paramaters of the exhaust gas at the main stack such as the measured volumetric flowrate (Nm^3/s) and the exit temperature the same values as in the scenario of the normal operation. The emission rates of the two scenarios are presented in the following table. For the emissions of carbon monoxide and the other pollutants for which no limits are defined, emissions are assumed to be the same as in the normal operation.

***Table 2.3**: Air pollutants emission rates at the main stack of the Lafarge Ciment (Moldova) S.A. plant in Raionul Rezina, Republica Moldova for the two scenarios*

Pollutant	Scenario 1 Current normal operation [g/s]	Scenario 2 Co-incineration [g/s]
HF	2.8443E-02	5.6573E-02
NH3	1.7894E-01	0.0000E+00
CO	7.6978E+01	0.0000E+00
NOx	1.5328E+02	2.8287E+01
SO2	4.7964E-01	2.8287E+00
TSP	6.2555E-01	1.6972E+00
HCl	9.8947E-03	5.6573E-01
TOC mgC/m3	2.8678E-01	5.6573E-01
Mercur (Hg)	2.6664E-04	2.8287E-03
Cadmiu (Cd) Taliu (Tl)	2.1671E-05	5.6573E-04
As,Co,Cr,Cu,Mn,Ni,Pb,Sb,V	1.4927E-04	2.8287E-02
Total Echivalent Toxic I-TEQ cu LOQ [ng/s]	7.2369E-01	5.6573E+00

2.4 Modelling options and assumptions

Modelling has been carried out based on US EPA guidelines on Air Quality Models (https://www.epa.gov/sites/default/files/2020-09/documents/appw_17.pdf) regarding input data, source categorization, receptor placement, temporal resolution and averaging period. The basic assumptions adopted during the modeling process are the following:

- *The plant operates continuously (24h/24h) for the periods March-April, June - July and September – October at a production level equal to that of the measurements*
- *The source is characterized as urban based upon the Land Use Procedure*
- *A conservative approach of full and instant conversion of NO to NO2 has been adopted (NO2/NOx ratio assumed to be 100%) for all averaging periods. (Tier 1*

conservative approach of full conversion recommended by the US EPA in the Guideline on Air Quality Models)
- *TSP emissions measured are 100% PM10 and 100% PM2.5 (conservative approach of the worst-case scenario)*
- *Chemical transformation and formulation of secondary air pollutants (e.g. O3) is not included in the analysis*
- *The physical mechanisms of air pollutants removal from plume such dry and wet depletion are not considered, approach that leads to higher estimated concentrations*
- *Deposition is only be taken into account for dioxins since there is no air limit value for them and the respiratory tract represents less than 5% of the daily intake according to WHO guidelines (https://www.who.int/publications/i/item/9789289013581).*
- *Background concentrations and the contribution of other sources are not taken into account.*
- *The height of the buildings and structures near the source is significantly lower than the height of the main stack; therefore, building downwash is not considered in the modeling*

2.5 Air quality standards

The Law No. LP98/2022 "On Atmospheric Air Quality" in Moldova establishes specific limit values for various air pollutants to protect public health and the environment. These values are designed to align with European Union (EU) directives and are summarized in the following table.

***Table 2.4**: Air quality standards according to national (LP98/2022) and European legisltation (DIRECTIVE 2008/50/EC & DIRECTIVE 2004/107/EC)*

Pollutant	***Limit value***	***Unit***	***Period***	***Allowed exceedances per year***	***Percentile***
PM10	*50*	*μg/m3*	*24h*	*35*	*90.41%*
PM10	*40*	*μg/m3*	*Annual*		
PM2.5	*25*	*μg/m3*	*Annual*		
SO2	*350*	*μg/m3*	*1h*	*24*	*99.73%*
SO2	*125*	*μg/m3*	*24h*	*3*	*99.18%*
NO2	*200*	*μg/m3*	*1h*	*18*	*99.79%*
NO2	*40*	*μg/m3*	*Annual*		
Benzene	*5*	*μg/m3*	*Annual*		
CO	*10000*	*μg/m3*	*8h*		
Pb	*0.5*	*μg/m3*	*Annual*		
SO2	*500*	*μg/m3*	*3h*		
NO2	*400*	*μg/m3*	*3h*		
NOx	*30*	*μg/m3*	*Annual*		
SO2	*20*	*μg/m3*	*1/10-31/3*		
As	*6*	*ng/m3*	*Annual*		
Cd	*5*	*ng/m3*	*Annual*		

Pollutant	Limit value	Unit	Period	Allowed exceedances per year	Percentile
Ni	20	ng/m3	Annual		
Polycyclic Aromatic Hydrocarbons expressed as concentration of Benzo(a)pyrene	1	ng/m3	Annual		
Pb	0.5	μg/m3	Annual		

For the rest of the air pollutants measured in the stack of the plant for which there is no limit values according to European and national standards, guideline values proposed by WHO and standards defined by the US Occupational Safety and Health Administration can be used in order to assess the impact of the plant emissions on the air quality. These values are presented in the following table. For dioxins and furans no limit values can be determined as there is no safe exposure value to protect human health.

***Table 2.5**: WHO guideline values and OSHA standards for air pollutants not covered by national and European legislation*

WHO AIR QUALITY GUIDELINES FOR EUROPE SECOND EDITION			
Pollutant	Limit value	Unit	Period
Hg	1	μg/m3	Annual
V	1	μg/m3	24h
Mn	0.15	μg/m3	Annual
NH3	270	μg/m3	24h
NH3	8	μg/m3	Annual
Occupational Safety and Health Administration (OSHA) - USA			
Pollutant	Limit value	Unit	Period
HCl	7	μg/m3	ceiling limit, which means it should not be exceeded at any time
HF	2.5	μg/m3	8h

3. Air dispersion modelling results

3.1 General

The AERMOD model calculates hourly ground-level concentrations (in μg/m³ or ng/m³) for the period from January 1, 2021, to December 31, 2023, at each receptor in the multi-tier grid. Based on the predicted hourly concentrations (3 × 8760 = 26,280 hourly values at each receptor), statistical parameters corresponding to the air quality standards presented in Tables 2.3 and 2.4 are calculated (e.g., annual average values, 90.41st percentile of 24-hour values for PM10, etc.).

Additionally, for dioxins and furans, total deposition is calculated at each receptor since these pollutants primarily enter the human body through food consumption, particularly via animal products that have bioaccumulated these compounds. Deposition studies help identify how and where dioxins settle onto soil and vegetation, which are subsequently consumed by livestock, entering the food chain.

Model results are presented in the form of iso-concentration contour maps in Annex I and in tables for the residential areas close to the plant. These results are compared to relevant air quality standards and guideline values to identify exceedances and assess the impact on air quality.

3.2 Results for the Scenario 1 (Current normal operation)

3.2.1 Results presented with contour Maps

As it is clear from the maps of Annex 1, the calculated ground level concentrations of all pollutants do not exceed both the legislative limits and WHO/OSHA guideline values and standards.

The highest 99.79th percentile of hourly NO2 concentration values ranges from 40 to 60 μg/m³. These maximum values are expected in regions located 1,000 to 1,200 meters from the main stack of the plant. In areas located more than 3,000 meters away, the calculated 99.79th percentile of hourly NO2 concentration is less than 20 μg/m³, which is 10 times lower than the limit value of 200 μg/m³. Maximum annual concentrations for NO2 are 1-1,5 μg/m³ significantly lower than the limit value of 40 μg/m³, while no exceedance of the alert threshold of 400 μg/m³ for 3-hourly values is expected.

Regarding SO2 and CO, the estimated ground-level concentrations for all periods are from more than 100 times to more than 1,000 lower than the air quality standards presented at Table 2.3. This indicates that the impact of the main stack is minimal for those pollutants, even in areas in close proximity to the plant.

Even in the worst-case scenario, assuming 100% of the particulate matter is PM2.5 and PM10, the emissions do not result in high ground-level concentrations. The estimated maximum annual concentrations are less than 0.01 μg/m³, mainly due to the seasonal operation of the plant, while daily maximum values do not exceed 0.2 μg/m³. The 90.41st percentile (36th highest value) is less than 0.03 μg/m³, compared to the limit value of 50 μg/m³ for PM10. The highest values are calculated at receptors located up to 500 meters from the plant's main stack.

Regarding the metals for which there are limit values in national and European legislation (As, Cd, Ni, and Pb), maximum annual ground-level concentrations are four to five orders of magnitude lower than the air quality standards.

The highest calculated ground-level concentrations for Total Organic Compounds (TOC) do not exceed 2.t x 10^{-3} μg/m³. The TOC measured in the stack emissions of a cement kiln *includes benzene, toluene, ethylene, xylene, formaldehyde, acetone, polycyclic aromatic hydrocarbons (PAHs) such as benzo(a)pyrene, naphthalene, and other organic compounds such as alkanes, alcohols, aldehydes, ketones, and organic acids. The calculated concentrations of TOC are lower than the limit value for benzene (5 μg/m³) but higher than the limit value for benzo(a)pyrene (1 ng/m³). Since the exact composition is not known and can vary depending on several factors, including the raw materials used, the type of fuel burned, kiln operation conditions, and the efficiency of air pollution control devices, it cannot be assessed whether there is an exceedance of air quality standards.*

The calculated concentrations for pollutants not included in national and European legislation (Mn, V, Hg, HCl, HF, and NH3) are also significantly lower than WHO guideline values and OSHA standards.

For dioxins and furans, there is no defined limit value or guideline value because there is no safe exposure level for the protection of human health. The respiratory route accounts for less than 5% of the daily intake, with the primary route being through the food chain (WHO, 2000). Indicatively, it is reported that typical values in an urban environment are 0.1 pg/m³, with maximum values reaching 1.46 pg/m³ (WHO, 2000). Exposure of a 60 kg person to a dioxin concentration of 3 pg/m³ corresponds to 25% to 100% of the daily tolerable limit. Maximum hourly ground-level concentrations of dioxins and furans are less than 2 x 10^{-4} pg/m³ at receptors located more than 4,000 meters from the main stack, while at receptors closer to the stack, they do not exceed 3 x 10^{-3} pg/m³. In both cases, the estimated values are lower than the typical value of 0.1 pg/m³.

In addition, the rate of deposition of dioxins on the ground through gravity and rain has also been calculated. According to the results of the dispersion model, the average annual deposition in an area 700-1,300 meters from the main stack ranges from 1 x 10^{-3} ng/m² to 2.7 x 10^{-2} ng/m², or from 1 pg/m² to 27 pg/m². For comparison, the World Health Organization's daily tolerable intake for dioxins is 1-4 pg/kg body weight (WHO, 2003). For a full assessment of the possible effects of dioxin deposition, it is necessary to record any agricultural and livestock holdings in the area, food facilities, water resources, and other sensitive receptors, and to assess the deposition in those contexts.

3.2.2 Results at residential areas

The detailed UTM coordinates and the results of air dispersion modelling for the residential areas (cities and towns around the cement plant) are presented in the following Table 3.1. In all residential areas the calculated ground level concentration is significantly lower than air quality standards and WHO/OSHA guidelines indicating that the impact of the facility operation on the air quality of the area is minimal.

***Table 3.1**: Ground level concentrations at residential areas due to the emissions of the main stack based on the results of AERMOD model for the scenario 1. Results are compared to legislative Air Quality Standards and OSHA/WHO Guideline values. For dioxins/furans the annual deposition is also presented*

		Pollutant	NO2	NO2	NO2	SO2	SO2	SO2	PM10	PM10/PM2.5	CO	DIOXINS CONC (pg/m3)	DIOXINS DEP (ng/m2)
		Period	1h	Annual	3h	1h	24h	3h	24h	Annual	8h	1h	ANN
		Statistic	99.79th percentile	Average	Maximum	99.73th percentile	99.18th percentile	Maximum	90.41th percentile	Average	Maximum	Maximum	Maximum
		Limit μg/m3	200	40	400	350	125	500	50	40/25	10000		
Limit value	X [m UTM]	Y [m UTM]	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3
Păpăuți	644298	5295339.5	32.76	0.57	37.46	0.09670	0.02963	0.11721	0.00768	0.00233	17.21	0.00028	0.00181
Mateuți	644448.6	5296995.1	23.25	0.37	29.36	0.06785	0.02080	0.09188	0.00401	0.00150	12.62	0.00025	0.00128
Rezina	647207.9	5290146.9	19.47	0.52	24.44	0.05843	0.02043	0.07647	0.00823	0.00211	8.43	0.00019	0.00105
Stohnaia	647249.7	5287800.6	13.90	0.27	17.23	0.04004	0.01046	0.05390	0.00419	0.00112	5.16	0.00014	0.00054
Rîbnița	650836.4	5292465.2	31.41	0.98	35.10	0.09541	0.03378	0.10983	0.01502	0.00399	15.41	0.00028	0.00200
Țareuca	641099.7	5290092.9	16.71	0.26	22.14	0.04787	0.01180	0.06928	0.00368	0.00106	8.19	0.00014	0.00063
Tahnăuti	639750.8	5289110.7	23.72	0.30	33.90	0.06433	0.01727	0.10608	0.00372	0.00121	11.66	0.00037	0.00047
Hîrjău	650111	5296290	18.23	0.31	32.05	0.05429	0.01541	0.10029	0.00449	0.00127	8.49	0.00023	0.00075
Lipceni	640046.6	5296591.8	10.29	0.14	19.92	0.02853	0.00755	0.06234	0.00174	0.00057	3.80	0.00013	0.00035
Glinjeni, Fălești	640585.9	5298039.5	10.39	0.13	25.85	0.02790	0.00740	0.08090	0.00166	0.00054	4.98	0.00015	0.00043
Cinişeuţi	639255.8	5284204.7	13.56	0.20	21.31	0.03787	0.00949	0.06670	0.00284	0.00082	5.50	0.00016	0.00034
Echimăuţi	642648.5	5283917.6	14.59	0.21	23.29	0.04100	0.00957	0.07288	0.00290	0.00086	8.11	0.00014	0.00043

		Pollutant	*NO2*	*NO2*	*NO2*	*SO2*	*SO2*	*SO2*	*PM10*	*PM10/PM2.5*	*CO*	*DIOXINS CONC (pg/m3)*	*DIOXINS DEP (ng/m2)*
		Period	*1h*	*Annual*	*3h*	*1h*	*24h*	*3h*	*24h*	*Annual*	*8h*	*1h*	*ANN*
		Statistic	*99.79th percentile*	*Average*	*Maximum*	*99.73th percentile*	*99.18th percentile*	*Maximum*	*90.41th percentile*	*Average*	*Maximum*	*Maximum*	*Maximum*
		Limit µg/m3	*200*	*40*	*400*	*350*	*125*	*500*	*50*	*40/25*	*10000*		
Limit value	*X [m UTM]*	*Y [m UTM]*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*	*µg/m3*
Gordinești	*635198.5*	*5283887.1*	*11.49*	*0.16*	*15.65*	*0.03244*	*0.00808*	*0.04898*	*0.00217*	*0.00063*	*5.71*	*0.00012*	*0.00023*
Ofatinţi	*649848.49*	*5281090.61*	*9.46*	*0.15*	*13.76*	*0.02572*	*0.00582*	*0.04307*	*0.00220*	*0.00060*	*2.90*	*0.00011*	*0.00024*
Parcani	*637517.5*	*5297655.6*	*7.85*	*0.10*	*16.31*	*0.02123*	*0.00534*	*0.05105*	*0.00114*	*0.00040*	*3.61*	*0.00012*	*0.00023*
Șoldănești	*634043.9*	*5296956.3*	*9.43*	*0.11*	*13.55*	*0.02405*	*0.00570*	*0.04241*	*0.00153*	*0.00045*	*4.53*	*0.00011*	*0.00021*
Mihuleni	*637502.7*	*5299143.1*	*7.67*	*0.09*	*20.86*	*0.01964*	*0.00562*	*0.06527*	*0.00101*	*0.00037*	*3.36*	*0.00011*	*0.00026*
Saharna	*648162.9*	*5283903.5*	*11.07*	*0.18*	*14.12*	*0.03132*	*0.00715*	*0.04418*	*0.00266*	*0.00072*	*3.93*	*0.00013*	*0.00032*
Saharna Noua	*646847*	*5282048.4*	*9.46*	*0.16*	*12.63*	*0.02773*	*0.00731*	*0.03951*	*0.00224*	*0.00065*	*3.58*	*0.00010*	*0.00028*
Ghidrim	*648187.51*	*5286496.12*	*13.47*	*0.25*	*16.44*	*0.03856*	*0.00923*	*0.05146*	*0.00387*	*0.00101*	*4.92*	*0.00013*	*0.00047*
Vărăncău	*658982.4*	*5285662.2*	*6.92*	*0.12*	*14.91*	*0.01961*	*0.00520*	*0.04665*	*0.00172*	*0.00049*	*3.09*	*0.00012*	*0.00021*
Ulmu	*657690.9*	*5290398.1*	*8.17*	*0.13*	*15.63*	*0.02182*	*0.00660*	*0.04890*	*0.00192*	*0.00053*	*4.68*	*0.00013*	*0.00025*

***Table 3.1 (continue)**: Ground level concentrations at residential areas due to the emissions of the main stack based on the results of AERMOD model for the scenario 1. Results are compared to legislative Air Quality Standards and OSHA/WHO Guideline values. For dioxins/furans the annual deposition is also presented*

		Pollutant	As	Cd	Ni	Pb	Hg	Mn	V	HCL	HF	NH3	NH3
		Period	Annual	Annual	Annual	Annual	Annual	Annual	24H	1h	8h	24H	Annual
		Statistic	Average	Average	Average	Average	Average	Average	Maximum	Maximum	Maximum	Maximum	Average
		Limit μg/m3	6.00E-03	5.00E-03	2.00E-02	5.00E-01	1.00E+00	1.50E-01	1.00E+00	1.00E+00	2.50E+00	2.70E+02	8.00E+00
Limit value	X [m UTM]	Y [m UTM]											
Păpăuți	644298	5295339.5	6.45E-08	1.61E-08	6.45E-08	6.45E-08	9.92E-07	4.16E-07	1.65E-06	3.83E-03	6.36E-03	1.63E-02	6.66E-04
Mateuți	644448.6	5296995.1	4.15E-08	1.04E-08	4.15E-08	4.15E-08	6.38E-07	2.68E-07	1.32E-06	3.49E-03	4.66E-03	1.30E-02	4.28E-04
Rezina	647207.9	5290146.9	5.86E-08	1.47E-08	5.86E-08	5.86E-08	9.01E-07	3.78E-07	1.09E-06	2.67E-03	3.11E-03	1.07E-02	6.05E-04
Stohnaia	647249.7	5287800.6	3.09E-08	7.73E-09	3.09E-08	3.09E-08	4.75E-07	2.00E-07	6.92E-07	2.04E-03	1.91E-03	6.83E-03	3.19E-04
Rîbnița	650836.4	5292465.2	1.11E-07	2.76E-08	1.11E-07	1.11E-07	1.70E-06	7.14E-07	1.69E-06	3.89E-03	5.70E-03	1.67E-02	1.14E-03
Țareuca	641099.7	5290092.9	2.95E-08	7.36E-09	2.95E-08	2.95E-08	4.53E-07	1.90E-07	7.43E-07	1.99E-03	3.03E-03	7.33E-03	3.04E-04
Tahnăuti	639750.8	5289110.7	3.36E-08	8.39E-09	3.36E-08	3.36E-08	5.16E-07	2.17E-07	9.31E-07	5.14E-03	4.31E-03	9.18E-03	3.46E-04
Hîrjău	650111	5296290	3.53E-08	8.81E-09	3.53E-08	3.53E-08	5.42E-07	2.28E-07	8.25E-07	3.18E-03	3.14E-03	8.14E-03	3.64E-04
Lipceni	640046.6	5296591.8	1.59E-08	3.97E-09	1.59E-08	1.59E-08	2.44E-07	1.02E-07	4.37E-07	1.85E-03	1.40E-03	4.31E-03	1.64E-04

		Pollutant	As	Cd	Ni	Pb	Hg	Mn	V	HCL	HF	NH3	NH3
		Period	Annual	Annual	Annual	Annual	Annual	Annual	24H	1h	8h	24H	Annual
		Statistic	Average	Average	Average	Average	Average	Average	Maximum	Maximum	Maximum	Maximum	Average
		Limit µg/m3	6.00E-03	5.00E-03	2.00E-02	5.00E-01	1.00E+00	1.50E-01	1.00E+00	1.00E+00	2.50E+00	2.70E+02	8.00E+00
Limit value	X [m UTM]	Y [m UTM]											
Glinjeni, Fălești	640585.9	5298039.5	1.50E-08	3.76E-09	1.50E-08	1.50E-08	2.31E-07	9.70E-08	5.27E-07	2.07E-03	1.84E-03	5.20E-03	1.55E-04
Cinişeuţi	639255.8	5284204.7	2.27E-08	5.68E-09	2.27E-08	2.27E-08	3.49E-07	1.47E-07	7.15E-07	2.20E-03	2.03E-03	7.05E-03	2.35E-04
Echimăuţi	642648.5	5283917.6	2.37E-08	5.93E-09	2.37E-08	2.37E-08	3.65E-07	1.53E-07	8.26E-07	1.98E-03	3.00E-03	8.15E-03	2.45E-04
Gordinești	635198.5	5283887.1	1.76E-08	4.39E-09	1.76E-08	1.76E-08	2.70E-07	1.13E-07	4.67E-07	1.67E-03	2.11E-03	4.61E-03	1.81E-04
Ofatinţi	649848.49	5281090.61	1.65E-08	4.13E-09	1.65E-08	1.65E-08	2.54E-07	1.07E-07	4.51E-07	1.47E-03	1.07E-03	4.45E-03	1.70E-04
Parcani	637517.5	5297655.6	1.10E-08	2.75E-09	1.10E-08	1.10E-08	1.69E-07	7.11E-08	3.16E-07	1.63E-03	1.33E-03	3.12E-03	1.14E-04
Șoldănești	634043.9	5296956.3	1.24E-08	3.11E-09	1.24E-08	1.24E-08	1.91E-07	8.03E-08	4.13E-07	1.46E-03	1.67E-03	4.08E-03	1.28E-04
Mihuleni	637502.7	5299143.1	1.03E-08	2.57E-09	1.03E-08	1.03E-08	1.58E-07	6.64E-08	4.14E-07	1.53E-03	1.24E-03	4.08E-03	1.06E-04
Saharna	648162.9	5283903.5	2.00E-08	5.01E-09	2.00E-08	2.00E-08	3.08E-07	1.29E-07	4.39E-07	1.75E-03	1.45E-03	4.33E-03	2.07E-04
Saharna Noua	646847	5282048.4	1.81E-08	4.52E-09	1.81E-08	1.81E-08	2.78E-07	1.17E-07	4.38E-07	1.41E-03	1.32E-03	4.32E-03	1.86E-04
Ghidrim	648187.51	5286496.12	2.79E-08	6.99E-09	2.79E-08	2.79E-08	4.30E-07	1.80E-07	6.44E-07	1.91E-03	1.82E-03	6.35E-03	2.88E-04
Vărăncău	658982.4	5285662.2	1.36E-08	3.40E-09	1.36E-08	1.36E-08	2.09E-07	8.78E-08	3.32E-07	1.85E-03	1.14E-03	3.28E-03	1.40E-04
Ulmu	657690.9	5290398.1	1.47E-08	3.68E-09	1.47E-08	1.47E-08	2.26E-07	9.49E-08	4.32E-07	1.86E-03	1.73E-03	4.27E-03	1.52E-04

3.3 Results for the Scenario 2 (Co-incinration)

3.3.1 Results presented with contour Maps

As evident from the maps in Annex 2, the calculated ground-level concentrations of all pollutants do not exceed the legislative limits or WHO/OSHA guideline values and standards. The calculated ground-level concentrations are lower than those in Scenario 1 for most pollutants, except for NO2.

More specifically, the highest 99.79th percentile of hourly NO2 concentration values ranges from 9 to 11 μg/m³. These maximum values are expected in regions located 1,000 to 1,200 meters from the main stack of the plant. In areas more than 2,000 meters away, the calculated 99.79th percentile of hourly NO2 concentration is less than 5 μg/m³, which is 40 times lower than the limit value of 200 μg/m³. Maximum annual concentrations for NO2 are 0.2-0.3 μg/m³, significantly lower than the limit value of 40 μg/m³, and no exceedance of the alert threshold of 400 μg/m³ for 3-hourly values is expected (maximum concentrations <70 μg/m³).

The estimated ground-level concentrations of SO2 for all periods are 75 to 350 times lower than the air quality standards presented in Table 2.3. This indicates that the impact of the main stack is minimal for those pollutants, even in areas close to the plant.

The estimated maximum annual concentrations of PM10 and PM2.5 are also significantly lower than air quality standards, with values less than 0.016 μg/m³, while the 90.41st percentile (36th highest value) of the daily values is less than 0.08 μg/m³, compared to the limit value of 50 μg/m³ for PM10.

Regarding metals (As, Cd, Ni, and Pb), maximum annual ground-level concentrations are one to three orders of magnitude lower than the air quality standards.

The highest calculated ground-level concentrations for Total Organic Compounds (TOC) do not exceed 5.4 x 10^{-3} μg/m³.

Maximum hourly ground-level concentrations of dioxins and furans are less than 2.5 x 10^-2 pg/m³ at receptors located close to the cement plant. At receptors more than 500 meters from the main stack, these concentrations do not exceed 3 x 10^-3 pg/m³. In both cases, the estimated values are lower than the typical value of 0.1 pg/m³. Regarding annual deposition, the highest values are estimated close to the cement plant (within 2,000 meters of the main stack), ranging from 1 x 10^-2 ng/m² to 2.07 x 10^-1 ng/m², or from 10 pg/m² to 207 pg/m². For comparison, the World Health Organization's daily tolerable intake for dioxins is 1-4 pg/kg of body weight (WHO, 2003). To fully assess the potential effects of dioxin deposition, it is necessary to document the presence of agricultural and livestock holdings, food facilities, water resources, and other sensitive receptors in the area and to evaluate the deposition levels in these contexts.

3.3.2 Results at residential areas

In all residential areas, the calculated ground-level concentrations for the second scenario are significantly lower than air quality standards and WHO/OSHA guidelines, indicating that the impact of the facility operation on the air quality of the area is minimal in the case of waste co-incineration as well.

***Table 3.2**: Ground level concentrations at residential areas due to the emissions of the main stack based on the results of AERMOD model for the scenario 2. Results are compared to legislative Air Quality Standards and OSHA/WHO Guideline values. For dioxins/furans the annual deposition is also presented*

		Pollutant	NO2	NO2	NO2	SO2	SO2	SO2	PM10	PM10/PM2.5	DIOXINS CONC (pg/m3)	DIOXINS DEP (ng/m2)
		Period	1h	Annual	3h	1h	24h	3h	24h	Annual	1h	ANN
		Statistic	99.79th percentile	Average	Maximum	99.73th percentile	99.18th percentile	Maximum	90.41th percentile	Average	Maximum	Maximum
		Limit μg/m3	200	40	400	350	125	500	50	40/25		
Limit value	X [m UTM]	Y [m UTM]	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3	μg/m3
Păpăuți	644298	5295339.5	6.05	0.11	6.91	0.57029	0.17475	0.69126	0.02082	0.00631	0.00218	0.01414
Mateuți	644448.6	5296995.1	4.29	0.07	5.42	0.40017	0.12266	0.54185	0.01089	0.00406	0.00198	0.01002
Rezina	647207.9	5290146.9	3.59	0.10	4.51	0.34459	0.12047	0.45097	0.02232	0.00574	0.00151	0.00818
Stohnaia	647249.7	5287800.6	2.57	0.05	3.18	0.23615	0.06168	0.31790	0.01136	0.00303	0.00111	0.00420
Rîbnița	650836.4	5292465.2	5.80	0.18	6.48	0.56266	0.19919	0.64773	0.04076	0.01082	0.00221	0.01560
Țareuca	641099.7	5290092.9	3.08	0.05	4.09	0.28230	0.06959	0.40857	0.00997	0.00288	0.00113	0.00492
Tahnăuti	639750.8	5289110.7	4.38	0.05	6.26	0.37936	0.10185	0.62559	0.01008	0.00328	0.00293	0.00366
Hîrjău	650111	5296290	3.36	0.06	5.91	0.32018	0.09085	0.59148	0.01218	0.00345	0.00178	0.00586
Lipceni	640046.6	5296591.8	1.90	0.03	3.68	0.16825	0.04455	0.36765	0.00473	0.00155	0.00103	0.00273
Glinjeni, Fălești	640585.9	5298039.5	1.92	0.02	4.77	0.16455	0.04364	0.47708	0.00449	0.00147	0.00116	0.00333
Cinişeuţi	639255.8	5284204.7	2.50	0.04	3.93	0.22336	0.05598	0.39335	0.00771	0.00222	0.00125	0.00267
Echimăuți	642648.5	5283917.6	2.69	0.04	4.30	0.24180	0.05641	0.42981	0.00786	0.00232	0.00113	0.00339

		Pollutant	NO2	NO2	NO2	SO2	SO2	SO2	PM10	PM10/PM2.5	DIOXINS CONC (pg/m3)	DIOXINS DEP (ng/m2)
		Period	1h	Annual	3h	1h	24h	3h	24h	Annual	1h	ANN
		Statistic	99.79th percentile	Average	Maximum	99.73th percentile	99.18th percentile	Maximum	90.41th percentile	Average	Maximum	Maximum
		Limit µg/m3	200	40	400	350	125	500	50	40/25		
Limit value	X [m UTM]	Y [m UTM]	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3	µg/m3
Gordinești	635198.5	5283887.1	2.12	0.03	2.89	0.19134	0.04765	0.28888	0.00590	0.00172	0.00095	0.00179
Ofatinţi	649848.49	5281090.61	1.75	0.03	2.54	0.15166	0.03431	0.25398	0.00597	0.00162	0.00084	0.00191
Parcani	637517.5	5297655.6	1.45	0.02	3.01	0.12518	0.03148	0.30107	0.00310	0.00108	0.00092	0.00178
Șoldănești	634043.9	5296956.3	1.74	0.02	2.50	0.14181	0.03362	0.25012	0.00414	0.00122	0.00083	0.00167
Mihuleni	637502.7	5299143.1	1.42	0.02	3.85	0.11583	0.03312	0.38491	0.00274	0.00101	0.00086	0.00200
Saharna	648162.9	5283903.5	2.04	0.03	2.61	0.18473	0.04217	0.26058	0.00721	0.00196	0.00100	0.00251
Saharna Noua	646847	5282048.4	1.75	0.03	2.33	0.16352	0.04310	0.23304	0.00607	0.00177	0.00080	0.00215
Ghidrim	648187.51	5286496.12	2.49	0.05	3.03	0.22743	0.05445	0.30346	0.01049	0.00274	0.00102	0.00368
Vărăncău	658982.4	5285662.2	1.28	0.02	2.75	0.11568	0.03065	0.27513	0.00467	0.00133	0.00090	0.00167
Ulmu	657690.9	5290398.1	1.51	0.02	2.88	0.12865	0.03893	0.28838	0.00521	0.00144	0.00103	0.00198

Table 3.2 (continue)*: Ground level concentrations at residential areas due to the emissions of the main stack based on the results of AERMOD model for the scenario 2. Results are compared to legislative Air Quality Standards and OSHA/WHO Guideline values. For dioxins/furans the annual deposition is also presented*

		Pollutant	Cd	As	Ni	Pb	Hg	Mn	V	HCL	HF
		Period	Annual	Annual	Annual	Annual	Annual	Annual	24H	1h	8h
		Statistic	Average	Average	Average	Average	Average	Average	Maximum	Maximum	Maximum
		Limit μg/m3	5.00E-03	6.00E-03	2.00E-02	5.00E-01	1.00E+00	1.50E-01	1.00E+00	1.00E+00	2.50E+00
Limit value	X [m UTM]	Y [m UTM]	1.00E-05	1.00E-04			1.00E-05	0.00E+00	0.00E+00	2.19E-01	1.27E-02
Păpăuți	644298	5295339.5	1.00E-05	7.00E-05			1.00E-05	0.00E+00	0.00E+00	2.00E-01	9.28E-03
Mateuți	644448.6	5296995.1	1.00E-05	9.00E-05			1.00E-05	0.00E+00	0.00E+00	1.53E-01	6.19E-03
Rezina	647207.9	5290146.9	1.00E-05	5.00E-05			1.00E-05	0.00E+00	0.00E+00	1.17E-01	3.79E-03
Stohnaia	647249.7	5287800.6	2.00E-05	1.80E-04			2.00E-05	0.00E+00	0.00E+00	2.22E-01	1.13E-02
Rîbnița	650836.4	5292465.2	0.00E+00	5.00E-05			0.00E+00	0.00E+00	0.00E+00	1.14E-01	6.02E-03
Țareuca	641099.7	5290092.9	1.00E-05	5.00E-05			1.00E-05	0.00E+00	0.00E+00	2.94E-01	8.57E-03
Tahnăuti	639750.8	5289110.7	1.00E-05	6.00E-05			1.00E-05	0.00E+00	0.00E+00	1.82E-01	6.24E-03
Hîrjău	650111	5296290	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	1.06E-01	2.79E-03
Lipceni	640046.6	5296591.8	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	1.18E-01	3.66E-03

		Pollutant	Cd	As	Ni	Pb	Hg	Mn	V	HCL	HF
		Period	Annual	Annual	Annual	Annual	Annual	Annual	24H	1h	8h
		Statistic	Average	Average	Average	Average	Average	Average	Maximum	Maximum	Maximum
		Limit µg/m3	5.00E-03	6.00E-03	2.00E-02	5.00E-01	1.00E+00	1.50E-01	1.00E+00	1.00E+00	2.50E+00
Limit value	X [m UTM]	Y [m UTM]	1.00E-05	1.00E-04			1.00E-05	0.00E+00	0.00E+00	2.19E-01	1.27E-02
Glinjeni, Fălești	640585.9	5298039.5	0.00E+00	4.00E-05			0.00E+00	0.00E+00	0.00E+00	1.26E-01	4.04E-03
Cinişeuţi	639255.8	5284204.7	0.00E+00	4.00E-05			0.00E+00	0.00E+00	0.00E+00	1.13E-01	5.96E-03
Echimăuţi	642648.5	5283917.6	0.00E+00	3.00E-05			0.00E+00	0.00E+00	0.00E+00	9.56E-02	4.20E-03
Gordinești	635198.5	5283887.1	0.00E+00	3.00E-05			0.00E+00	0.00E+00	0.00E+00	8.39E-02	2.13E-03
Ofatinţi	649848.49	5281090.61	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	9.29E-02	2.65E-03
Parcani	637517.5	5297655.6	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	8.35E-02	3.33E-03
Șoldănești	634043.9	5296956.3	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	8.74E-02	2.47E-03
Mihuleni	637502.7	5299143.1	0.00E+00	3.00E-05			0.00E+00	0.00E+00	0.00E+00	1.00E-01	2.89E-03
Saharna	648162.9	5283903.5	0.00E+00	3.00E-05			0.00E+00	0.00E+00	0.00E+00	8.07E-02	2.63E-03
Saharna Noua	646847	5282048.4	0.00E+00	4.00E-05			0.00E+00	0.00E+00	0.00E+00	1.09E-01	3.61E-03
Ghidrim	648187.51	5286496.12	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	1.06E-01	2.27E-03
Vărăncău	658982.4	5285662.2	0.00E+00	2.00E-05			0.00E+00	0.00E+00	0.00E+00	1.06E-01	3.44E-03
Ulmu	657690.9	5290398.1	1.00E-05	1.00E-04			1.00E-05	0.00E+00	0.00E+00	2.19E-01	1.27E-02

4. Summary and Conclusions

Emissions for the first scenario were calculated based on measurements of air pollutant concentrations in the exhaust gas and the corresponding volumetric flow rate. These measurements were conducted on March 19, 2024, by an accredited company. Emissions for the second scenario were calculated based on the emission limit values outlined in the IPPC Directive 2010/75/EU.

For the modeling calculations, the guidelines of the US EPA on Air Quality models were followed, including model selection, input data usage, assumptions made, and post-processing of the results. The widely used AERMOD model was applied in this study, and the results of ground-level concentrations were compared to European and national air quality standards, as well as WHO/OSHA guidelines, to identify any exceedances.

According to the results, the highest concentration of air pollutants due to the operation of the facility is mainly found at receptors within a maximum distance of 1,000 meters from the main stack. However, these values are significantly lower than the air quality standards and WHO/OSHA guideline values for both scenarios. The calculated ground-level concentrations are even lower in the residential areas near the Lafarge Ciment Moldova plant.

Annex 1: Contour Maps for the Scenario 1

1. NO2 99.79th percentile of 1h concentration
2. NO2 annual average concentration
3. NO2 maximum 3hr concentration
4. SO2 99.73rd percentile of 1h concentration
5. SO2 99.18th percentile of 24h concentration
6. SO2 maximum 3hr concentration
7. PM10 90.41st percentile of 24h concentrations
8. PM10 Annual average concentration
9. PM2.5 Annual average concentration
10. CO Maximum 8h concentration
11. Dioxins/Furans maximum 1h concentration
12. Dioxins/Furans annual deposition
13. As annual average concentration
14. Cd annual average concentration
15. Ni annual average concentration
16. Pb annual average concentration
17. TOC annual average concentration
18. Hg annual average concentration
19. Mn annual average concentration
20. V maximum 24h concentration
21. HCl maximum 1h concentration
22. HF maximum 8h concentration
23. NH3 maximum 24h concentration
24. NH3 annual average concentration

Annex 2: Contour Maps for the Scenario 2

1. NO_2 99.79th percentile of 1h concentration
2. NO_2 annual average concentration
3. NO_2 maximum 3hr concentration
4. SO_2 99.73rd percentile of 1h concentration
5. SO_2 99.18th percentile of 24h concentration
6. SO_2 maximum 3hr concentration
7. PM10 90.41st percentile of 24h concentrations
8. PM10 Annual average concentration
9. PM2.5 Annual average concentration
10. Dioxins/Furans maximum 1h concentration
11. Dioxins/Furans annual deposition
12. Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V annual average concentration
13. Cd + Tl annual average concentration
14. TOC annual average concentration
15. Hg annual average concentration
16. HCl maximum 1h concentration
17. HF maximum 8h concentration

Hellenic Accreditation System S.A.

Annex F1/20 to the Certificate No. **412-5**

SCOPE of ACCREDITATION

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ENVIROMETRICS S.A

Materials/Products tested	Types of test/Properties measured	Applied methods/Techniques used
Sampling and Physical / Chemical tests		
Stack emissions from stationary sources	1. Sampling and determination of mass concentration of particulate matter	EN 13284-01:2017 ISO 9096:2017
	2. Sampling and determination of emissions PM10 particles	EN 13284-01:2017 ISO 9096:2017
	3. Measurement of velocity and volume flow rate of gas streams in ducts	ISO 10780:1994 EN ISO 16911-1:2013
	4.Determination of the water vapour in ducts	EN 14790:2017
	5. Sampling and determination of total organic carbon (TOC)	EN 12619:2013
	6. Sampling and determination of concentration of oxides of Nitrogen (NO_x)	EN 14792:2017
	7. Determination of volume concentration of oxygen (O_2)	EN 14789:2017
	8. Determination of the mass concentration of carbon monoxide (CO)	EN 15058:2017
	9. Determination of carbon monoxide (CO), carbon dioxide (CO_2) and oxygen (O_2)	ISO 12039:2019

Materials/Products tested	Types of test/Properties measured	Applied methods/Techniques used
	10. Determination of the mass concentration of sulfur dioxide (SO_2)	ISO 7935:1992
	11. Determination of the mass concentration of dinitrogen monoxide (N_2O)	EN ISO 21258:2011
	12. Determination of the mass concentration of nitrogen oxides (NOx)	ISO 10849:1996
	13. Optical estimation of darkness of smoke evolving from chimney with use of RINGLEMANN chart	ΕΛΟΤ 815:1986
	14.Validation and performance test of automatic measurement systems*	Quality assurance of automated measurement systems according to EN 14181:2014, QAL2 and AST
	15.Sampling and determination of odour concentration by dynamic Olfactometry and odour emission rate	EN 13725:2022 VDI 3880:2011
Ambient Air	1. Determination of the PM10 or PM 2,5 fraction of suspended particulate matter. Reference method and field test procedure to demonstrate reference equivalence of measurement methods.	EN 12341:2014
	2. Measurement and assessment of environmental noise emitted by machinery and equipment (dB)	ISO 11201:2010 ISO 1996-1:2016 ISO 1996-2:2017 EN 61672-1:2013 ISO 1999:2013
	3. Sampling and determination of odour concentration by dynamic Olfactometry	EN 13725:2022
Workplace Atmosphere	1.Determination of inhalable and respirable dust	EN 481:1993 EN ISO 13137:2013
	2. Personal sound exposure	EN 61252:2011 ISO 1999:2013
Wastes	1. Determination of pH	EN 13037:2011
	2. Determination of electrical conductivity	EN 13038:2011

Materials/Products tested	Types of test/Properties measured	Applied methods/Techniques used
	Sampling	
Stack emissions from stationary sources	1. Sampling for the determination of As, Cd, Cr, Co, Cu, Mn, Ni, Pb, Sb, Tl and V	EN 14385:2004
	2. Sampling for the determination of PCDDs/PCDFs and dioxin-like PCBs	EN 1948-1:2006 EN 1948-4:2010+A1:2013
	3. Sampling for the determination of PAHs	ISO 11338-1:2003
	4. Sampling for the determination of HCl	EN 1911:2010
	5. Sampling for the determination of gaseous fluorine compounds HF	ISO 15713:2006
	6. Sampling for the determination of SO_2 (as included in the reference method).	EN 14791:2017
	7. Sampling for the determination of total Hg	EN 13211:2001 / AC:2005
	8. Determination of the mass concentration of individual gaseous organic compounds (VOCs)	CEN/TS 13649:2014
	9. Sampling for the determination of the mass concentration of ammonia	EN ISO 21877:2019
Ambient Air	1. Measurement of Pb, Cd, As and Ni in the PM10 fraction of suspended particulate matter (Standard method)	EN 14902:2005
	2. Measurement of the concentration of benzo(a)pyrene (Standard method)	EN 15549:2008
	3. Sampling for the determination of PCDDs/PCDFs and PCBs in Ambient Air	EPA TO-9A
Workplace Atmosphere	1. Sampling and determination of volatile organic compounds (VOCs)	NIOSH 1500 NIOSH 1501 EN 689:2018+AC:2019
Wastes	1. Sampling of waste materials for characterization of wastes	EN 14899:2005 CEN/TR 15310-1, 2, 3, 4, 5:2006

** Refers to the accredited tests of the present scope*

Site of assessment: **Permanent laboratory premises, 3 Kodrou str, Chalandri 15232, Greece.**
Approved signatories: **A. Siskos, V. Sideri, K. Platymesi.**

This Scope of Accreditation replaces the previous one dated 07.07.2023.

The Accreditation Certificate No. **412**-5, to ELOT EN ISO/IEC 17025:2017, is valid until 11.09.2024.

Athens, 06.02.2024

Christos Nestoras
CEO of E.SY.D.