SLOVENSKI STANDARD
SIST EN 19694-5:2017

01-julij-2017

Emisije nepremičnih virov - Določevanje emisij toplogrednih plinov (TGP) v energetsko intenzivnih industrijah - 5. del: Proizvodnja apna

Stationary source emissions - Determination of greenhouse gas (GHG) emissions in energy-intensive industries - Part 5: Lime industry

Emissionen aus stationären Quellen - Bestimmung von Treibhausgasen (THG) aus energieintensiven Industrien - Teil 5: Kalkindustrie

Émissions de sources fixes - Détermination des émissions des gaz à effet de serre dans les industries à forte intensité énergétique - Partie 5: Industrie de la chaux

Ta slovenski standard je istoveten z: EN 19694-5:2016

ICS:

13.020.40	Onesnaževanje, nadzor nad onesnaževanjem in ohranjanje	Pollution, pollution control and conservation
13.040.40	Emisije nepremičnih virov	Stationary source emissions
91.100.10	Cement. Mavec. Apno. Malta	Cement. Gypsum. Lime. Mortar

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 19694-5

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English Version

Stationary source emissions - Determination of greenhouse gas (GHG) emissions in energy-intensive industries - Part 5: Lime industry

Émissions de sources fixes - Détermination des émissions de gaz à effet de serre (GES) dans les industries énergo-intensives - Partie 5: Industrie de la chaux

Emissionen aus stationären Quellen - Bestimmung von Treibhausgasen (THG) aus energieintensiven Industrien - Teil 5: Kalkindustrie

This European Standard was approved by CEN on 5 May 2016.

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European foreword

This document (EN 19694-5:2016) has been prepared by Technical Committee CEN/TC 264 "Air quality", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate M/478 given to CEN by the European Commission and the European Free Trade Association.

This part of EN 19694 deals with sector-specific aspects for the determination of greenhouse gas (GHG) emissions from lime manufacture.

This European Standard can be used to measure, report and compare the GHG emissions of a lime manufacturing plant. Data for individual plants, sites or works may be combined to measure, report and compare GHG emissions for an organization, corporation or group.

EN 19694, *Stationary source emissions — Determination of greenhouse gas (GHG) emissions in energy intensive industries* is a series of standards that consists of the following parts:

— *Part 1: General aspects*

— *Part 2: Iron and steel industry*

— *Part 3: Cement industry*

— *Part 4: Aluminium industry*

— *Part 5: Lime industry*

— *Part 6: Ferroalloy industry*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard provides a harmonized methodology for calculating GHG emissions from the lime industry. It includes the manufacture of lime, and any downstream lime products manufactured at the plant, such as ground or hydrated lime. This standard allows for reporting of GHG emissions for various purposes and on different basis, such as plant basis, company basis (by country or by region) or international organization basis.

Since lime is defined as the generic name for quicklime, dolime and sintered dolime, plants manufacturing at least one of these products shall be covered by this standard.

This European Standard addresses all of the following direct and indirect sources of GHG included as defined in ISO 14064-1:

— direct greenhouse gas emissions from greenhouse gas sources that are owned or controlled by the company, such as emissions resulting from the following sources:

  — calcination of carbonates and combustion of organic carbon contained in the kiln stone;

  — combustion of kiln fuels (fossil kiln fuels, alternative fossil fuels, mixed fuels with biogenic carbon content, biomass fuels and bio fuels) related to lime production and/or drying of raw materials;

  — combustion of non-kiln fuels (fossil kiln fuels, mixed fuels with biogenic carbon content, biomass fuels and bio fuels) related to equipment and on-site vehicles, heating/cooling and other on-site uses;

  — combustion of fuels for on-site power generation.

— indirect greenhouse gas emissions from the generation of imported electricity, heat or steam consumed by the organization;

— other indirect greenhouse gas emissions, other than energy indirect GHG emissions, which is a consequence of an organization's activities, but arises from greenhouse gas sources that are owned or controlled by other organizations such as from imported kiln stone.

This European Standard is to be used in conjunction with EN 19694-1, which contains generic, overall requirements, definitions and rules applicable to the determination of GHG emissions for all energy-intensive sectors, provides common methodological issues and defines the details for applying the rules. The application of this standard to the sector-specific standards ensures accuracy, precision and reproducibility of the results and is for this reason a normative reference standard.

Together these standards provide a harmonized method for:

a) measuring, testing and quantifying methods for GHG emissions;

b) assessing the level of GHG emissions performance of production processes over time, at production sites;

c) establishment and provision of reliable, accurate and quality information for reporting and verification purposes.

GHG emissions offset mechanisms, including but not limited to voluntary offset schemes or nationally or internationally recognized offset mechanisms, shall not be used at any point in the GHG assessment according to this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 459-2, *Building lime — Part 2: Test methods*

EN 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

EN 12485, *Chemicals used for treatment of water intended for human consumption — Calcium carbonate, high-calcium lime, half-burnt dolomite, magnesium oxide and calcium magnesium carbonate — Test methods*

EN 13639, *Determination of total organic carbon in limestone*

EN 15442, *Solid recovered fuels — Methods for sampling*

EN 19694-1:2016, *Stationary source emissions — Determination of greenhouse gas (GHG) emissions in energy-intensive industries — Part 1: General aspects*

ISO 5069-1, *Brown coals and lignites — Principles of sampling — Part 1: Sampling for determination of moisture content and for general analysis*

ISO 13909 (all parts), *Hard coal and coke — Mechanical sampling*

ISO 18283, *Hard coal and coke — Manual sampling*

ISO 14064-1, *Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 19694-1 and the following apply.

3.1
activity data
information on material flow, consumption of fuel, input material or production output

Note 1 to entry: Expressed as energy [GJ] or as mass or volume [t or m^3_N] in the case of fuels and mass or volume in the case of raw materials or products [t or m^3_N].

3.2
dolime
product resulting from the calcination of kiln stone consisting of calcium carbonate and magnesium carbonate

3.3
downstream lime product
downstream lime products including Run-Of-Kiln lime (ROK), Lime Kiln Dust (LKD) and products made from them at the plant including ground lime and hydrated lime

3.4
free CaO and MgO
calcium oxide or magnesium oxide that has been produced in the kiln during the decarbonation of calcium carbonate or magnesium carbonate

Note 1 to entry: The terminology free CaO and MgO as used in this standard may differ from the terminology applied in other standards.

3.5
kiln battery
group of kilns at the same plant and of the same design

EXAMPLE Parallel Flow Regenerative Kilns, Annular Shaft Kilns, Mixed Feed Shaft Kilns, Preheater Rotary Kilns or Long Rotary Kilns

3.6
kiln stone
limestone that is fed into the kiln

3.7
lime
LI
generic name for quicklime, dolime or sintered dolime

3.8
lime kiln dust
LKD
partly calcined kiln stone material which is extracted by the kiln particulate abatement system

3.9
limestone
LS
sedimentary rock consisting of calcium carbonate ($CaCO_3$), magnesium carbonate ($MgCO_3$), mineral and other minor impurities, including in some cases a small fraction of organic carbon

3.10
non kiln stone aggregates
all stones extracted from a quarry except that used as kiln stone

3.11
quicklime
product resulting from the calcination of limestone consisting primarily of calcium carbonate

3.12
residual CO_2
CO_2 that remains in the product leaving the kiln which is bound with CaO in the form of $CaCO_3$ and possibly with MgO in form of $MgCO_3$

3.13
run-of-kiln lime
ROK
direct output from the kiln

3.14
sintered dolime
dolime heated to temperatures below its melting temperature, so as to increase its density

4 Symbols and abbreviations

$m_{CO2-stack}$	mass of CO_2 emitted through the stack	t
$\bar{x}$	arithmetic mean of the measured values	
$CaCO_{3\ LI-ROK}$	weight fraction of calcium carbonate in the dry ROK lime produced by the kiln	
$CaCO_{3\ LKD}$	weight fraction of calcium carbonate in the dry LKD	
$CaCO_{3\ LS}$	weight fraction of calcium carbonate in the dry limestone fed into the kiln	
CaO_{fr}	free *CaO*	
CaO_{LI-ROK}	weight fraction of free calcium oxide in the dry ROK lime produced by the kiln	
CaO_{LKD}	weight fraction of free calcium oxide in the dry LKD	
CaO_t	total *CaO*	
CV_{Fy}	calorific value of the fuel (y). It is important to note that the applied calorific value always has to match the status of the fuel, especially with respect to the correct moisture content during its weighing (e.g. raw coal or dried coal)	GJ/t or GJ/m3N
d_i	the transport distance of the kiln stone for the mode i	
EF_{LI}	emission factor of the ROK lime, here the CO_2 emissions resulting from the calcination of the limestone factor per mass of ROK lime	CO_{2e} / t
EF_{LS}	emission factor of the limestone, here the CO_2 emissions resulting from the calcination of the limestone factor per mass of limestone	CO_{2e} / t
EF_{ELEC}	emission factor of externally generated electricity	(CO_{2e} / kWh)
EF_{Fy}	emission factor of the fuel (y) expressed as (combustion emissions)	t_{CO2e}/GJ
$EF_{LS-PUR\ i}$	the greenhouse gas emission factor of imported kiln stone	
LI	lime	
LKD	lime kiln dust	
LS	limestone	
m_{LI-ROK}	dry mass of ROK lime	t
m_{LKD}	dry mass of LKD generated by the process	t
m_{LS}	dry mass of limestone fed into the kiln or kiln battery	t
M_{MgCO3}	molar mass of magnesium carbonate	84,314 g/mol
M_{MgO}	molar mass of magnesium oxide	40,304 g/mol

M_{CaCO3}	molar mass of calcium carbonate	100,087 g/mol
M_{CaO}	molar mass of calcium oxide	56,077 g/mol
M_{CO2}	molar mass of carbon dioxide	44,010 g/mol
m_{Fy}	material flow of a fuel (y), i.e. the fuel consumption expressed as mass for solid and liquid fuels or as volume for gaseous fuels	t or m^3_N
$MgCO_{3\ LI\text{-}ROK}$	weight fraction of magnesium carbonate in the dry ROK lime produced by the kiln. In practice, this mass fraction can be considered as close to 0 as the magnesium carbonate is fully converted to magnesium oxide due to the temperatures prevailing in the kiln	
$MgCO_{3\ LKD}$	weight fraction of magnesium carbonate in the dry LKD	
$MgCO_{3\ LS}$	weight fraction of magnesium carbonate in the dry limestone fed into the kiln	
$MgO_{\ LI\text{-}ROK}$	weight fraction of free magnesium oxide in the dry ROK lime produced by the kiln	
$MgO_{\ LKD}$	weight fraction of free magnesium oxide in the dry LKD	
MgO_{fr}		
m_i	the mass of load i	t
$m_{LI\text{-}Prod}$	measured mass of downstream lime product	
$m_{LKD\text{-}out}$	dry mass of LKD that is not blended with the downstream lime	t
$m_{LS\text{-}PUR\ i}$	the annual total (wet) mass of imported kiln stone from the third party that is imported into the plant and used for lime manufacture during the 12 month reporting period	t
Ox_{Fy}	oxidation factor of the fuel (y)	
Q_{ELEC}	quantity of electricity consumed	
ROK	run of kiln	
t	metric tonne	t
t_e	tonnes of aggregates used for the production of fillers	t_e
$TF_{LS\text{-}PUR}$	emission factor per wet mass for kiln stone imported	$kgCO_2/t$
$TF_{LS\text{-}PUR\ i}$	the GHG emission factor of transport mode i	
t_{gt}	a given period of time	t_{gt}
$TOC_{\ LS}$	total organic carbon content of the limestone	
Ua	uncertainty associated with the overall analytical procedure	
U_i	relative expanded uncertainty	
Um	uncertainty associated with the sampling procedure	
Umi	uncertainty of the weighbridge for measurement of load I	
Umtotal	total relative uncertainty of the mass measurement	
w	average moisture content of the kiln stone determined according to the provisions of 9.2.2.3	

x_i absolute amount of mass flow or material in stock in the mass balance

y fuel consumed

η_{LI} mass flow of LKD generated in the dedusting system(s) of the kiln divided by the mass flow of ROK lime produced by the kiln

η_{LS} mass flow of LKD generated in the dedusting system(s) of the kiln divided by the dry mass flow of limestone fed into the kiln

5 Introduction

5.1 Overview of the lime manufacturing process

Lime manufacture includes three main process steps: 1

a) kiln stone preparation including quarrying, crushing, washing, screening and transporting to the lime kiln;

b) kiln operation including lime manufacture using pyro-processing to calcine the kiln stone in a lime kiln;

c) downstream processing including crushing, screening, transporting to silos, grinding/milling, hydrating and packing.

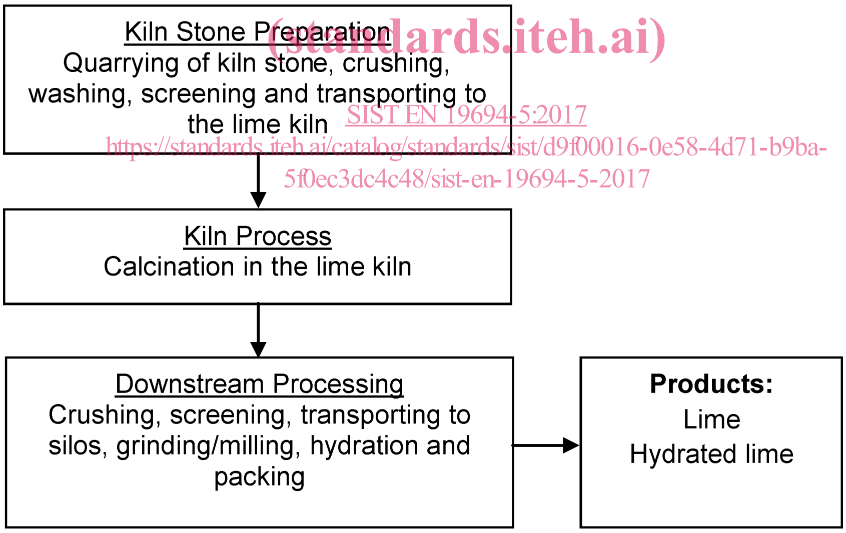

Figure 1 — Process steps in lime manufacture

A lime manufacturing plant may also encompass the use of additional fuel for on-site power generation and for preparation or processing of fuels for use in the plant.

There are two main sources of direct greenhouse gas emissions in the lime manufacturing process:

— calcination of kiln stone through pyro-processing in the lime kiln (known as process emissions);

— combustion of kiln fuels (known as combustion emissions).

These two sources are described in more detail below.

Other minor direct greenhouse gas emissions may come from non-kiln fuels such as on-site transport, pumps, room heating and other on-site uses.

The main source of energy indirect greenhouse gas emissions in the lime manufacturing process come from external power production or transport but these sources are relatively small in comparison to the direct greenhouse gas emissions.

For the lime sector, only the greenhouse gas CO_2 is relevant as demonstrated by different field tests. Details about these tests are provided in Annex A.

5.2 Direct greenhouse gas emissions from calcination of kiln stone (process emissions)

In the lime manufacturing process, CO_2 is released due to the chemical decomposition of calcium, magnesium and other carbonates in the kiln stone when the kiln stone is heated to high temperatures:

$$CaCO_3 \rightarrow CaO + CO_2 \quad (1)$$

$$MgCO_3 \rightarrow MgO + CO_2 \quad (2)$$

This process is called "calcining" or "calcination". It results in direct emissions of CO_2 through the kiln stack. When considering CO_2 emissions due to calcination, two components can be distinguished:

— CO_2 from kiln stone used for lime production;

— CO_2 from materials leaving the kiln system as partly calcined LKD.

The CO_2 from lime production is dependent on the quality of the final lime product, i.e. the degree of calcination. This varies depending on the kiln design and targeted final lime product properties. The amount of LKD leaving the kiln system varies with kiln type. The associated greenhouse gas emissions are likely to be relevant and so shall be accounted for.

CO_2 emissions from calcination can be determined as a part of the measurement method or by using the following mass-balance-based methods which are in principle equivalent:

a) the Input Method, based on the mass of kiln stone entering the kiln and chemical composition of the limestone, lime and LKD leaving the kiln system;

b) the Output Method, based on the mass and chemical composition of the lime and LKD leaving the kiln system;

c) direct greenhouse gas emissions from organic carbon in kiln stone.

Some kiln stone sources contain a small fraction of organic carbon, which can be expressed as total organic carbon (TOC) content. Organic carbon in the kiln stone is converted to CO_2 during pyro-processing. The contribution of this component to the overall CO_2 emissions is typically very small. The organic carbon content of kiln stone can, however, vary substantially between locations and shall be assessed.

5.3 Direct greenhouse gas emissions from fuels for kiln operation (combustion emissions)

The lime industry uses various fossil fuels to heat the kiln, including natural gas, coal and fuel oil. In recent years, fuels derived from waste materials have become important substitutes. These alternative fuels (AF) include fossil fuel-derived fractions, such as waste oil, as well as biomass-derived fractions, such as waste wood. Furthermore, fuels are increasingly used which contain both fossil and biogenic carbon, such as municipal and pre-treated industrial wastes or waste tyres (containing natural and synthetic rubber).

Both traditional and AF result in direct greenhouse gas emissions through the kiln stack. However, biomass fuels and the biomass component of mixed fuels are considered “climate-neutral” in accordance with IPCC definitions.

Greenhouse gas emissions from combustion of fuels can be calculated based on the mass, calorific value and chemical composition of fuels entering the kiln.

The mass-balance-based method used in this standard is compatible with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories issued by the Intergovernmental Panel on Climate Change (IPCC).

Alternatively, kiln GHG emissions, from combustion, calcination and organic carbon in the kiln stone, can be determined by direct measurement at the kiln stack using the stack-measurement-based method. Emissions from the kiln stack all sources are determined based on continuous measurement of the concentration of the relevant GHG in the flue gas and of the flue gas volume flow. For the stack-measurement-based method non-kiln emissions are measured using a mass balance approach similar to the mass-balance-based method. Direct greenhouse gas emissions from non-kiln fuels (combustion emissions)

Greenhouse gas emissions from use of fuels in non-kiln applications which are part of the lime manufacturing plant, such as on-site transport, fuel heating, and room heating are determined in a similar way to the greenhouse gas from fuels for kiln operation.

5.4 Energy indirect greenhouse gas emissions

In lime manufacture the main energy indirect greenhouse gas emission source is electricity purchased by the plant but generated off-site. Where kiln stone is imported to the plant, the emissions associated with its manufacture to the plant shall be included within the scope of this standard. The emissions associated with the off-site transport of purchased kiln stone to the plant may be included within the scope of this standard.

6 System boundaries

6.1 Appropriate boundaries to distinguish

The reporting entity shall define appropriate boundaries in line with ISO 14064-1 which distinguishes between organizational and operational boundaries.

6.2 Organizational boundaries

Organizational boundaries define which parts of an organization – for example wholly owned operations, joint ventures and subsidiaries – are covered by an inventory, and how the emissions of these entities are consolidated.

The rules for defining organizational boundaries in EN 19694-1 shall be applied.

In particular, the lime industry shall include the following types of activities:

— kiln stone preparation including quarrying, crushing, washing, screening and transporting to the lime kiln;

— calcination in the lime kiln;

— downstream processing including crushing, screening, transporting to silos, grinding/milling, hydrating and packing;

— fuel use for on-site power generation or heat;

— preparation or processing of fuels in own installations.

6.3 Operational boundaries

6.3.1 Scopes of emissions to be included

Operational boundaries define the types of sources of emissions covered by this standard.

The requirements for defining the scopes of emissions in EN 19694-1 shall be applied.

Subject to the limitations set out in 6.4 below, the following greenhouse gas emissions sources shall be measured for lime manufacturing plant facilities:

— all direct greenhouse gas emissions (direct emissions) from greenhouse gas sources owned or controlled by the organization;

— all energy indirect greenhouse gas emissions (indirect emissions) from the generation of imported electricity, heat or steam consumed by the organization;

— other indirect greenhouse gas emissions (other indirect emissions) from the production and transportation of imported kiln stone.

Each lime plant shall undertake an assessment of its direct greenhouse gas emission sources, energy indirect greenhouse gas emission sources and, where relevant, other indirect greenhouse gas emission sources. The assessment shall include GHG emissions from all stages of the lime manufacturing process undertaken at the plant including kiln stone preparation, calcination and downstream processing of the lime products such as into ground lime or hydrated lime. Where kiln stone is imported into the site, GHG emissions from its production shall be included for use in performance assessments.

By way of example, but not restricted to, the following greenhouse gas emissions as shown in Table 1 are relevant for a typical lime manufacturing plant:

Table 1 — Relevant GHG emissions for a lime manufacturing plant

	Scope	Process steps
Kiln stone preparation	direct greenhouse gas emissions	Direct greenhouse gas emissions including extraction, quarry operations, transport to stone processing plant, processing (washing, crushing, screening), transport to the lime kiln
	energy indirect greenhouse gas emissions	Indirect greenhouse gas emissions including extraction, quarry operations including quarry dewatering, transport to stone processing plant, processing (washing, crushing, screening), transport to the lime kiln
	other indirect greenhouse gas emissions	Includes imported kiln stone extraction, quarry operations including quarry dewatering, transport to stone processing plant, processing (washing, crushing, screening), transport to the lime kiln
Kiln process	direct greenhouse gas emissions	Direct greenhouse gas emissions from the manufacture of lime
		Direct greenhouse gas emissions from the production of LKD
		Direct greenhouse gas emissions from the combustion of fossil fuels
	energy indirect greenhouse gas emissions	Indirect greenhouse gas emissions from kiln operation and infrastructure
Downstream processing	direct greenhouse gas emissions	Includes transport to silos, grinding/milling, hydrating or packing
	energy indirect greenhouse gas emissions	Includes transport to silos, grinding/milling, hydrating or packing

It is not necessary to include the following greenhouse gas emissions as these are deemed to be insignificant or out of scope:

— greenhouse gas emissions from overburden removal in the quarry;