

ACM0019 v02.0

N₂O abatament from nitric acid production

“Catalytic N₂O destruction project at the new nitric acid
plant PANNA 4 of Enaex S.A.”

Calculation Tool

for ex-ante estimation of Emission Reductions

POST REGISTRATION CHANGE FROM 19/03/2013 ONWARDS

(ER from 19/12/2011 - 18/03/2013 are verified, issued ER acc. to ACM0019 v01.0
ER from 19/03/2013 onwards are estimated ER acc. to ACM0019 v02.0)

Sectoral Scope: 05

EB 73

Confidential Information

Input data & N₂O outlet concentration calculation (ex-ante estimation)

Input Data	PANNA 4		Sources
Designed capacity	MTPD	925	Operation manual Project Panna 4
Designed annual capacity	t HNO ₃ /a	323,750	Calculated
Operating Days Forecast	d/a	350	Production plan 2014, Operation manual Project Panna 4
Tail gas mass flow rate (actual conditions)	kg/h	153,705	Mass balance (based on 925 tHNO ₃ /d)
Density tail gas	kg/m ³	0.845	Mass balance
Tail gas volume flow rate (actual conditions)	m ³ dry gas / h	181,899	Calculated; Parameter is considered to be dry.
Efficiency Technology	%	94%	Technical details for HERAEUS secondary catalyst system
P _t - Pressure at measuring point (AMS)	bar	1.00	Monitoring Period 1 (average value)
T _t - Temperature at measuring point (AMS)	°C	116.54	Monitoring Period 1 (average value)
R _u - Universal ideal gas constant	Pa.m ³ / kmol.K	8,314	Tool to determine the mass flow of a greenhouse gas in a gaseous stream v2
MM _i - Molecular mass of greenhouse gas i (N ₂ O)	kg / kmol	44.02	Tool to determine the mass flow of a greenhouse gas in a gaseous stream v2
N ₂ O concentration <u>before</u> abatement	ppmv	1,200	Operation manual Project Panna 4
N ₂ O concentration <u>after</u> abatement	ppmv	72	Calculated
GWP N ₂ O (valid from 01/01/2013 onwards)		298	Relevant decisions by the CMP
GWP N ₂ O (valid until 31/12/2012)		310	Relevant decisions by the CMP

Please note:

Ex-ante estimation of emission reductions was done for the period from 19/03/2013 onwards only, since from then onwards methodology ACM0019 v02.0 was applied. Values of ER before that date are real emission reductions (already generated, verified and issued during Monitoring Periods # 1 - 4 of CDM project).

Mass flow of greenhous gas i in the gaseous stream in time interval t (kg gas/h)

		OPTION A			
Parameter <i>"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" v2</i>		$F_{N2O,tail\ gas,h} = F_{i,t}$	$\rho_{i,t}$	$V_{t,db}$	$v_{i,t,db}$
Formula / TAG Number		Mass flow of N ₂ O in the gaseous stream of the tail gas in the hour h	Density of greenhouse gas <i>i</i> in the gaseous stream in time interval <i>t</i>	Volumetric flow of the gaseous stream in time interval <i>t</i> on a dry basis	Volumetric fraction of greenhouse gas <i>i</i> in the gaseous stream in a time interval <i>t</i> on a dry basis
Unit		(5) $F_{i,t} = V_{t,db} \times v_{i,t,db} \times \rho_{i,t}$	(6) $\rho_{i,t} = P_t \times MM_i / (R_u \times T_t)$		
		kg N ₂ O/h	kg gas <i>i</i> / m ³ gas <i>i</i>	m ³ dry gas / h	m ³ gas <i>i</i> / m ³ dry gas
year 0	2011	15.01	1.404	179,813	5.11E-05
year 1	2012	65.80	1.400	169,319	2.43E-04
year 2	01/01/ - 18/03/2013	62.98	1.408	166,772	2.25E-04
	19/03/ - 31/12/2013	17.87	1.364	181,899	7.20E-05
year 3	2014	17.87	1.364	181,899	7.20E-05
year 4	2015	17.87	1.364	181,899	7.20E-05
year 5	2016	17.87	1.364	181,899	7.20E-05
year 6	2017	17.87	1.364	181,899	7.20E-05
year 7	2018	17.87	1.364	181,899	7.20E-05
year 8	2019	17.87	1.364	181,899	7.20E-05
year 9	2020	17.87	1.364	181,899	7.20E-05
year 10	2021	17.87	1.364	181,899	7.20E-05
Crediting period					

Moisture content of gaseous stream at normal conditions in time interval t

Moisture content will be determined by measurement according to USEPA CF42 method.
Option A of the tool can be applied, if the moisture content is less than 0.05 kg H₂O/m³ dry gas.

Measurement	
Date of measurements	24.09. - 25.09.2012
Report Type	AST Report 2012
Highest measured value	0.0036 kg H ₂ O/m ³ dry gas
Threshold value	0.0500 kg H ₂ O/m ³ dry gas
Check if Option A is valid	TRUE

Measurement	
Date of measurements	23.10 - 25.10.2013
Report Type	QAL2/AST Report 2013
Highest measured value	0.0028 kg H ₂ O/m ³ dry gas
Threshold value	0.0500 kg H ₂ O/m ³ dry gas
Check if Option A is valid	TRUE

Baseline N₂O emission factor for nitric acid production in year y

	Emission factor
Year	(kg N ₂ O/t HNO ₃)
2005	5.10
2006	4.90
2007	4.70
2008	4.60
2009	4.40
2010	4.20
2011	4.10
2012	3.90
2013	3.70
2014	3.50
2015	3.40
2016	3.20
2017	3.00
2018	2.80
2019	2.70
2020	2.50
2021	2.50
2022	2.50
2023	2.50
...	...
Year n	2.50