2.B.2 - Nitric Acid Production

Short description

Category Code	**Method**				**AD**				**EF**					
2.B.2	T2				PS				D					
	NO_x	**NMVOC**	**SO_2**	**NH_3**	**$PM_{2.5}$**	**PM_{10}**	**TSP**	**BC**	**CO**	**Pb**	**Cd**	**Hg**	**Diox**	**PAH**	**HCB**
Key Category:	-/-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

T = key source by Trend **L** = key source by Level

Methods	
D	Default
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/EEA Emission Inventory Guidebook - 2019, in the group specific chapters.	

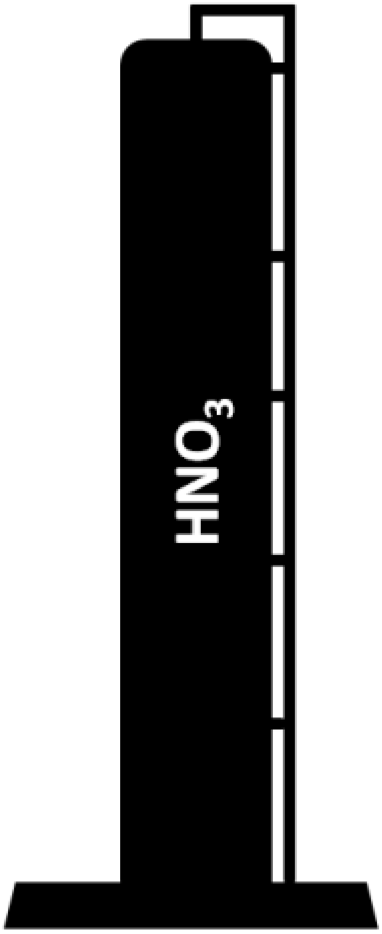
AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
As	Associations, business organisations
Q	specific Questionnaires (or surveys)
M	Model / Modelled
C	Confidential

EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data
M	Model / Modelled

During the production of nitric acid (HNO_3), nitrogen oxide is produced unintentionally in a secondary reaction during the catalytic oxidation of ammonia (NH_3). HNO_3 production occurs in two process stages:

- Oxidation of NH_3 to NO and
- Conversion of NO to NO_2 and absorption in H_2O.

Details of the process are outlined below:



Catalytic oxidation of ammonia

A mixture of ammonia and air at a ratio of 1:9 is oxidised, in the presence of a platinum catalyst alloyed with rhodium and/or palladium, at a temperature of between 800 and 950 °C. The reaction according to the Oswald process is as follows:

$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

Simultaneously, nitrogen, nitrous oxide and water are formed by the following undesired secondary reactions:

$4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$

$4\ NH_3 + 4\ O_2 \rightarrow 2\ N_2O + 6\ H_2O$

All three oxidation reactions are exothermic. Heat may be recovered to produce steam for the process and for export to other plants and/or to preheat the residual gas. The reaction water is condensed in a cooling condenser, during the cooling of the reaction gases, and is then conveyed into the absorption column.

Method

In Germany, there are currently nine nitric acid plants.

Activity data

As this source category is a key category for N_2O, plant specific activity data is collected here according to the IPCC guidelines.

This data is made available basically via a co-operation agreement with the nitric acid producers and the IVA (Industrieverband Agrar). As the data provided by the producers has to be treated as confidential, it is anonymised by the IVA before submitting it to the UBA. However, one producer is delivering its data directly to the UBA. After checking this specific data, it is merged with that provided by the IVA.

According to the IVA, catalytic reduction is used as an abatement method in some of the plants.

Emission factors

Different T2 default NO_x emission factors based on different technology types and abatement systems are used from the EEA Emission Inventory Guidebook 2019 (EF for medium and high pressure processes and for catalytic reduction of low, medium and high pressure process)[1)]. The applied emissions factors are listed in **Table 1**.

Table 1: Tier 2 emission factor of NOx for source category 2.B.2 Nitric acid production

Emission factor (kg/t)	Process
7.5	medium pressure process
3	high pressure process
0.4	low, medium and high pressure process, catalytic reduction

Recalculations

With emission factors revised for each plant, recalculations of NOx have been carried out compared to last year's submission. So far a T1 method with a T1 Default EF was used. With the sabmissionsubmission 2022 a T2 method is applied with T2 EFs. The total emissions from 1990 to 2019 for the latest two submissions and their difference are listed in **Table 2**.

Table 2: NOx emissions from nitric acid production

	Submission 2022	Submission 2021	Difference
Year	**NO_x emission (in kt)**	**NO_x emission (in kt)**	**NO_x emission (in kt)**
1990	11.30	16.98	5.68
1991	10.40	15.60	5.20
1992	10.08	14.76	4.69
1993	9.60	14.76	5.17
1994	9.45	14.59	5.14
1995	10.33	16.25	5.91
1996	10.65	16.60	5.95
1997	10.50	16.33	5.83
1998	10.55	16.54	5.99
1999	10.94	17.40	6.46
2000	11.93	19.23	7.30
2001	11.24	18.07	6.83
2002	14.05	21.12	7.07
2003	14.67	22.49	7.82
2004	17.59	25.99	8.40
2005	17.92	26.34	8.43
2006	18.26	26.95	8.69
2007	14.28	28.79	14.50
2008	12.91	26.30	13.39
2009	2.78	22.58	19.81
2010	1.01	25.25	24.24
2011	0.99	24.85	23.85
2012	1.00	24.90	23.90
2013	1.03	25.72	24.69
2014	1.04	26.01	24.97
2015	1.01	25.22	24.21
2016	1.02	25.41	24.39
2017	1.08	27.11	26.03
2018	1.07	26.69	25.62

	Submission 2022	Submission 2021	Difference
Year	**NO_x emission (in kt)**	**NO_x emission (in kt)**	**NO_x emission (in kt)**
2019	1.07	26.69	25.62

For **pollutant-specific information on recalculated emission estimates for Base Year and 2019**, please see the pollutant specific recalculation tables following chapter 8.1 - Recalculations.

Planned improvements

No category-specific improvements are planned.

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[1] EEA, Oct 2019: : EMEP/EEA air pollutant emission inventory guidebook 2019, Part B: sectoral guidance chapters, 2.B Chemical industry: pp.21-23, Table 3.11, Table 3.12 and Table 3.14.