

## 2.B.2 - Nitric Acid Production

### Short description

| Category Code | Method          |                 |                 |        |    | AD |    |    |    |      | EF  |     |     |                  |                   |
|---------------|-----------------|-----------------|-----------------|--------|----|----|----|----|----|------|-----|-----|-----|------------------|-------------------|
| 2.B.2         | T2              |                 |                 |        |    | PS |    |    |    |      | D   |     |     |                  |                   |
| Key Category  | SO <sub>2</sub> | NO <sub>x</sub> | NH <sub>3</sub> | NM VOC | CO | BC | Pb | Hg | Cd | Diox | PAH | HCB | TSP | PM <sub>10</sub> | PM <sub>2.5</sub> |
| 2.B.2         | -               | L/-             | -               | -      | -  | -  | -  | -  | -  | -    | -   | -   | -   | -                | -                 |

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

| Methods   |                                 |
|-----------|---------------------------------|
| <b>D</b>  | Default                         |
| <b>T1</b> | Tier 1 / Simple Methodology *   |
| <b>T2</b> | Tier 2*                         |
| <b>T3</b> | Tier 3 / Detailed Methodology * |
| <b>C</b>  | CORINAIR                        |
| <b>CS</b> | Country Specific                |
| <b>M</b>  | Model                           |

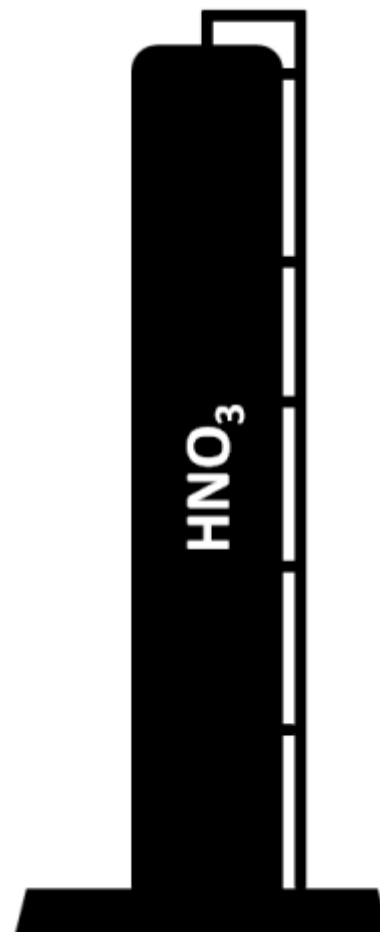
\* as described in the EMEP/EEA Emission Inventory Guidebook - 2019, in the group specific chapters.

| AD - Data Source for Activity Data |                                      |
|------------------------------------|--------------------------------------|
| <b>NS</b>                          | National Statistics                  |
| <b>RS</b>                          | Regional Statistics                  |
| <b>IS</b>                          | International Statistics             |
| <b>PS</b>                          | Plant Specific data                  |
| <b>As</b>                          | Associations, business organisations |
| <b>Q</b>                           | specific Questionnaires (or surveys) |
| <b>M</b>                           | Model / Modelled                     |
| <b>C</b>                           | Confidential                         |
| EF - Emission Factors              |                                      |
| <b>D</b>                           | Default (EMEP Guidebook)             |
| <b>C</b>                           | Confidential                         |
| <b>CS</b>                          | Country Specific                     |
| <b>PS</b>                          | Plant Specific data                  |
| <b>M</b>                           | Model / Modelled                     |

During the production of nitric acid (HNO<sub>3</sub>), nitrogen oxide is produced unintentionally in a secondary reaction during the catalytic oxidation of ammonia (NH<sub>3</sub>). HNO<sub>3</sub> production occurs in two process stages:

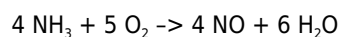
- Oxidation of NH<sub>3</sub> to NO and
- Conversion of NO to NO<sub>2</sub> and absorption in H<sub>2</sub>O.

Details of the process are outlined below:

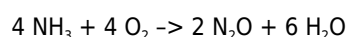
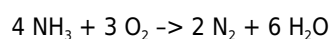


### Catalytic oxidation of ammonia

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:



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



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 seven nitric acid plants.

### Activity data

As this source category is a key category for N<sub>2</sub>O, 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<sub>x</sub> 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<sup>1)</sup>). The applied emissions factors are listed in Table 1.

**Table 1:** Tier 2 emission factor of NO<sub>x</sub> 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 NO<sub>x</sub> have been carried out compared to last year's submission. So far a T1 method with a T1 Default EF was used. With the submission 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:** NO<sub>x</sub> emissions from nitric acid production

|      | Submission 2022                  | Submission 2021                  | Difference                       |
|------|----------------------------------|----------------------------------|----------------------------------|
| Year | NO <sub>x</sub> emission (in kt) | NO <sub>x</sub> emission (in kt) | NO <sub>x</sub> 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 <sub>x</sub> emission (in kt) | NO <sub>x</sub> emission (in kt) | NO <sub>x</sub> emission (in kt) |
| 2019 | 1.07                             | 26.69                            | 25.62                            |



For pollutant-specific information on recalculated emission estimates for Base Year and 2018, please see the pollutant specific recalculation tables following [chapter 8.1 - Recalculations](#).

## Planned improvements

No category-specific improvements are planned.

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<sup>1)</sup> 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.