

# HANDBOOK OF EMISSIONFACTORS

5.9 Nitric Acid

BR chapt. 4 Ref. 15

Note: This is a reference cited in AP 42, *Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at [www.epa.gov/ttn/chief/ap42/](http://www.epa.gov/ttn/chief/ap42/)

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02\_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

INDUSTRA



MINISTRY OF HOUSING,  
PHYSICAL PLANNING AND  
ENVIRONMENT

6

Anon.

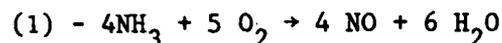
Atmospheric Emissions from Hydrochloric Acid Manufacturing Processes  
Air Pollution Series. AP 54

Public Health Service, National Air Pollution Control Administration  
1969

## 7.5 Nitric-acid plant

### 7.5.1 Process description

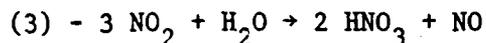
The manufacture of nitric acid ( $\text{HNO}_3$ ) from ammonia ( $\text{NH}_3$ ) proceeds in three steps:



By choosing the proper catalyst (platinum-rhodium catalyst), the proper temperature and a high gas velocity, side reactions producing nitrogen are suppressed



The oxidation of NO with air is effected under pressure (3-8 bar), which increases the rate of oxidation of NO.



On increasing the concentration of  $\text{NO}_2$ , dimerisation of  $\text{NO}_2$  to  $\text{N}_2\text{O}_4$  takes place, which increases the production of  $\text{NO}_2$  from NO.

Oxidation converts  $\text{N}_2\text{O}_4$  into  $\text{N}_2\text{O}_5$ , the anhydride of nitric acid.

The final product is a 57%  $\text{HNO}_3$ -solution, which is sufficiently concentrated to be used for the manufacture of ammonium nitrate (c.f. section 8.4).

Dehydrating agents such as sulphuric acid or magnesium sulphate are required for the production of highly concentrated nitric acid.

Direct manufacture of 98% nitric acid is possible by effecting the absorption of  $\text{NO}_2$  and  $\text{O}_2$  in water at a pressure of approx 50 atm.

7.5.2 Emissions

Emissions from nitric acid manufacture consist primarily of nitric oxide (NO), and nitrogen dioxide (NO<sub>2</sub>). The main source of emissions is the tail gas from the absorption tower. To reduce these emissions the two techniques most commonly applied are catalytic reduction and extended absorption.

In the catalytic reduction process tail gases are heated to ignition temperature, mixed with a reducing agent (hydrogen, natural gas, carbon monoxide, etc), and passed over a catalyst. By this process the nitrogen oxides are reduced to nitrogen.

The extending absorption technique reduces emissions by higher pressures, in this way increasing the efficiency of the absorption in the absorption tower.

Because ammonia is the base material for nitric-acid production, there is a slight emission of ammonia.

7.5.3 Emission factors

Table 50 gives the emission factors for the manufacture of nitric acid.

TABLE 50 (kg/ton of nitric acid 100%)

|   | NO <sub>x</sub> | lb/ton  | NH <sub>3</sub> | lb/ton   |
|---|-----------------|---------|-----------------|----------|
| Tail gas, uncontrolled                  | 9-18            | 20-40   | 0.01-0.1        | 0.02-0.2 |
| with catalytic reduction<br>of tail gas | 0.1-0.9         | 0.2-2.0 | 0.01-0.1        | 0.02-0.2 |
| extended absorption by<br>high pressure | 0.3-1.2         | 0.7-2.6 | 0.01-0.1        | 0.02-0.2 |

Remark: In the process demineralised water is used. During regeneration of the ion exchangers NaCl is emitted to water.

#### 7.5.4 Source

The data are based on the results of measurements carried out in some nitric-acid plants.

#### 7.5.5 References

1

Vatavuk, W

Nitric acid

Compilation of Air Pollutant Emission Factors AP 42, 3rd ed., 5.9-1  
U.S. Environmental Protection Agency

2

Kirk, R.E., D.F. Othmer

Encyclopedia of Chemical Technology, Vol. 9, 333-336 (1952)

The Interscience Encyclopedia Inc, New York

3

Toering, W.

Methoden ter vermindering van de NO<sub>x</sub>-emissie van salpeterzuur-  
fabrieken

Polytechnisch Tijdschrift/procestechniek 35(1980), 1, 13-24

4

Anton, P., C. Spanoudakis

Verminderung der NO<sub>x</sub>-Emission bei der Salpetersäureherstellung  
in der Bundesrepublik Deutschland

UFOPLAN Nr. 10403545 (1.2.1978)

Umweltbundesamt, Bismarckplatz 1, 100 Berlin 33

#### 7.6 Phosphoric-acid plant

##### 7.6.1 Process description

Phosphoric acid can be manufactured in several ways:

- The basic material is a calcium phosphate (apatite) containing fluoride, which is ground thoroughly and subsequently mixed with sulphuric acid:

