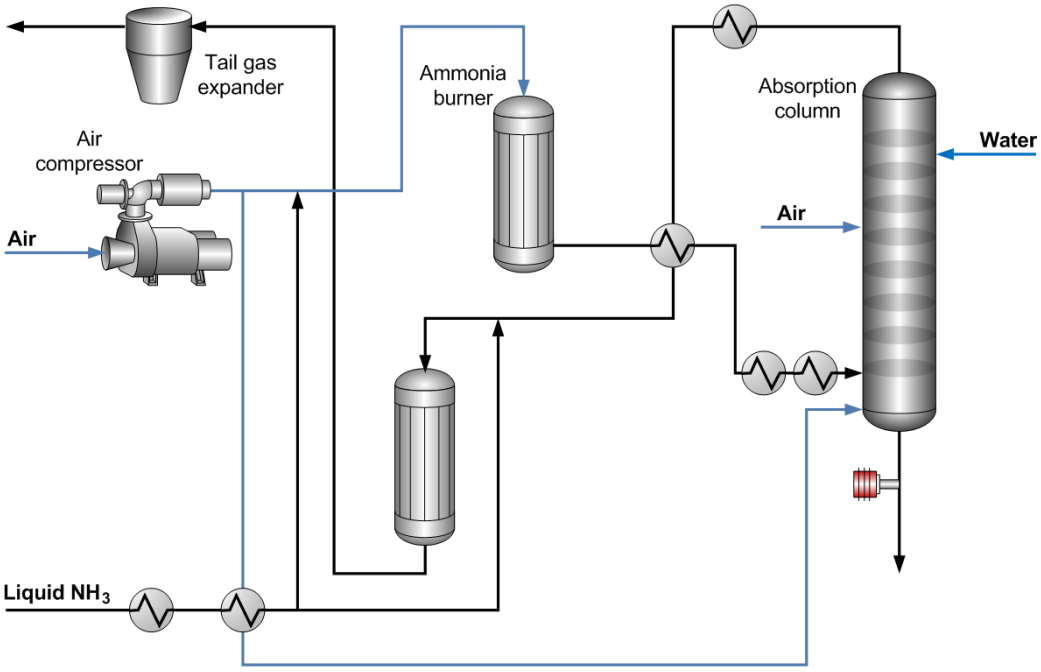
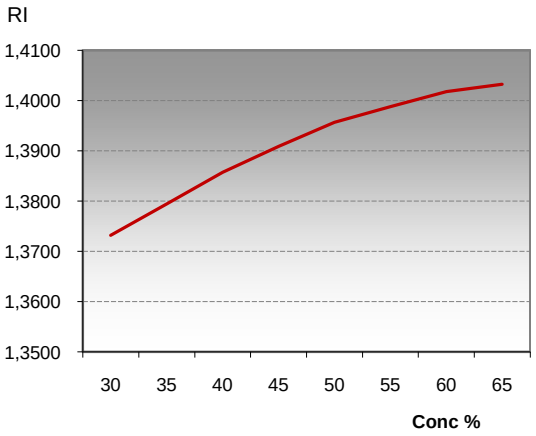


NITRIC ACID, HNO_3

Typical end products

Nitric acid of approx. 60% Conc. by weight

Chemical curve: Nitric acid R.I. per Conc% b.w. at Ref. Temp. of 20˚C



Introduction

Nitric acid (HNO_3), also known as aqua fortis or spirit of nitre, is highly toxic and corrosive.

Approximately 70% of all nitric acid produced is used for the production of ammonium nitrate, which is used in fertilizers. Nitric acid is also a key component in the manufacturing of adipic acid and terephatalic acid. Other applications include explosives, mine leaching and stainless steel pickling.

Application

Nitric acid production, depending on the required final concentration, can be composed of one or two processes.

Much of the nitric acid manufacturing in the world is via the high-temperature catalytic oxidation of ammonia. This process consists of three main steps: ammonia oxidation, nitric oxide oxidation and absorption. Processing can be achieved through single or multiple pressures.

A mixture, composed of a 1:9 ratio of ammonia and air, is oxidized at a temperature close to 760 °C (1400 °F) in a catalytic converter according to the reaction:

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

The most common catalyst is composed of about 90% platinum and 10% rhodium (by weight). The catalyst is formed in the wire gauze and inserted into the converter. The exothermic reaction proceeds to a nitric oxide yield of about 93-98%.

The nitric oxide is cooled (and water condensed) to a temperature of 40 °C (104 °F) or less, at a pressure

upto 7.8 bar (115 psi). The nitric oxide reacts (non-catalytically) with oxygen to form nitrogen dioxide and nitrogen tetroxide via the reaction:

$2\ NO\ +\ O_2 \rightarrow 2\ NO_2\ +\ N_2O_4$

This reaction is highly dependent on both temperature and pressure. Low temperatures and high pressures favor the production of nitrogen dioxide (preferred) over nitrogen tetroxide.

After cooling down, the nitrogen dioxide/nitrogen tetroxide mixture enters an absorption column. The gaseous mixture is introduced to the bottom of the column, while liquid dinitrogen tetroxide and de-ionized water enter from the top. Liquids flow countercurrent to the gases in the system, while the oxidation takes place between the trays while absorption takes place on the trays (usually bubble cap trays). The reaction in the absorption column proceeds by:

$3\ NO_2\ +\ H_2O \rightarrow 2\ HNO_3\ +\ NO$

A second air stream entering the column further oxidizes the NO and removes the NO_2 from the product acid. Acid concentrations leaving the absorption tower are typically between 55-65% by weight.

Installation

The K-Patents In-line Refractometer is mounted in the outlet pipe of the absorber (position 1) to control the absorption process and to get a stable nitric acid value. The PR-23-M should be installed in a by-pass.

When multiple measurements are required, operating two sensors through a single transmitter reduces investment costs.

Instrumentation	Description
	Teflon Body Refractometer PR-23-M. A compact refractometer for chemically aggressive solutions and ultra-pure fine chemical processes. Connected to the process by a G1/2" female or a 1/2" NPT process connection. It has a built-in flow cell designed to keep all metal and other easily corroding parts from coming into contact with the process liquid.
	Saunders Body Refractometer PR-23-W. A heavy-duty refractometer for chemically aggressive liquids in large-scale production and in large pipe sizes (diameter 50, 80 or 100mm/2", 3" or 4"). The Saunders body material is graphite cast iron, which provides a solid mechanical base. A PFA-lining ensures the chemical resistance.
Measurement range:	50-65% Nitric acid. Typical accuracy +/-0,75% by weight.