Nitric acid design with maximum energy recovery optimum for low plant capacities.

STAMI
NITRIC ACID
Mono Pressure Technology

Nitric acid design with maximum energy recovery optimum for low plant capacities.
The challenge
A nitric acid plant design offered for capacities up to 600MTPD (100% HNO₃).

Stamicarbon’s solution
A nitric acid technology with maximum energy recovery, reliable operation and minimal greenhouse gas emissions.

THE PROCESS
The process is operated at 8 bar(a).
Compressed air and NH₃ are mixed and introduced in the ammonia burner. In the ammonia burner, NH₃ is oxidized to NO on Pt/Rh gauzes, small amounts of N₂ and N₂O are formed as side products. The temperature at the gauzes is controlled at optimum.

The produced NO is oxidized to NO₂ in the gas phase of the downstream sections which then will lead to the formation of HNO₃. The heat released by the oxidation reaction is first used to produce high pressure steam and to heat tail gas.

Downstream the waste heat boiler, the nitrous gas is further cooled down in a boiler feed water preheater before entering the cooler condenser. In the cooler condenser, a weak acid solution is condensed and sent to the oxidation/absorption column. The remaining gas enters at the bottom of the oxidation/absorption column which consists of a series of sieve trays.

The acid from the sieve trays is fed to the top of the bleaching trays. In the bleaching trays, located at the bottom of the absorption column, the produced acid is stripped with air to remove traces of NOx and so, obtaining a colorless nitric acid solution of about 58-63% wt.

The overhead vapor of the absorption/oxidation column, so-called tail gas, still contains traces of NOₓ and N₂O. To remove these to an acceptable level the tail gas is heated to about 480°C and introduced into a tertiary abatement system. In this system two catalyst beds are installed where subsequently N₂O and NOₓ are converted to water and nitrogen.

The tail gas is expanded in the expansion turbine where the in-line compressor train configuration allows the usage of the released power to drive the air compressor. Additional power needed is provided by a steam turbine or electromotor.

After expansion, the heat content of the tail gas stream is still sufficient to allow another heat exchanging step, reducing the temperature of the tail gas released to the atmosphere.

Benefits
- N₂O decomposition is favored by high tail gas temperature and takes place without the addition of an external agent like natural gas.
- Maximum energy recovery:
  - Extra power generation in the expansion turbine.
  - Additional heat recovery step before releasing the tail gas to atmosphere.
- Corrosion prevention design.
Consumption Figures

<table>
<thead>
<tr>
<th>Operating range</th>
<th>%</th>
<th>70-110</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₃ consumption</td>
<td>kg/ton 100% HNO₃</td>
<td>284-286</td>
</tr>
<tr>
<td>Pt losses (incl. recovery)</td>
<td>g/ton 100% HNO₃</td>
<td>0,035</td>
</tr>
<tr>
<td>HP steam export, 45bar, 450°C</td>
<td>kg/ton 100% HNO₃</td>
<td>&gt; 600</td>
</tr>
<tr>
<td>NOₓ</td>
<td>ppm vol</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>N₂O</td>
<td>ppm vol</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Cooling Water</td>
<td>ton/ton 100% HNO₃</td>
<td>110</td>
</tr>
<tr>
<td>Process Water</td>
<td>ton/ton 100% HNO₃</td>
<td>0,3</td>
</tr>
</tbody>
</table>

Mono pressure technology for nitric acid production process scheme

- A: Compressor Train
- B: Burner
- C: Tail Gas Heater
- D: Waste Heat Boiler
- E: Absorption Column
- F: Bleaching Column
- G: N₂O/NOx Abatement Reactor