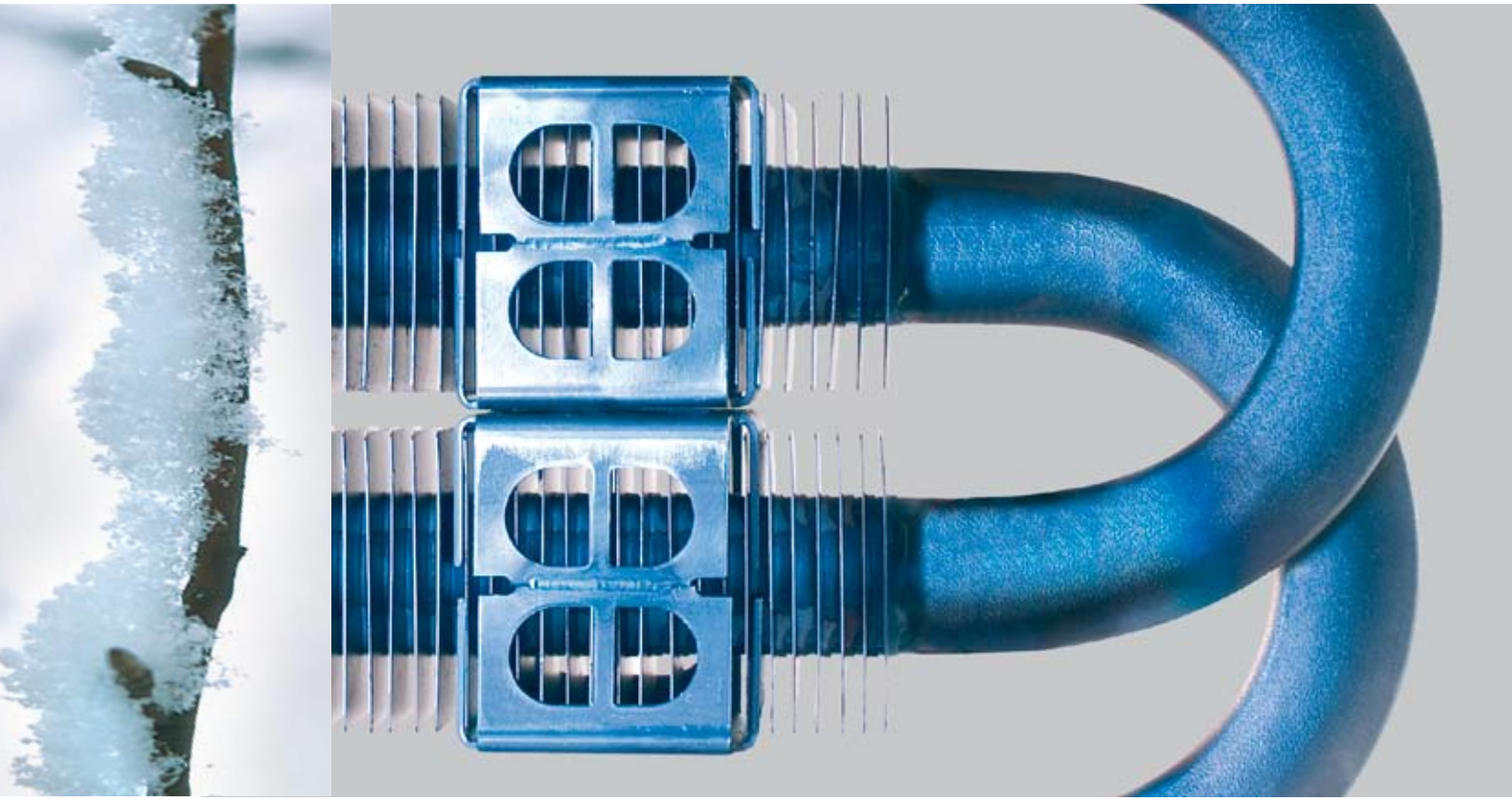
PA Process



GEA Luftkühler – Pioneer in PA Process

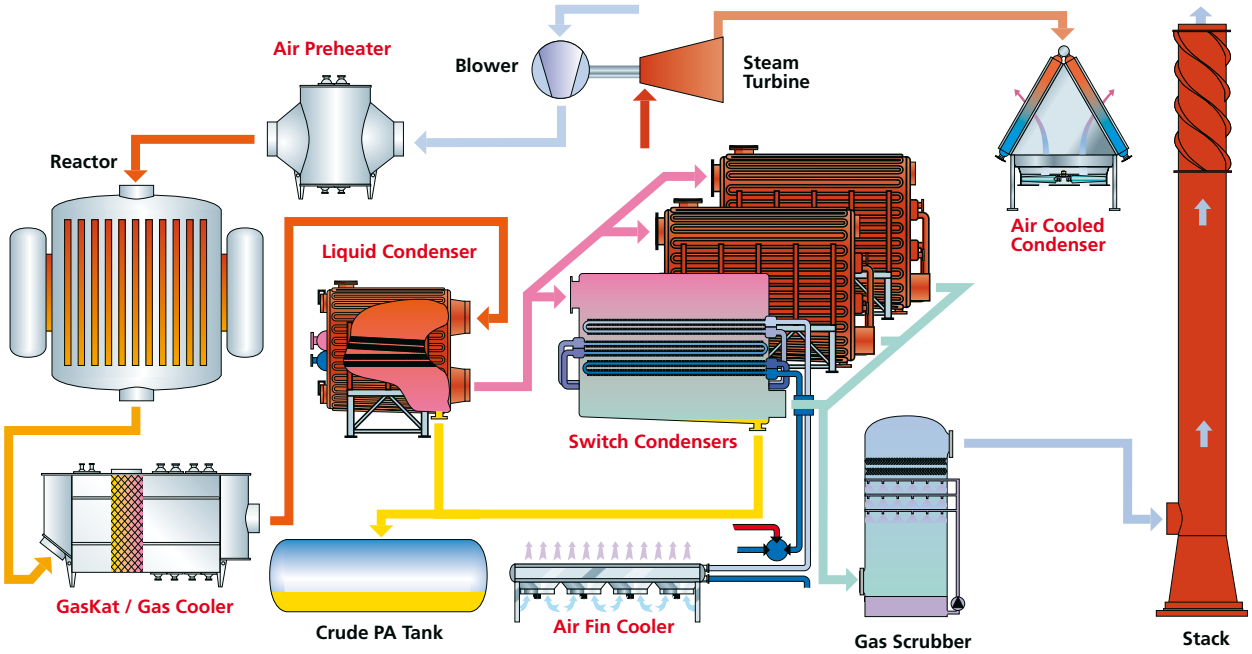


The history of GEA in the PA process started in 1954 with the invention of the PA switch condenser. Up to now, GEA has introduced several new equipment for the PA process and is continuously optimizing their performance and design. Nowadays almost the entire key equipment of the oxidation part of the PA process is part of GEA's product range:

- Air Cooled Condenser (ACC)
- Air Preheater
- GasKat, Gas Cooler
- Liquid Condenser
- Switch Condenser
- Air Fin Cooler (AFC)

Together with our partners we continuously work on the development of the PA process. Therefore, our equipment is known for its technological leadership. Additionally, due to the very close relationship to our customers we have the best understanding of their needs and requirements.

This is the reason why we have kept the pioneer position in developing excellent equipment for the PA process for more than 50 years. This is our target for the next fifty years, as well.





Our team is highly focused on designing and manufacturing first class PA equipment. We are able to design our equipment according to all international codes and regulations. The centre of excellence for our manufacturing is located in Herne, Germany, for more than 50 years.



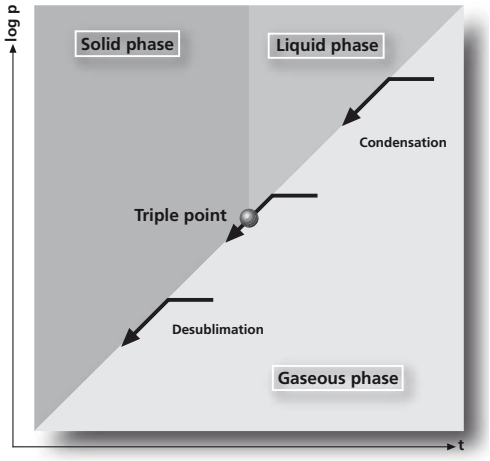
We are convinced that

- innovative technology
- advanced equipment
- highest quality
- hardworking team

are a must in order to ensure our common success.

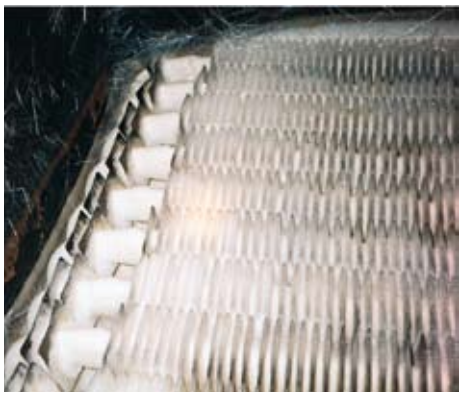
Physical Fundamentals

As one can see in a log P/T-diagram, desublimation of PA occurs if its partial pressure is below the triple point. Here, for collecting PA in solid phase a switch condenser is required. If its partial pressure is above the triple point, PA can be collected in liquid phase with a liquid condenser (pre-condenser) or again in solid phase with a switch condenser.



GEA Switch Condenser





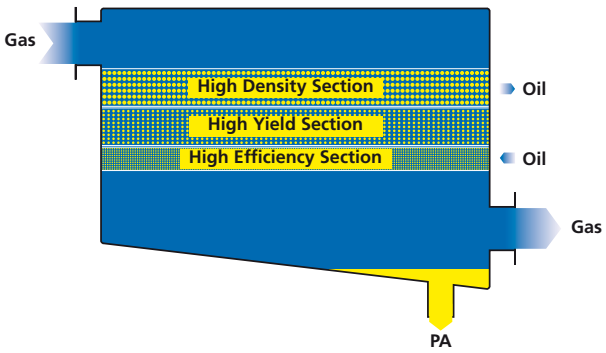
Since the invention of the Switch Condenser in 1954 GEA has delivered about 1500 switch condensers worldwide. We have continuously developed the mechanical as well as the process design of the switch condensers. In particular, we have adapted the special designed fin tube system composed of rectangular fins to the newest requirement of the PA process, mainly to the increasing feedstock loading of the air.

The most important process key figures of the newest switch condensers are:

- gas flow: max. 30,000 Nm^3/h
- capacity: max. 10,000 kg PA/cycle
- efficiency: min. 99.5 %
- oX-loading: 100 g/(Nm^3 air) and higher

The design philosophy of our switch condensers is the optimal use of the entire installed surface for collecting PA. For that reason, we have introduced three sections of fin tube systems with different designs and functions.

The main task of the **High Density Section** is collecting PA in a very compact form. The **High Yield Section** is not only for PA collecting but also for gas cooling. Finally, the **High Efficiency Section** has a special filter function for PA needles, what guarantees the very high efficiency of GEA switch condensers.



GEA Liquid Condenser

The GEA liquid condenser (pre-condenser) for the PA process was invented in 1989 in co-operation of GEA with Lurgi. Since then, we have delivered in total 18 liquid condensers for PA plants worldwide. Nowadays, the liquid condenser is standard equipment in all new and modern PA plants.

In the liquid condenser PA is collected in continuous operation instead of batch operation of switch condensers. Therefore, in the total PA plant only one liquid condenser is required upstream of the switch condensers.

The design philosophy of the GEA liquid condenser is to ensure that the maximum amount of condensable PA is collected in liquid form. For that reason, condensation occurs at temperatures just above the triple point. In order to avoid desublimation inside the liquid condenser temperatures of cooling medium and casing have to be exactly controlled.

The most important process key figures of the newest GEA liquid condensers are:

- gas flow: max. 150,000 kg/h
- efficiency/ capacity: all PA above 62 g oX/Nm³
- oX-loading: up to 120 g oX/ Nm³ air



GEA PA Separating System

A liquid condenser cannot be operated alone. Moreover, liquid condenser and switch condensers build a common system. In this case the design of the switch condenser has to be adapted to the special operating conditions. For that reason, the GEA PA separating system consisting of one liquid condenser and at least three switch condensers was born.

The most significant advantages of the GEA PA separating system are:

- reduced energy costs
- higher plant safety
- reduced PA production costs
- higher flexibility with future debottlenecking
- stable switch condenser operation (independent of oX-loading of the air)

The trends of future PA technology development will lead to oX-loading of the air higher than 100 g/Nm3. Especially in case of plant revamping, the GEA separating system can be introduced through the installation of an additional GEA liquid condenser. Existing GEA switch condensers can easily be modified to the new process requirements.

GEA GasKat

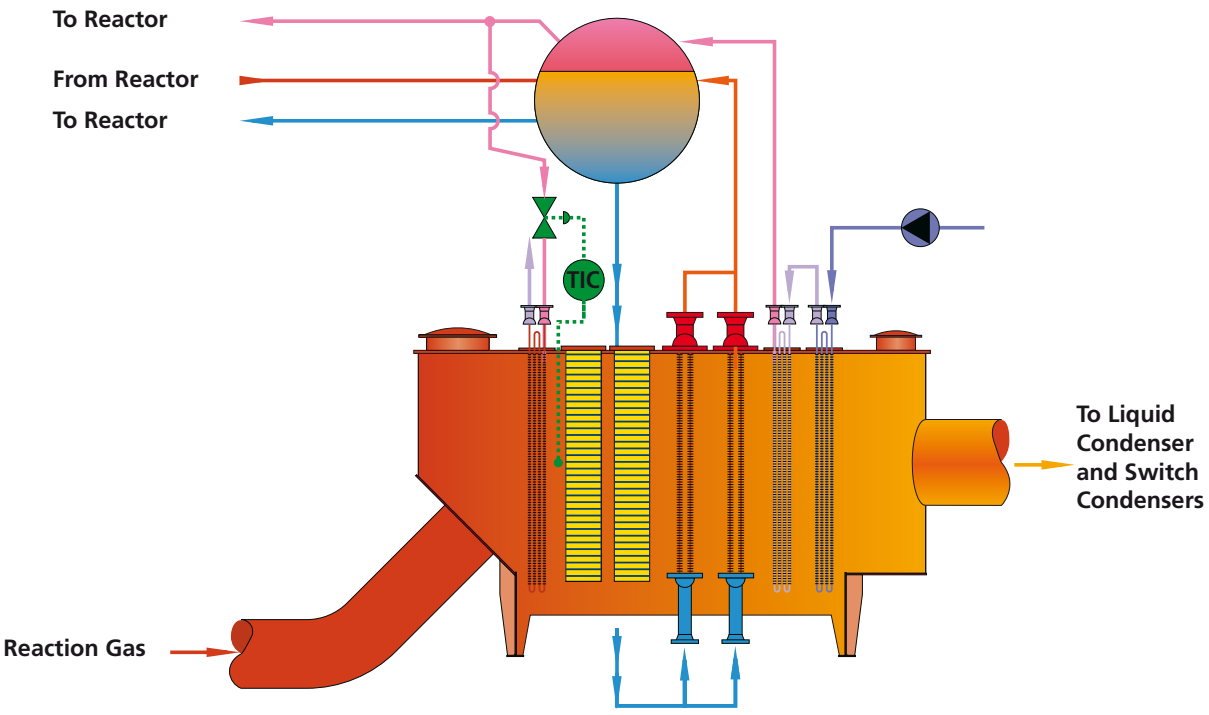
In some PA plants post reactor technology is installed to improve plant performance. The conventional post reactor technology has separate vessels for gas inter-cooling and catalytic post reaction and thus is extremely space consuming.

The modular and compact design of the GEA GasKat offers significant benefits:

- low invest and operating costs
- low gas side pressure drop
- easy catalyst replacement
- small gas volume (i.e. low risk with potentially explosive gases)

The much more intelligent solution is the patented GEA GasKat, which combines up to three process steps in one common casing:

- controlled gas inter cooling
- catalytic post reaction
- subsequent gas cooling



GEA Gas Cooler / GEA Gas Heater



Instead of the out-dated shell & tube heat exchanger, GEA designs and manufactures so called cassette gas coolers and heaters, which are classified by the design concept "gas around the tubes".

Depending on the application, the unit consists of a common casing that contains different heat exchangers in modular design. The use of fin tubes provides larger cooling areas using the smallest volume. The main features and benefits of the GEA cassette heat exchanger are:

- lower operating costs
- higher operational reliability
- very compact design
- low gas side pressure drop
- easy maintenance due to modular design





Thermal Engineering

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