Evonik’s Andrussow process expertise for tailor-made solutions
Scope of a standard HCN technology license

Evonik Performance Materials GmbH offers plant designs for the production of gaseous and liquid hydrogen cyanide, using the Andrussow process technology.

Depending on the down-stream application and the OSBL (OutSide Battery Limits) conditions, a tailor-made set-up is provided to the licensee.

**Feedstocks:**
- Natural gas, ammonia, air

**Catalyst:**
- Gauzes made from a platinum/rhodium alloy

The main process steps (for the production of liquid HCN) are shown in the ISBL (InSide Battery Limits) chart below.
Evonik’s expertise for tailor-made plant layouts

At Evonik’s site in Worms, Germany, Andrussov plants have been in operation since 1950. Starting from small reactors and plant capacities, we have continuously improved the HCN technology and became one of the leading HCN producers in the world. Currently, there are 15 Andrussov reactor systems globally based on Evonik’s HCN technology. Those facilities differ in production capacity and technical set-up depending on the down-stream application. Common to all plants is the highly sophisticated safety concept implemented in the plant set-up. The integrated interlock & trip systems have been developed and continuously improved by Evonik’s HCN-experts over decades.

On a regular basis we are in discussions with our licensees, external colleagues within the global HCN production community and technology partners (e.g., catalyst manufacturers) for further improvements (technology, safety and economically) of the Andrussov technology.

Therefore, Evonik is in the unique situation to offer a comprehensive license-package tailored to the specific needs of the customer. This ensures a safe and economical operation right from the start.

Evonik Performance Materials GmbH will provide a tailor-made Process Design Package (PDP) to the licensee. With this PDP, the main Hydrogen Cyanide process know-how is transferred to the licensee.

The licensee’s project management is supported by a team of experts from Evonik. This team consists of engineers and chemists from different departments, such as plant managers and plant engineers of the Andrussov plants operating and optimizing Evonik’s production facilities. All project phases along the licensee’s plant lifecycle will be supported by this experienced team of HCN experts.

We support the licensee in basic- & detail-engineering, construction, start-up and during plant operation. Due to our long-term experience, we will to find the best configuration for the plant on the respective site concerning the OSBL conditions (Steam-production from off-gas, utilization of cooling media, treatment of ammonium sulfate solution, etc.).
Andrussov process

The process is based on the ammon-oxidation of methane, described for the first time by Leonid Andrussov (1930).

Gas mixing and reaction:
The components methane (supplied as natural gas), ammonia (from evaporators), and oxygen from the air are mixed and reacted over a platinum/rhodium catalyst to form hydrogen cyanide:

\[
\text{CH}_4 + \text{NH}_3 + 1.5\text{O}_2 \rightarrow \text{HCN} + 3\text{H}_2\text{O} \quad \Delta H = -474 \text{ kJ/mol.}
\]

The product gases, at about 1,000°C, are quickly quenched by passing through tubes of a waste heat boiler. The generated steam can be utilized for heating purposes in down-stream processing steps. The remaining surplus steam can be fed to an on-site steam system.

The gases are sucked (or pushed through) the plant by blowers, located downstream of the HCN absorption column or up-stream of the HCN reactor (depending on the plant design).

Ammonia absorption and processing of ammonium sulfate solution:
Down-stream of the waste heat boiler, the gases are routed to a scrubber column to remove unreacted ammonia with sulfuric acid from the gases. Within this process step an ammonium sulfate solution product stream is generated. The stream is continuously processed to a stripper column in order to desorb the HCN dissolved in the ammonium sulfate solution.

HCN absorption:
Hydrogen cyanide is absorbed with cold water in second scrubber column. The bottom product, an aqueous solution of HCN, is discharged and stabilized.

The head product of the scrubber column, the off-gas, is routed to an off-gas treatment facility by the blower.

HCN distillation:
The HCN solution is routed to a distillation column. The water discharged at the bottom is recycled to the HCN absorption. Excess water, generated during the HCN reaction, is discharged and purified.

On top of the HCN distillation column the HCN vapor is condensed. The liquid HCN can be fed immediately to a down-stream production unit or a tank.
Evonik’s process know-how

Within Evonik there is an experienced R&D department working on various Hydrogen Cyanide projects. The outcome of these projects are transferred to Evonik’s production facilities and are finally implemented into the plant set-up of the licensees plants.

Andrussow chemistry
With more than 60 years of Andrussow operations and a large number of R&D projects, Evonik has an extensive know-how in HCN technology providing excellence in safe and effective HCN production.

Catalyst set-up
In the past, Evonik had several cooperation projects with catalyst manufacturers to identify the most effective catalyst gauze configuration for the Andrussow process.

Intellectual Property
In addition to the HCN expertise, Evonik holds technology patents regarding the Andrussow technology. All this technology IP is integrated in the technology set-up.

Simulation of the HCN-yield related to the air/ammonia and methan/ammonia ratios in the gas stream going to the HCN reactor.

Examples of Evonik’s patents along the Andrussow technology.