PÖRNER FORMALDEHYDE & DERIVATIVES

FORMALDEHYDE
+ DERIVATIVES

PÖRNER GRUPPE

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COMPETENCE CENTRE

PÖRNER FORMALDEHYDE SPECIALISTS

For more than 25 years the Pörner Group has been liaising with renowned European licensors and experienced partners to build plants for the formaldehyde product family as an EPCM or turn-key contractor.

The Group offers its expertise to build a wide range of plants of the formaldehyde product family such as: formalin, hexamine, pentaerythritol, glues, resins and novolaks. Together with renowed partners the plants are completely designed in-house, built and put into operation in countries all over the world like in Hungary, Germany, Austria, the Czech Republic, Russia, USA and Canada, including the second largest formalin plant in the world in Gubakha / Russia.

Best of its kind

In close cooperation with Dynea AS / Norway, the longtime licensing partner, the silver catalyst process for production of formalin has been constantly improved to become the best of its kind. Technical and economic comparisons of several international clients as well as the experience from joint design and construction of more than 20 plants in the last years prove this.

Formalin plant for Metadynea Austria GmbH, Krems / Austria

STEP BY STEP TO A SUCCESSFUL PROJECT

It takes many steps and the cooperation of several departments, to ensure that a project succeeds. Pörner offers all engineering services for the construction of modern automated and highly productive process plants; all from a single source.

As a process-oriented engineering and contracting company the Pörner Group supports customers right from the initial idea all the way to the turn-key completion of every phase of the project, tailored to the specific customer requirements. We offer integrated engineering services, ranging from process development, basic and detail engineering and procurement to construction supervision and commissioning.

Every Pörner office has a complete organizational structure with all disciplines for the success of plant projects. For each project the requirements and wishes of the client are brought together by the project team to be successfully implemented in the project execution. The customer has only one contact for all solutions and coordination, the Pörner-Project Manager.

Meeting on site of the resin plant at Spolchemie, Usti nad Labem, Czech Republic

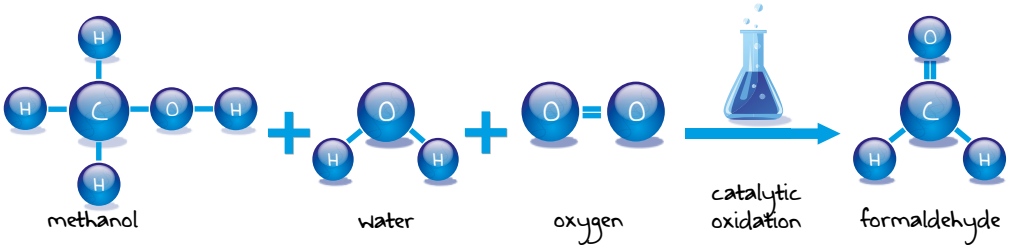
FORMALDEHYDE PRODUCTION PROCESS

Formaldehyde can be produced industrially by the catalytic oxidation of methanol.
For this purpose, two methods are suitable, the silver catalyst and the metal oxide process.

THE SILVER CATALYST PROCESS

The silver catalyst process is the safest process of formaldehyde production. Formaldehyde concentration and residue methanol content with the silver catalyst process is as good as the best metal oxide process. Less formic acid and no caustic soda and antifoam agent makes the product more versatile for all formulations and customers.
There is also no hot oil used in this process, just water/steam which reduces the fire risk.
There is no oxygen in the absorber, this not only further reduces the fire risk but improves the product quality as well. The catalyst can be removed without dust and waste in a few hours.
Re-catalization can take less than 24 hours so only small holding tanks are necessary to serve customers during re-catalization.
The investment costs for the silver catalyst process are similar compared to the metal oxide process but there are other advantages to this system, the catalyst is inexpensive because it is fully regenerable, there is less electricity consumption, higher steam generation and less cooling demand. These factors more than compensate for the slightly higher methanol consumption compared to the metal oxide process.

- An evaporated methanol water mixture is fed together with ambient air to the silver catalyst. The generated process gas is then absorbed in water and condensed in a selective absorption step.
- Standard trade solutions up to 49 % w/w formaldehyde with 1 - 2 % w/w methanol are produced without distillation.
- Alternatively we offer the special tail gas recycling technology to achieve high concentrated formaldehyde solutions up to 55 % w/w formaldehyde with 0.5 - 1 % w/w methanol without distillation.
- The H_2 rich absorption tail gas is combusted in a thermal oxidizer or special boiler and is generating steam or can even be fed to a gas motor generating electric power.

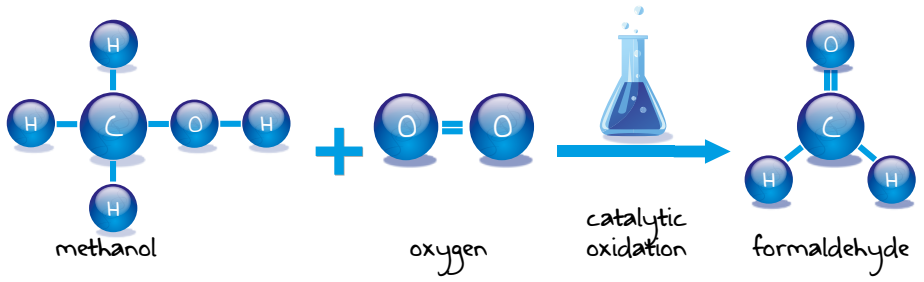



Delivery of long-lead item

THE METAL OXIDE PROCESS

The metal oxide process yields better quantities of formaldehyde, therefore there is slightly less consumption of methanol. It also has similar investment costs to the silver catalyst process.
The metal oxide process also allows the free choice of catalyst supplier as Pörner and its licensor are independent companies with the client's wishes at heart. The final decision on which process to choose depends on the individual client and their needs.
Factors that influence this decision include costs of raw materials, utility costs, catalyst costs and safety and operation aspects etc.

- Methanol is fed together with ambient air to the metal oxide catalyst (iron oxide in combination with molybdenum and/or vanadium).
- The generated process gas is then absorbed in water and condensed in an absorption step.
- About two third of the absorption off-gas is recycled to the reactor. Formaldehyde solutions up to 55 % w/w formaldehyde with 0,5 -1 % w/w methanol are produced.
- The absorption off-gas is oxidized on a palladium catalyst which can be equipped alternatively with waste heat recovery.



Formaldehyde: The Substance

Formaldehyde is an important raw material for the chemical industry and is used to manufacture many industrial and consumer products. Over 50 branches of industry now use formaldehyde and its derivatives in glues and resins and many other industrial applications. Formaldehyde is also one of the most important organic raw materials in the chemical industry. The annual consumption of formaldehyde is about 41 million tons. In nature, formaldehyde is generated as an intermediate during normal metabolism. The adult organism produces about 50 grams of formaldehyde daily.

Formaldehyde vs. Formalin

There has always been confusion as to the different terms, formaldehyde and formalin. Formaldehyde is a gas in its natural state of aggregation, whereas formalin is the aqueous solution of formaldehyde which is stabilized in order to avoid polymerization with 5-15 % methyl alcohol. Formaldehyde can be produced industrially by the catalytic oxidation of methanol.

FORMALDEHYDE DERIVATIVES

Pörner Group is a specialist in engineering of formaldehyde plants. Thus, our experts gained profound process know-how for the production of formaldehyde derivatives.
These derivatives are used for many different applications across industry and households.

UREA FORMALDEHYDE PRECONDENSATE (UFC)

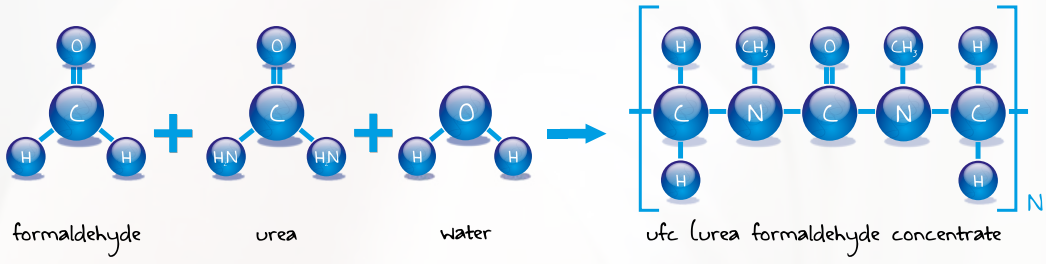
Urea-formaldehyde is a non-transparent thermosetting resin or plastic made from urea and formaldehyde, using the same process as for formalin production, but absorbing the formalin in urea solution. Urea-formaldehyde is used in many manufacturing processes due to its useful properties. Examples include resins, decorative laminates, paper, wrinkle resistant fabrics, cotton blends, rayon, corduroy, thermosettings etc.

Silver catalyst process:

- An evaporated methanol water mixture is fed together with ambient air to the silver catalyst.
- The generated process gas is then absorbed in an urea-water-solution and condensed in a selective absorption step.
- Standard trade solutions of up to UFC 75 can be produced directly in the absorber. Higher concentrations are not achievable due to process water balance.
- The H_2 rich absorption tail gas is combusted in a thermal oxidizer or special boiler and is generating steam or can even be fed to a gas motor generating electric power.

Metal oxide process:

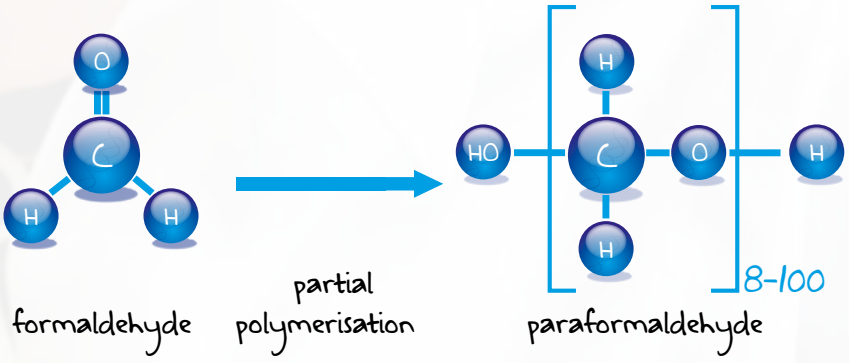
- Methanol is fed together with ambient air to the metal oxide catalyst (iron oxide in combination with molybdenum and/or vanadium).
- The generated process gas is then absorbed in a urea-water-solution and condensed in a selective absorption step.
- About two thirds of the absorption off gas is recycled to the reactor
- The absorption off gas is oxidized on a palladium catalyst which can be equipped
- alternatively with waste heat recovery.
- All standard trade solutions of up to UFC 85 can be produced.



PARAFORMALDEHYDE

Paraformaldehyde is used for the same applications as formalin and has the advantage of lower transport costs and can be stored over long periods.

- The formaldehyde solution is concentrated by evaporation. Depending on the feed concentration two or three evaporation steps are required.
- The concentrated solution is then congealed and subsequently dried according to the various product specifications.
- The paraformaldehyde that is produced is made up of white, free flowing granules or prills with a formaldehyde content of 91 – 98 % w/w with the ideal being 95 ± 1 % w/w.
- Key features of the product are:
  - high reactivity
  - excellent solubility
  - very good storage properties

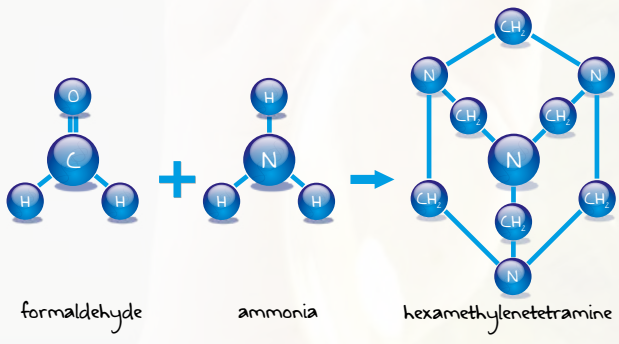


HEXAMETHYLENETETRAMINE

Hexamethylenetetramine is useful in the synthesis of other chemical compounds, e.g. plastics, pharmaceuticals and rubber additives. The dominant use is in the production of phenolic resins and its compounds. These products are used as binders, e.g. in brake linings, abrasive products and fireproof materials.

Hexamine liquid and gaseous phase processes:

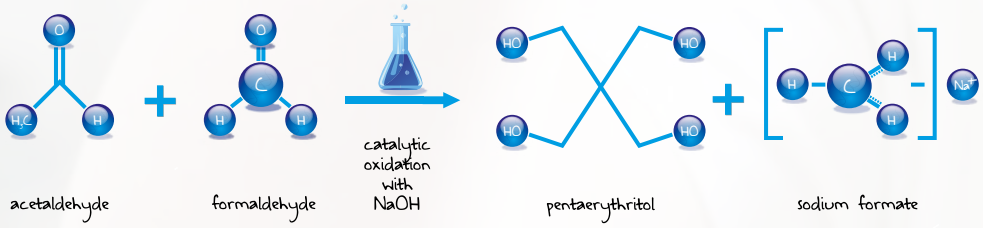
- During the liquid phase pocess liquid ammonia is evaporated and fed into the reactor system where it reacts with a formaldehyde solution to hexamine molecules which are dissolved in a mother-liquor
- During the gasous phase process liquid ammonia is evaported and fed into the reactor system where it reacts with a formaldehyde gas from the formaldehyde reactor to hexamine molecules which are dissolved in a mother-liquor
- The mother-liquor is fed to a crystalization unit where the hexamine crystals are formed
- The hexamine crystals are separated in a centrifuge and the hexamine is subsequently dried in a fluidized bed drier
- The residue mother-liquor from the centrifuge is recirculated to the reactor
- Key features of the product are:
  - pure white and crystalline structure
  - very good flow characteristics
  - stabilization with SiO_2 is possible



PENTAERYTHRITOL

Pentaerythritol, a white, crystalline polyol, is a versatile building block for the preparation of many polyfunctionalized compounds and nitration processes. Halogen-free pentaerythritol esters are also environmentally friendly alternatives to conventional electrical transformer fluids, being both readily biodegradable and non-hazardous in water.

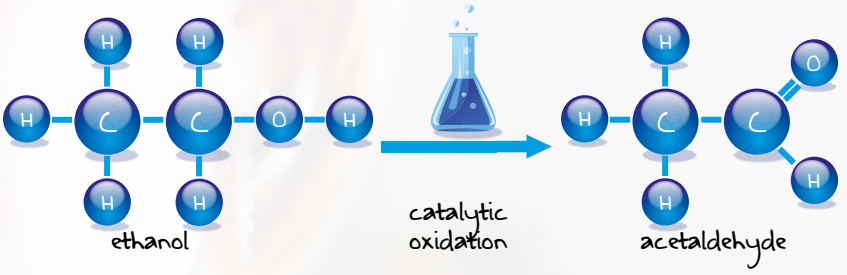
- Acetaldehyde and formaldehyde solution react in a continuous process in a first step under alkaline conditions (aldol condensation) and in a second reaction step it reacts with formaldehyde (Cannizzaro reaction) to complete the synthesis of penta
- The reaction product is fed to a continuous crystallization unit
- Di-pentaerythritol can also be produced as secondary product
- Sodium formate is formed as a by-product
- Key features of the continuous process are:
  - low formation of unwanted by-products
  - low and constant utility demand
  - excellent operation results in small apparatuses



ACETALDEHYDE

Acetaldehyde is one of the most important aldehydes, occurring widely in nature and being produced on a large scale in industry. Acetaldehyde occurs naturally in coffee, bread, and ripe fruit, and is produced by plants. In terms of condensation reactions, acetaldehyde is an important precursor to pyridine derivatives, pentaerythritol and crotonaldehyde.

- Evaporated ethanol is fed together with ambient air to the silver catalyst. The generated process gas is then absorbed in water and condensed.
- The generated solution is then fed to the acetaldehyde distillation unit where the pure acetaldehyde product of the desired concentration is produced.
- The sump product of the acetaldehyde distillation which is left unreacted - ethanol and water - is fed to the ethanol distillation step where the ethanol is recovered as head product and recycled to the reaction section.
- The sump product of the ethanol distillation is mainly used as absorption water in the absorption unit, only a small quantity is discharged as waste water.
- The H_2-rich absorption tail gas can be thermally oxidized and the generated heat can be utilized for steam generation.



GLUES AND RESINS

Glues and resin plants designed and supplied by Pörner are tailor adapted and optimized production units for a broad range of products: Urea formaldehyde resins (UF), melamine formaldehyde resins (MF) and melamine urea resins (MUF) production plants, phenol formaldehyde resins (PF) production plants, epoxy resins production plants, alkyd and polyester resins production plants, glue production plants, novolak and resol production units, powder bakelite production units.

- The reagents (varying with the desired product) are fed in to a stirred reaction vessel on weighing cells which provide for precise and accurate dosing.
- The reactor is equipped (according to the desired product) with internal and external cooling / heating systems which secure optimal temperature profile during the reaction process.
- For several products where a distillation step is required, a condenser and vacuum unit is added to the reaction equipment.
- If the production recipe includes solid raw materials the solids are fed with hoppers on weighing cells and screw conveyors or, where needed, special feed equipment for big bags or bags
- If further dissolving or sedation is required, special stirred vessels with/or without internal and external cooling systems are installed.
- For Novolaks and similar products a cooling belt is used to produce pastilles.
- For Powder Bakelite the Novolaks are mixed with hexamine and grinded and classified.

SELECTED REFERENCES

FORMALIN PLANT

Installation of a plant for the production of formalin (55 %) based on the Dynea silver catalyst process; in compliance with Russian norms and standards

Pörner scope:
Basic and detail engineering for mechanics and electrics, 3D plant model, delivery of piping material and MCC

Client:
Dynea AS /
OOO METAFRAX

Capacity:
180.000 TPA

Location:
Gubakha / Russia

Year: 2021

FORMALIN PLANT

Turnkey formalin plant based on the Dynea silver catalyst process incl. methanol and formalin tanks and methanol unloading station, incineration unit with waste heat recovery.

Scope:	Turnkey supply of the entire plant incl.: authority engineering, basic engineering, detail engineering, procurement and supply, construction and erection, commissioning, documentation
Client:	LANXESS AG
Location:	Krefeld-Uerdingen / Germany
Year:	2011

FORMALIN PLANT

Re-installation and modernization of a formalin plant including methanol tanks and infrastructure

Scope:	Supply of detail engineering, procurement services and site supervision
Client:	Dynea Erkner GmbH
Location:	Erkner, Germany
Year:	2015

FORMALIN PLANT

Installation of a production plant for formalin based on the Dynea silver catalyst process, incineration unit

Scope:	General planning, authority engineering, basic engineering, detail engineering, procurement and supply of all equipment and material and PLC, site supervision, commissioning support, training, documentation
Client:	OAO Metafrax
Location:	Gubakha / Russia
Year:	2006

HEXAMINE PLANT

Construction of a hexamine production plant and supply including GOST-R certificate

Scope:	General planning incl. authority engineering, basic engineering, detail engineering, procurement and supply of equipment, material and process control system, construction supervision, commissioning support, training and documentation
Client:	OJSC Metafrax
Location:	Gubahka / Russia
Year:	2011

UNSATURATED POLYESTER AND ALKYD RESIN PLANT

Errection and expansion of a polyester and alkyd resin plant;
Follow-up contract to new installation in 2006

Scope:	EPCM contractor incl.: engineering, procurement and supply of equipment, materials, process control system, construction management, commissioning
Client:	Spolchemie AG
Location:	Usti nad Labem / Czech Republic
Year:	2006 / 2009

EPOXY RESIN PLANT

Construction of an epoxy resin production plant (Leuna Harze 3)

Scope:	Basic engineering, detail engineering, procurement, construction supervision
Client:	LEUNA Epilox GmbH
Location:	Leuna / Germany
Year:	2007

FURTHER REFERENCES

Plant	Client	Location / Country	Year
Formalin plant	SAMAC	Jubail / Saudi Arabia	2017
Formalin plant	Borsodchem BCKC	Kazincbarcika / Hungary	2017
Epoxy resin production plant	Confidential	Leuna / Germany	2017
Formalin plant	Lerg SA	Pustkov / Poland	2015
Pentaerythritol plant	OJSC Metafrax	Gubakha / Russia	2014
Phenolic resin plant	Dynea Erkner Gmbh	Erkner / Germany	2014
Formalin plant	Evonik	Shanghai / China	2014

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