



CUSTOMIZED QUALITY



**CALORIC ANLAGENBAU GMBH**

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CALORIC is one of the leading companies in Europe specialised in designing and manufacturing of gas generating plants and incinerators for chemical and pharmaceutical industries.












The company specializes in customer-specific, cost-optimized solutions. A key characteristic of the plants is their high level of prefabrication, which makes it possible to deliver and commission high quality plants in short time. The company is headquartered in Graefelfing near Munich/Germany. CALORIC was founded in 1965, originating from an engineering

consultant based in Munich since 1937. Since its foundation CALORIC has steadily accumulated a great wealth of unique technologies and know-how.

More than 500 plants of various types in all parts of the world proudly demonstrate CALORIC's high technical standard.



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# H<sub>2</sub> GENERATION PLANTS

CALORIC provides a wide range of processes to generate pure hydrogen (up to 99.9999 vol.-%) most economical for the customer. Depending on the availability and commercial attractiveness of different feed stocks CALORIC is capable to provide plant designs based on natural gas, LPG, naphtha, methanol or hydrogen rich gases from several sources.

Besides the aspect of feedstock CALORIC's customised plants will follow customers' preferences in focusing on investment costs (CAPEX) and/or operational costs (OPEX). A variety of design and plant options will be

available to fulfill customer needs and requirements, e.g minimizing feed stock consumption, maximizing steam by-product or highest thermal efficiency.



**Methanol reformer for 840 Nm<sup>3</sup>/h hydrogen purity (99.9999%)**



**Steam reformer for 4000 Nm<sup>3</sup>/h hydrogen (purity 99,9%)**

Syngas Plant for 1500 Nm<sup>3</sup>/h

## SYNGAS GENERATION PLANTS

CALORIC has developed and supplied syngas generating plants based on the steam reforming HC process, the MeOH reforming HM process or the CALCOR CO generation process. Depending on the required H<sub>2</sub> to CO ratio, purity requirements and feed situation, various plant configurations are available.

Typically the syngas generation process is close to the conventional reforming processes. Depending on the specific requirements of the downstream process using the syngas for the final product the H<sub>2</sub> / CO ratio is of major importance for process efficiency. Beyond the adaption of process parameters, e.g. reforming temperature and pressure, several selective process units can be implemented to achieve the requested ratio, e.g. shift reactors, CO<sub>2</sub> recycle or selective membranes.

The CALORIC reforming technologies provide optimized syngas generation systems capable to handle associated and stranded gas for GtL plants. Furthermore GtL plants provide specific challenges which are met by the well proven CALORIC reforming processes.

# GAS PURIFICATION PLANTS

CALORIC offers several processes to purify gas streams most cost efficient for the customer (up to 99.9999 vol.-%). A variety of design options will be available to fulfill customer requirements, based on catalytic, absorptive and adsorptive processes as well as selective permeation.

A variety of design and process plant options will be available to fulfill customer needs and requirements, e.g. PSA or membrane

## Membrane Purification

Clean gas is generated by purification of the the feed gas using membrane technology of globally leading suppliers. Depending on the required product purity and the efficiency, the system including amount and configuration of membranes are arranged.

## Pressure Swing Adsorption (PSA)

The feed gas passes the molecular-sieve PSA unit in which the hydrogen is isolated to the specified purity. The PSA unit separates the residual impurities from hydrogen at high-pressure level. The PSA unit consists of 4/5/6 adsorber vessels with several layers of different adsorbents. At any time one adsorber vessel is active for H<sub>2</sub>-production while the other 3/4/5 adsorber vessel are in different regeneration steps.



PSA unit for hydrogen purification in the Netherlands

Calcor® plant for 530 Nm<sup>3</sup>/h

## CO-GENERATION PLANTS

The Calcor® standard process is a dry reforming process combined with a CO<sub>2</sub> recovery and a CO purification step. The feed (either natural gas or LPG) is mixed with CO<sub>2</sub>. Whilst passing the catalyst in the reformer, the mixture of CO<sub>2</sub> and feed is converted into a CO-rich syngas.

After leaving the reformer, the syngas is cooled to ambient temperature prior to undergoing the CO<sub>2</sub> removal and recovery. In this process step the CO<sub>2</sub> from the reformer flue gas as well as the CO<sub>2</sub> from the syngas is absorbed in packed towers by amine solution (MEA). In a stripper, the CO<sub>2</sub> is separated from the scrubbing liquid and recycled back to the reforming process. The syngas which typically consists of 70 % by vol. CO and 30 % by vol. H<sub>2</sub> and still carries traces of CO<sub>2</sub> and CH<sub>4</sub> enters the CO

purification step. The selective properties of membranes make it possible to simultaneously separate H<sub>2</sub> and CO<sub>2</sub> from the CO product, which results in a simplified design of the Calcor® process. In this “economy” version of the Calcor® process, the CO<sub>2</sub> recovery part of the process is deleted and imported CO<sub>2</sub> is used instead of recovered CO<sub>2</sub>.



Amine recovery skid during manufacturing

## GAS SWEETENING PLANTS

With the SCB process, carbon dioxide (CO<sub>2</sub>) and/or hydrogen sulphide (H<sub>2</sub>S) are removed from gas streams. The SCB process is designed for gas sweetening at highest efficiency from various sour gases using aqueous amine solutions (e.g. MEA or MDEA).

CO<sub>2</sub> and/or H<sub>2</sub>S rich carrier gas is sent to the absorber. The absorber is designed as packed tower with an aqueous amine-solution as scrubbing liquid. Downstream of the absorber a demister is installed to avoid droplet entrainment into the treated gas.

The sour gas enriched amine-solution from the bottom of the absorber column is led to the regeneration unit prior passing heat exchanger for preheating. The regeneration unit comprises the stripper and the reboiler. The stripper is designed as packed tower with a demister on top of

the stripper column. The rich solvent in the reboiler with steam. The stripped CO<sub>2</sub> and/or H<sub>2</sub>S is cooled at heat exchanger before vented to the atmosphere.

The lean solvent out of the stripper is cooled down in a heat exchanger. After dosing anti-foam agent to the lean solvent line the solvent is forwarded via pump station to the absorber. Before entering the absorber the lean solvent is partly sent to an activated carbon filter unit to remove degradation products of the amine-solution and other impurities if any.



# INCINERATION PLANTS

CALORIC Incinerators and Thermal Oxidisers are designed to dispose complex liquid and gaseous waste streams from chemical and pharmaceutical industries. Typically, such units consist of one or more combustion chambers, a heat recovery system, a flue gas treatment system and a stack.

Depending on the waste properties, process requirements and legal requirements, the configuration of the incineration system will be selected case by case using the appropriate technology in each of the process steps. By this, the destruction efficiency of CALORIC incinerators meets the stringent emission regulations of the European legislation for incineration of hazardous wastes. CALORIC can derive advantage from experience

out of nearly 100 plants already designed and built in the last 40 years for selecting the best technology. The thermal capacity of CALORIC incinerator units ranges from 0.5 MW up to 23 MW. Typical wastes treated in CALORIC incinerators contain hydrocarbons plus anorganics like halogenes, salts and silica. Furthermore, CALORIC can provide acid recovery systems from waste incineration to increase profitability.



Incinerator for disposing organic polluted NaCl solution



Incinerator for organically polluted NaCl solution

## PILOT/DEMONSTRATION PLANTS

CALORIC's strength is gained from more than 50 years' experience in the design of small scale and modularized industrial process plants according to the actual customer requirements. The strength includes the management of such complex projects while providing a highly but not over-engineered product to the customer.

CALORIC's design team is prepared to focus on

- High reliability by industrial design
- Operability and maintainability
- High operational flexibility
- Economically feasible solutions
- Programming and measurement ensuring enhanced data analysis
- Fast and easy installation "plug and play"



CO<sub>2</sub> removal within bio DME demonstration plant



Skid mounted steam boiler is placed on prepared foundation

## WASTE HEAT MANAGEMENT SYSTEMS

CALORIC has acquired indepth know-how on waste heat management systems with the implementation of steam boilers into syngas generating plants and into hazardous waste incinerators.

Based on this know-how, CALORIC is in the position to offer individual waste heat management systems to the market as standalone product. Our emphasis is on the

non-standard applications with requirements on special process conditions as well as extensive equipment specifications.

# ENGINEERING

Since the start-up of the company, CALORIC has extensive experience in process development and engineering to supply clients with the most suitable solutions.

CALORIC offers the full range from first feasibility studies to entire detail engineering packages. The processes and technologies offered by CALORIC are proprietary and have been developed in-house. To maintain the competitive edge permanent research and development activities are going on.

Depending on clients request CALORIC will design and engineer according to major European, American and Asian standards and codes, as well as to clients engineering specifications, e.g. world class chemical companies, oil & gas companies and globally operating EPC companies.



Valve skid



Mechanical revamp

## SERVICE

One of CALORIC's strengths is the support of our clients over the total lifetime of their plants.

CALORIC provides services throughout the plant life cycle. The various services will start from turnkey erection and comprises also operator training, optimisation of the process as well as complete maintenance schedules or revamp services.

- Spare parts supply
- Operator training
- Process optimization
- Remote services
- Approval management
- Maintenance
- Revamps (process, mechanical, electrical)

CALORIC develops project specific schedules to get the job executed on time and within budget.



Natural gas steam reformer capacity 5000 Nm<sup>3</sup>/h during erection

## DESIGN CONCEPT: MODULAR SKID CONSTRUCTION

A key component and basis for fixed prices and short delivery times is the successful modular design concept of pre-manufactured skid-mounted equipment for CALORIC's various types of plants.

Due to this modular design concept the skids can be fully pre-fabricated and pre-assembled in CALORIC's own factory. This includes fabrication, assembly, painting and cabling of the skids. To ensure highest quality, the entire

fabrication process is permanently controlled according to the quality management system and finalised by the FAT (factory acceptance test).

# DESIGN CONCEPT – PROCEDURE

## Step 01



Pre-manufacturing of skid in CALORIC's production facility

## Step 02



Pre-assembly of the plant in CALORIC's production facility

## Step 03



Factory acceptance test in CALORIC's production facility

## Step 04



Easy transportation of container adapted modules

## Step 05



Placement of skid on prepared foundation

## Step 06



Assembly of the plant at site

## Step 07



Start-up of the plant

# PORTFOLIO

CALORIC is one of the leading companies in Europe specialised in designing and manufacturing of gas processing plants, incinerators for chemical and pharmaceutical industries as well as related engineering performances and system supply.

 **H<sub>2</sub> Generation Plants**

 **Syngas Generation Plants**

 **Gas Purification Plants**

 **CO Generation Plants**

 **Gas Sweetening Plants**

 **Incineration Plants**

 **Pilot/Demonstration Plants**

 **Waste Heat Management System**

 **Engineering**

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