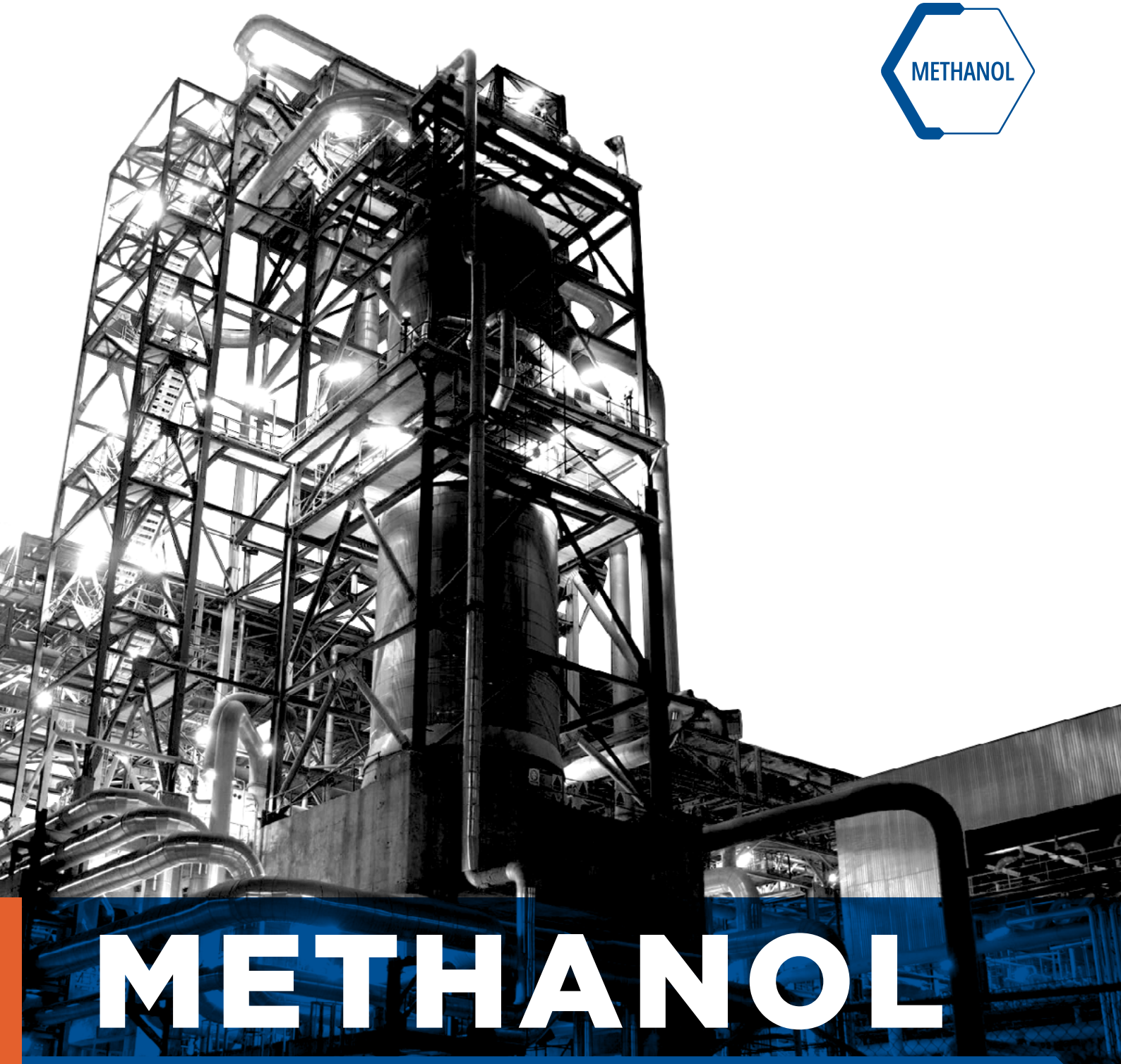


METHANOL

METHANOL

M-LOOP

Casale's Methanol synthesis loop for inert free syngas

CASALE

We are a global partner
in the chemical industry,
offering **integrated technologies,**
engineering, contracting
and construction solutions
for over a century.

Our mission

Contribute to shape a new sustainable planet with our plants for the production of fertilizer, methanol, hydrogen, melamine and derivatives, and help our customers creating value respecting the environment.

We are a global company front leader in the energy transition: a key player in the sustainable transformation of the chemical and energy industry, from a social, economic and environmental point of view.

Our values

INNOVATION PEOPLE CARE **PROFESSIONAL EXCELLENCE**
QUALITY **SAFETY** ETHIC **SUSTAINABILITY**

METHANOL

M-LOOP

The process for methanol synthesis from coal gasification is quite different from the natural gas route, In coal-based methanol plants the gasifier is third-party technology, therefore, Casale is the licensor of only the CO shift section, synthesis loop and distillation.

Capacity

- Best suited from **1000 MTD** to **7000 MTD** of MTG/MTO grade, Grade A, Grade AA, IMPCA grade methanol

Performances

- Syngas consumption, per ton of methanol produced: **2200-2300 Nm³**
- Carbon efficiency: higher than **94%**
- Saturated steam production, per ton of methanol produced: **1.15-1.30 metric ton**

Benefits

- Low energy consumption
- Reduced CAPEX
- Use of any first-class commercially available catalyst
- Compact and simple lay-out, with all sections arranged in a way to minimize the overall footprint as well as optimize the connections across the different sections of the plant
- The design can be customized to specific Client's needs and integrated with downstream distillation section

Casale technical assets

- IMC® methanol converter
- Axial-Radial® sour CO-shift converter
- Design of the distillation section

Enviromental Impact

The operation of the methanol synloop is emission free, except for the purge gases and by-products, which, overall, have an impact lower than 0.1 MT CO_2/M ton of methanol.

PROCESS OUTLINE

COMPRESSION

The fresh make up gas from coal gasification is mixed with the hydrogen rich stream coming from Hydrogen Recovery Unit (HRU) and compressed in the make-up compressor up to required pressure for methanol synthesis. The recycle gas from synthesis loop is added in the compressor's last stage.

METHANOL SYNTHESIS

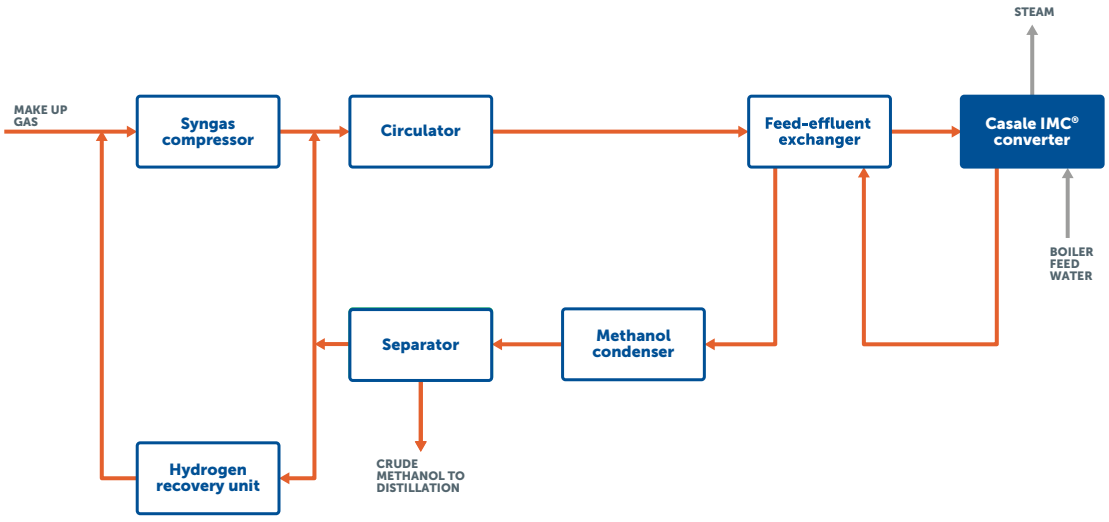
The resulting stream is routed to the converter's feed/effluent heat exchanger where it is heated up to the converter inlet temperature by the the hot converter effluent.

The preheated feed gas enters the highly efficient Casale IMC® converter (Isothermal Methanol Converter). A notable feature of this patented design is its array of proprietary, hollow heat-exchanging plates. These plates serve the essential function of removing the reaction heat by generating medium-pressure steam through a circulation of hot boiler feedwater within the plates. The paramount advantage of this configuration lies in its ability to maintain the catalyst temperature at a nearly constant level, closely aligned with the optimum value for methanol synthesis.

REACTION HEAT RECOVERY AND METHANOL CONDENSATION

The hot converter effluent is firstly routed to the feed /effluent heat exchanger, then to the distillation's topping column reboiler and finally to the trim condensers where the final condensing temperature is reached.

The crude methanol is separated in the high-pressure separator, then is let-down to the low-pressure separator where the dissolved vapors are washed by a stream of water and methanol from purge gas washing column. The crude methanol is directly sent to the distillation section.



RECYCLE

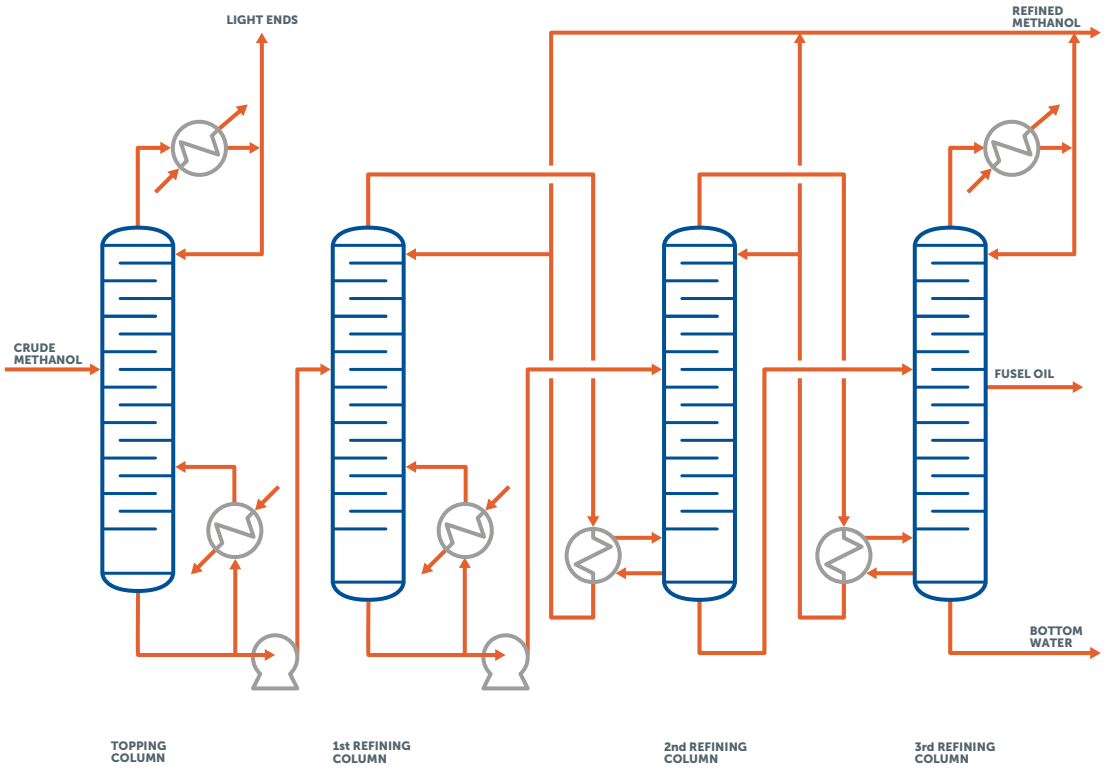
From the top of high-pressure separator, the vapors containing non-converted reactants are mainly recycled back to the synthesis loop through the syngas compressor circulator.

A stream of purge gas is removed from the recycle gas to control the inerts' concentration in the synloop and it is washed in column by a stream of bottom water from the distillation section in order to recover the traces of produced methanol. The washed purge gas from the top of the column is sent to the HRU unit to recover as much as possible the hydrogen. The recovered hydrogen is recycled back to the synthesis gas compressor suction.

DISTILLATION

Refined AA grade methanol is produced by purifying the crude methanol through a two-stage distillation process.
In the 1st stage, one column (topping) separates the lighter compounds, followed by the refining stage where water and higher-end impurities are separated.
Typically, one refining column is enough when the cost of energy is low or for small plants whereas in all other cases two or three refining columns are the preferred arrangements.

Casale offers an advanced scheme utilizing four columns, which significantly minimizes the energy consumption.



FEATURES IN DETAIL

SYNGAS BALANCING AND PURIFICATION

The raw syngas generated in the coal gasifier contains an excess of carbon monoxide (CO), which needs therefore to be converted into H_2 to obtain a more balanced gas for methanol synthesis.
For this purpose, one or two Casale Axial-Radial® shift converters are typically installed downstream of the gasifier. They are designed to withstand the sulfur and excess carbon dioxide before their subsequent removal in the sections upstream the synloop.

However, any potential underperformance or operational upsets of this final purification stage can result in undesirable levels of such impurities remaining in the gas. This, in turn, could irreversibly poison the synthesis catalyst. To prevent this Casale provides a guard reactor, either at the suction or at the discharge of the synthesis gas compressor, where a combination of an hydrolysis catalyst and a zinc oxide bed, eliminate all contaminants.

CASALE IMC® CONVERTER DESIGN

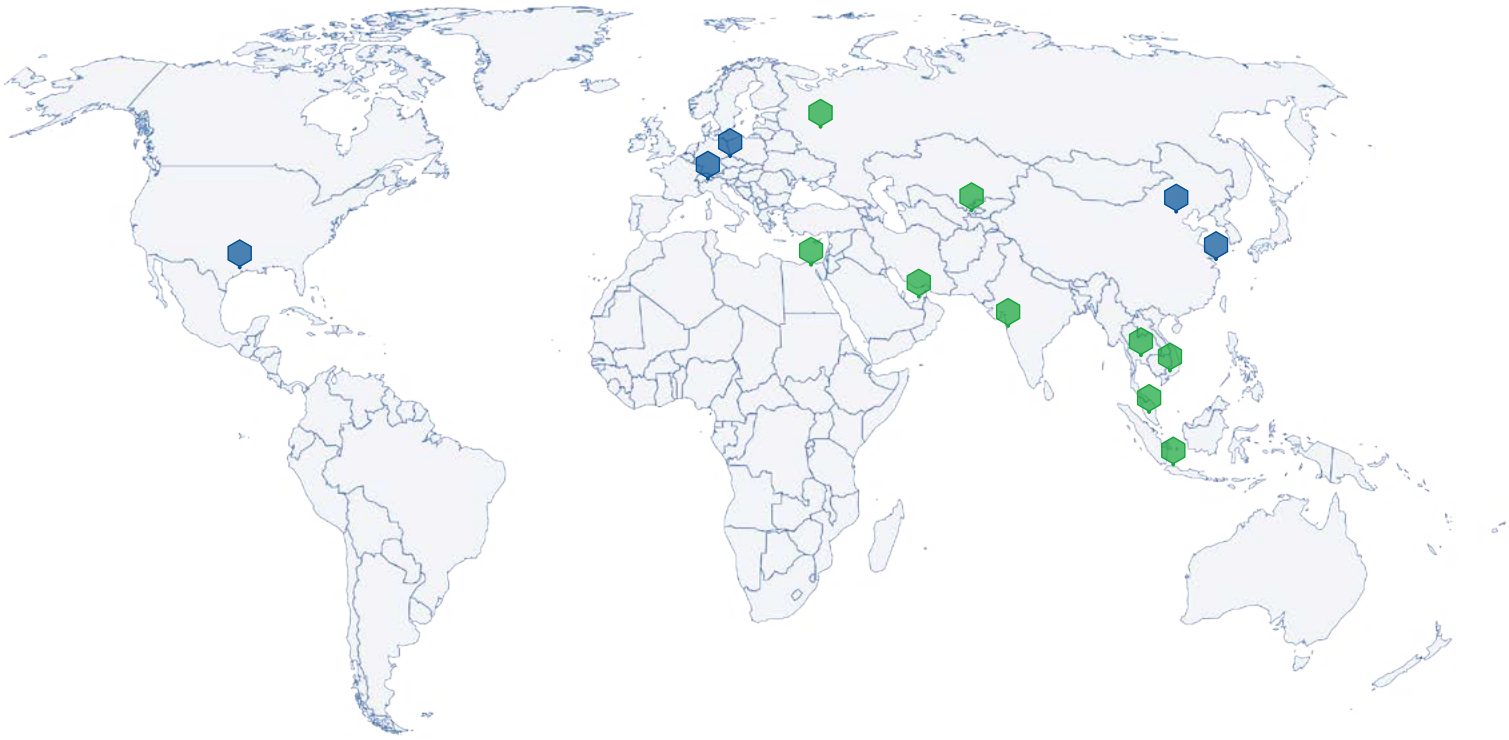
In a coal gasification plant, the syngas is richer in carbon monoxide (CO) and contains fewer inerts as against in a natural gas-based plant. This imparts a higher reactivity allowing, in turn, higher production rates. However, this fact may lead to catalyst overheating, resulting in performance degradation. This issue is mitigated through the use of an efficient converter such as Casale's IMC®, which very effectively removes the reaction heat by generating medium-pressure steam. The increased intrinsic reactivity leads also to reduced circulating gas flow rates, enabling the use of smaller and less costly equipment.

Thanks to its high efficiency and compact design, one single IMC® converter - either axial or Axial-Radial® flow type - is sufficient in most of the cases, even for high capacities, whereas other designs available on the market require multiple vessels.
Only if dictated by specific constraints (e.g. transportation size limitations), two separate converters can be considered.

PLANTS FOR
A NEW PLANET.
SINCE 1921.

v.01.04.24

Casale in the world



Headquarter

CASALE SA
Via Giulio Pocobelli, 6
6900 Lugano | Switzerland

Branch offices

Switzerland | Lugano
Czech Republic | Prague
China | Beijing, Shanghai
North America | Houston

Network of Representatives

Egypt, India, Uzbekistan, Indonesia, Thailand, Malaysia, Russia, United Arab Emirates, Vietnam

CASALE

Casale.ch