

GASIFICATION SOLUTIONS – FOR GREY AND GREEN

FROM A SYNGAS COOLING
PERSPECTIVE!

Ragnar Stare, Kapil Girotra, Shailesh Bade |
Gasification India | November 2022

SCHMIDTSCHACK

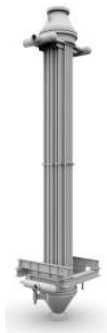
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OUR PORTFOLIO. OUR SHARE.

STEAM CRACKING

Transfer Line Exchanger



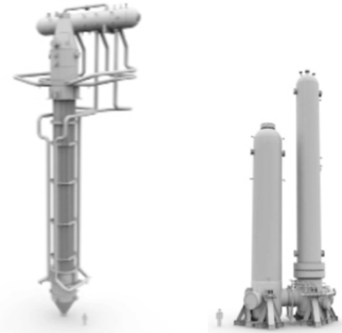
STEAM REFORMING

Process Gas Boiler, Heat Recovery System



GASIFICATION & POX

Reactor, Syngas Cooler



AMMONIA OXIDATION

Process Gas Cooler



CARBON BLACK

Air Preheater, Quench Boiler



SLUDGE INCINERATION

Air Preheater, Waste Heat Boiler



PROCESS HEATING

Customized Fired Heater



DIRECT REDUCTION

Heat Recovery System



MESSAGES

- Syngas - today and tomorrow
- Syngas Cooling Solutions – and how to select one
- Two Current technical hurdles
- Solutions provided by SCS

SYNGAS TODAY AND TOMORROW – ALWAYS GOVERNED BY COMBINED ENERGY AND CONVERSION COSTS

...BUT GOING FROM ENERGY TO CARBON AS LIMITED RESOURCE

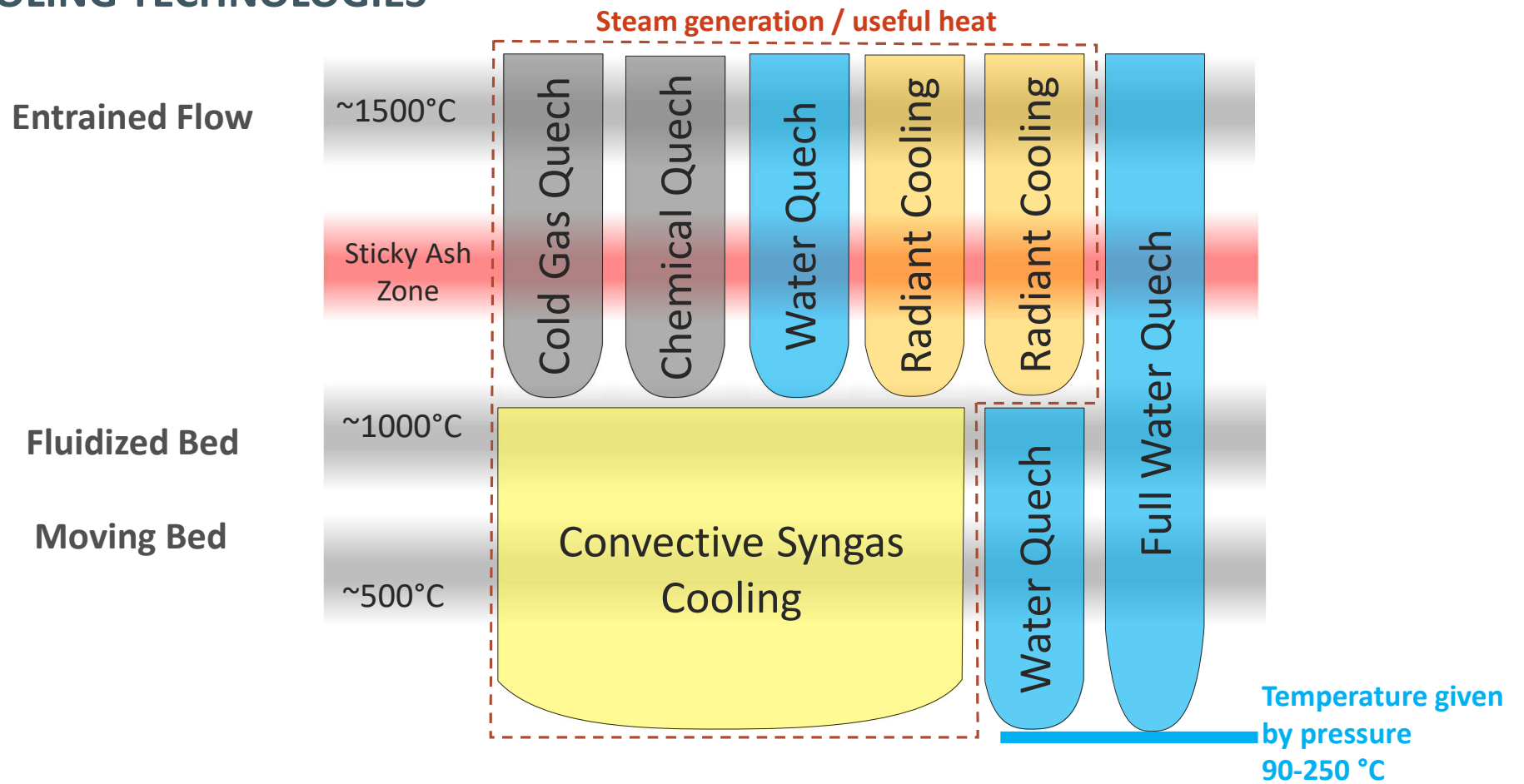
- **Today in operation** - Gasification of coal and residues from oil are by far the largest syngas generators from gasification.
- **Today in design and under construction**
 - In Asia/Pacific (APAC) coal (cost and feedstock availability)
 - In Europe/America biomass and waste gasification (circular economy /greenhouse gas reduction)
- **Tomorrow? A positive speculation – carbon and not energy the limited resource**
 - Renewable energy so abundant that syngas from reverse water gas shift applications are competitive to fossil.
 - Biomass and waste gasification applications and integrated part of circular/sustainable supply chains of material flows – when suitable with CCS for negative GHG emissions.
 - Fossil applications with CCS to reduce greenhouse gas (GHG) emissions, as carbon source –not main energy source.

2

Solutions – for syngas
cooling

SOLUTIONS – OVERALL PROFITABILITY

SYNGAS COOLING TECHNOLOGIES



THE LESS ENERGY RICH FEEDSTOCK – THE HIGHER RELATIVE VALUE OF SYNGAS COOLING

- Most useful syngas heat is lost in a quench.
- For a high temperature waste, biomass or low-BTU coal gasification, the syngas cooling energy is in the 30% range of the clean syngas heating value flow!
- ...and less water-resources utilized with a syngas cooler

**Saved coal cost of ~3,75
MUSD/y**

(3 134 lakh Rs/year)

By having a syngas cooler instead
of a quench

Comparing A 500 t/d gasifier with a
1250 C syngas temp with a syngas
cooler generating steam – to a gasifier
with a quench and having the same
amount of steam made made by a coal
steam boiler (5700 kcal/t coal costing
11,000 rs/t)

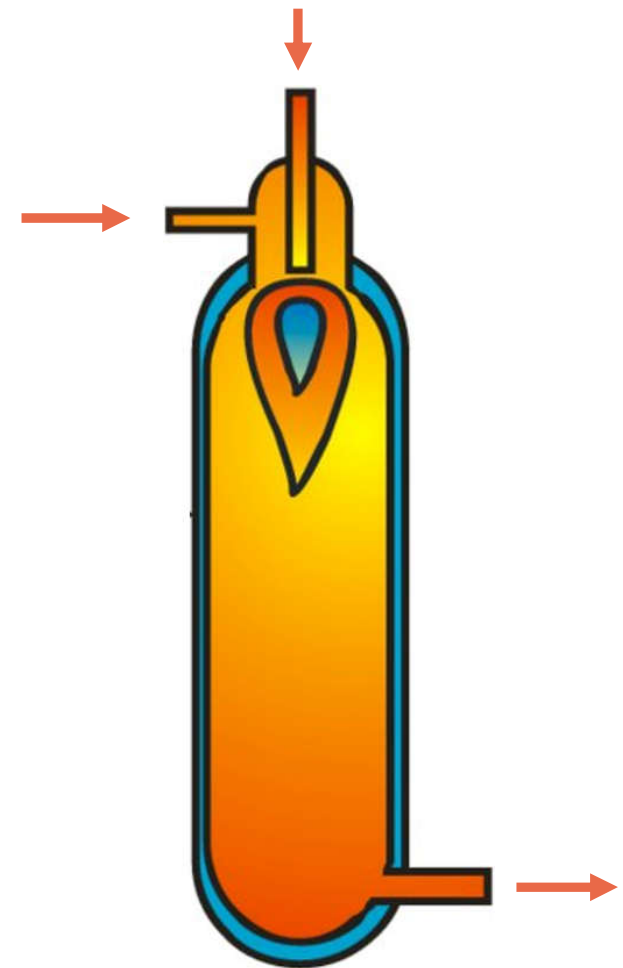
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Addressing two current technical hurdles

- Tars in raw syngas
- High ash coal gasification

THERMAL OXIDATION – PARTIAL OXIDATION, POX IN BIOMASS & WASTE GASIFICATION PROCESSES

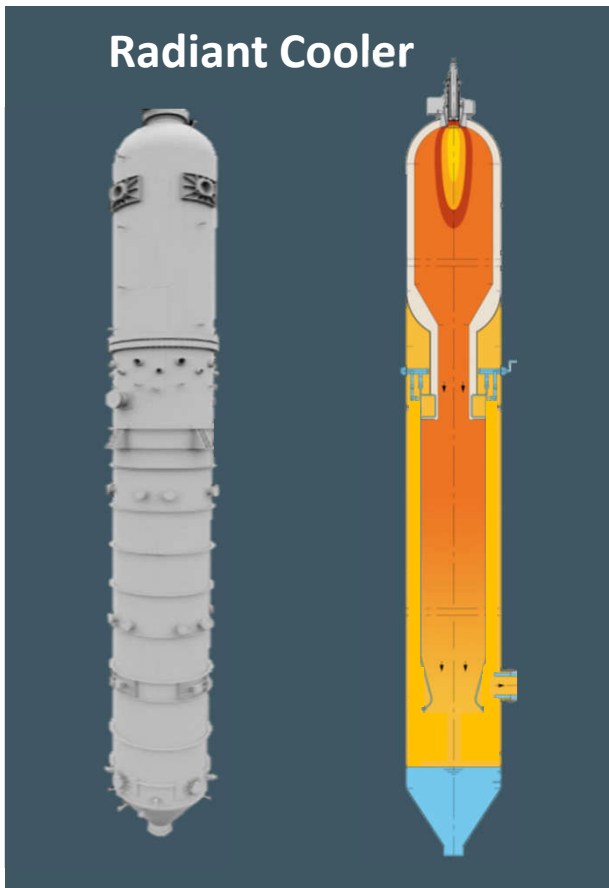
- Synthesis gas from gasification can be further upgraded to renewable fuels and chemicals provided that the gas is **ultra clean**
- In the past, a major hurdle, however, has been the removal of tar formed during the biomass gasification process
- Nowadays, impurities, such as light hydrocarbons and tar compounds present in the gasification gas can be converted to syngas by reforming
- Noncatalytic thermal oxidation is
 1. Robust with respect to the wide variation found in these feedstocks
 2. Allows additional syngas generation from other hydrocarbon sources and recycled streams



DESIGN FEATURES

MSW & BIOMASS (with and w/o slag) GASIFICATION

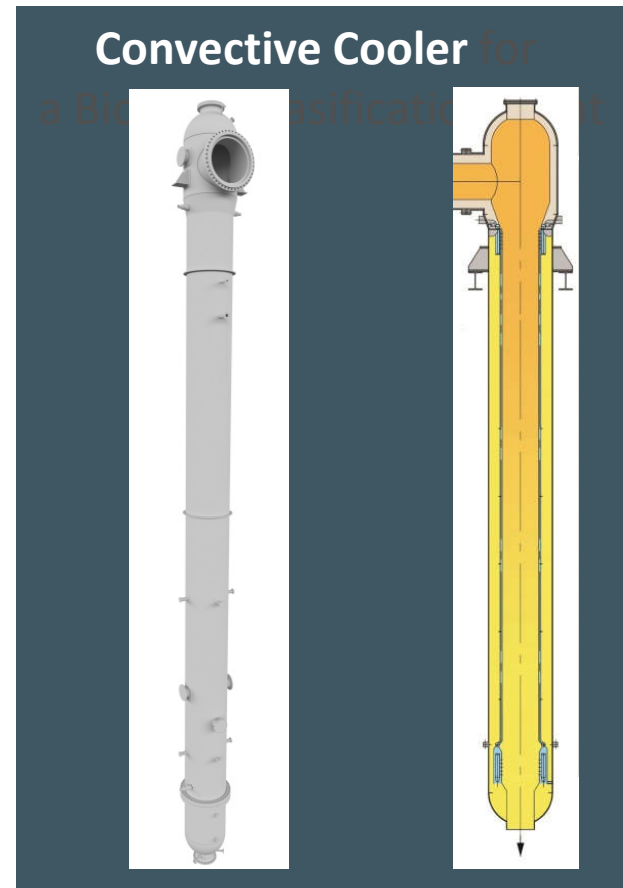
Radiant Cooler



The Radiant (RSC) and Convective Syngas Cooler (CSC) design principle put into service in several coal and slagging gasification plants.

The design concept has been developed further and can be adapted to the individual needs of renewable processes. Typical process and operation challenges can be managed by featured equipment fit for purpose.

Convective Cooler for



HIGH ASH COAL GASIFICATION

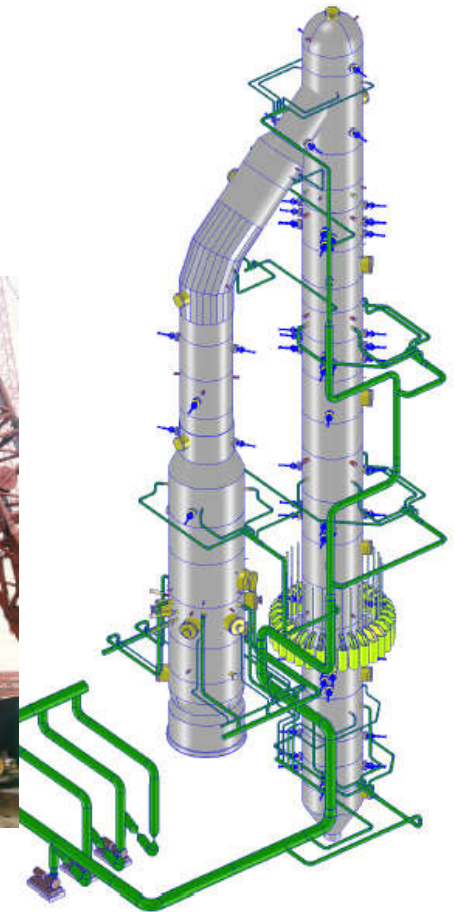
ENTRAINED FLOW AND FLUID BED

- Entrained flow
 - Talcher (Air Products / Shell) feedstock by a petcoke/coal MIX
 - Utilize the (Shell)-Air product gas quench system that mitigates problems by
 - Ensuring no liquid slag in contact with walls by cooling with recirculated filtered gas down to 900 C – gas quench
 - Ensuring gas cooling from 900 °C with a robust convective cooling solution
- Pressurized steam-oxygen fluidbed gasification of high ash coal

SYNGAS COOLING IN COOPERATION WITH AIR PRODUCTS SYNGAS SOLUTIONS

AIR
PRODUCTS

- The Air Products process for gasification of solids was developed by Shell and called SCGP, there are versions for both Quench mode and with syngas cooling , both with gasifier of membrane wall type.
- SCS is Authorized Designer for:
 - Coal Gasification technology SCGP
- Slagging type gasifiers with membrane wall
 - Taean IGCC, Korea, 3000 MTPD
 - Lu'an CTL, China, 4 units
 - Yima II, China
- Slagging type Quench Mode gasifiers
 - Hulunbuir Jinxin, China,



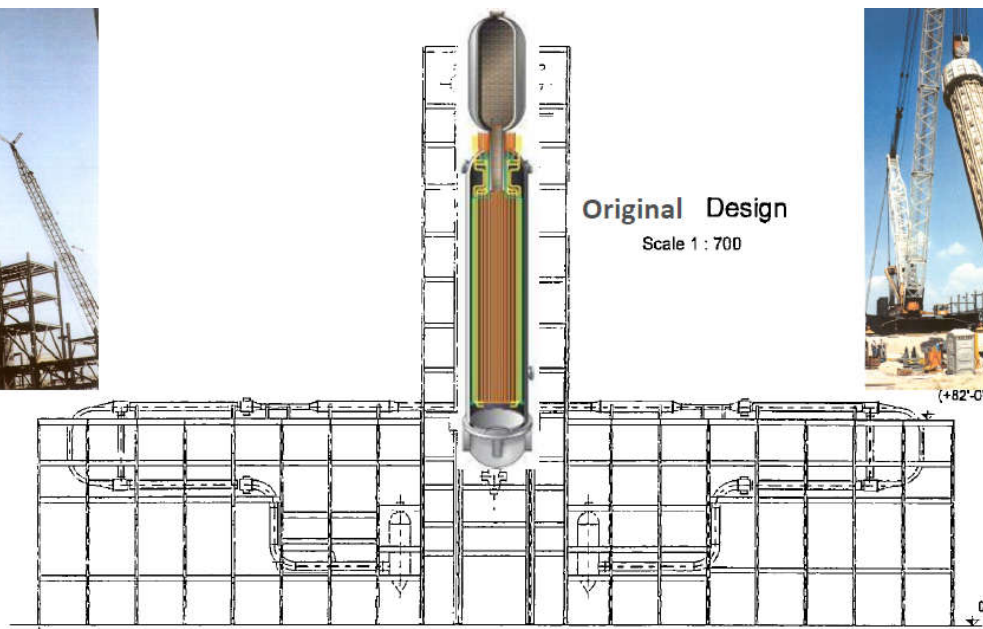
HIGH ASH COAL GASIFICATION

ENTRAINED FLOW AND FLUID BED

- Entrained flow
- Pressurized steam-oxygen fluidbed gasification of high ash coal
 - Plants in China runs in full industrial scale of western design
 - Large part of the ash in the coal is taken out from the bed – not with the syngas
 - SCS have made syngas cooler designs for that technology based on similar features based on RSC/CSC technology that shown above
 - Those RSC/CSC tech developed originally for Coal/petcoke, i.e. metallurgy and chemistry well tested.

TAMPA ELECTRIC 250 MW IGCC COAL GASIFICATION PLANT

- SCS redesigned the RSC thermodynamically and mechanically to deliver additional RSC and new CSC heating surfaces.



Gasifier, a Texaco slurryfed oxygen blown operating at 1300-1470 °C, consuming >2000 t/d of coal

Report comment from
<https://www.tampaelectric.com/>

The RSC typically recovers between 250 and 300 MMBTU/Hr in the form of 1650 psig steam. This represents highly efficient and relatively trouble-free recovery of between 12% and 15% of the fuel's heating value.

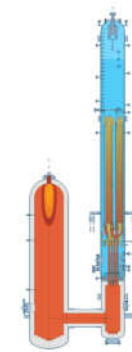
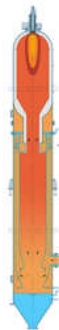
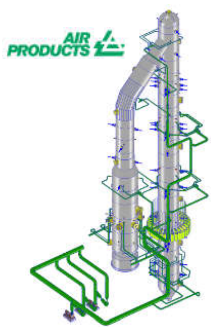
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Schmidtsche Schack – Gasification offer

SCHMIDTSCHESCHACK –GASIFICATION OFFER

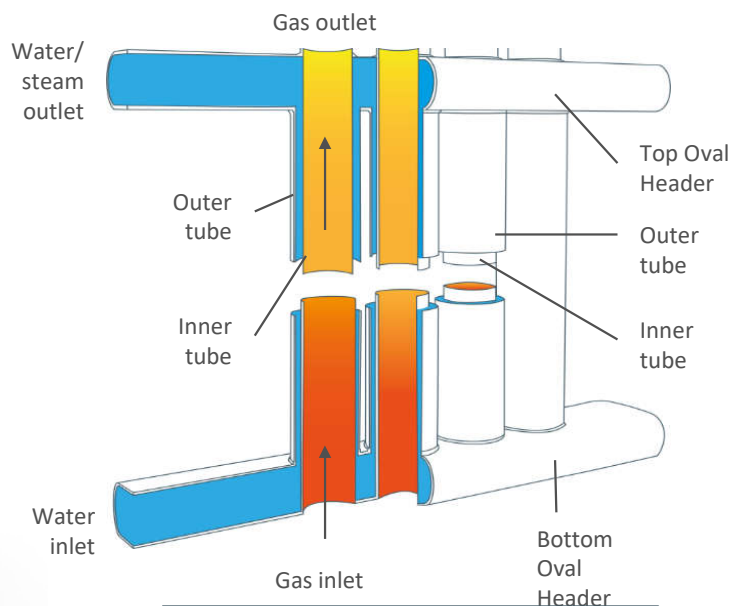
HARDWARE AND ENGINEERING – GREY BLUE AND GREEN

- Fossil –Grey and Blue (CCS)
- Fossil applications - Software
 - **Conceptual design support** - paid studies mostly needed to define hardware sufficient for quotations, except for some gas/liquid applications
 - Normally as design support to licensors. SCS does not own gasification technology, conversion information always from licensors.
- Fossil applications - Hardware
 - Gaseous and liquid feedstock - **Gasifier & Syngas coolers – hardware**
 - Solid feedstock (coal, petcoke)- **Syngas coolers as hardware**, gasifier as design /design support



TECHNOLOGY & SCOPE

REFERENCES: SUCCESSFUL LARGE CAPEX PROJECT
SCHMIDTSCH® DESIGN, JAMNAGAR



Successfull serial fabrication

DESCRIPTION

Application

- SGC in E- GAS PETCOKE GASIFICATION PLANT
- World Largest: **10 UNITS** ~500t each
- Petcoke gasification at temperature up to 1,500 °C (2,732 °F) and pressures up to 130 bar (1,885 PSI) with a Thermal Syngas Cooler power of 1,000 MW

Challenges

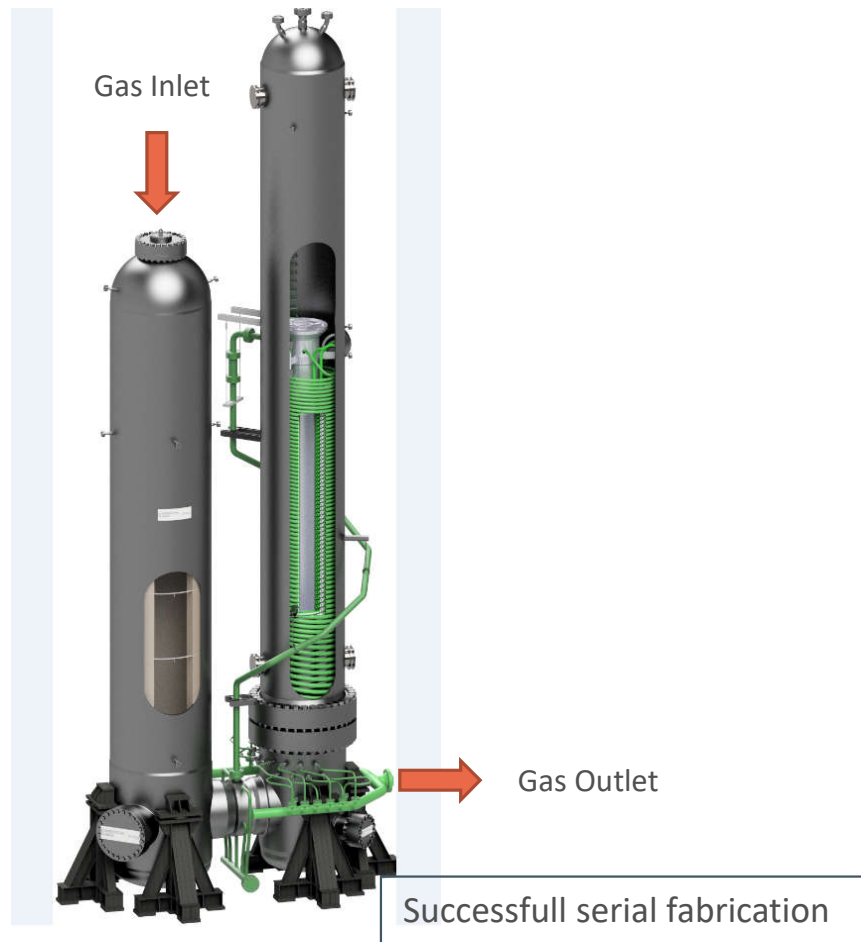
- Successful MATERIAL SUPPLY & FABRICATION CONCEPT
- Handles harsh operating conditions and highly abrasive dust loads
- Dust laden syngas, corrosive syngas composition
- High temperatures & pressures

SCS Advantages

- Based on the proven SCHMIDT'SCH® Double Tube & Oval Header technology platform
- Utilized in the ethylene industry for decades and successfully adapted for the gasification industry

TECHNOLOGY & SCOPE

REFERENCES: SUCCESSFUL LARGE CAPEX PROJECT: JAZAN:
SCS AS SHELL AUTHORIZED VENDOR & DESIGNER



DESCRIPTION

Application

- POX AND SYNGAS COOLER in SHELL Heavy Residue oil gasification
- World largest **15 Units** ~ 450t SGC each
- at temperature up to 1,400 °C and pressures up to 130 bar

Challenges

- Successful MATERIAL SUPPLY & FABRICATION CONCEPT
- **Successful Serial Fabrication**
- Handles harsh operating conditions and highly abrasive dust loads
- Very largescale plants
- Dust laden syngas
- Corrosive syngas composition
- High temperatures & pressures

SCS Advantages

- Jazan as result being **SHELL Authorized SOLE Designer** and **Authorized Vendor**

SCHMIDTSCHESCHACK –GASIFICATION OFFER

HARDWARE AND ENGINEERING – GREY BLUE AND GREEN

■ Renewable – Biomass and Waste applications - Software

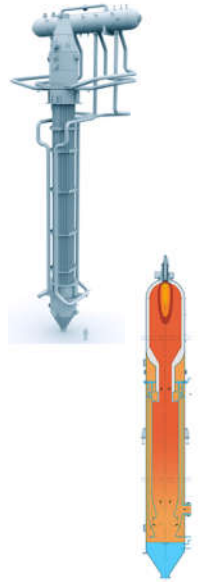
- Conceptual design support - paid studies needed for most application to define hardware sufficient for quotations. Studies done exclusively as part of project development process.
- Normally as design support to licensors. Conversion information always from licensors.

■ Renewable – Biomass and Waste applications - Hardware

- Syngas Cooling Systems – most applications, including auxiliary systems, e.g. slag handling
- Gasifiers for tar reforming – as hardware, together with burner suppliers as licensors
- Gasifier for solids gasification- Design support together with syngas cooling supply.
- Package Unit – Gasifier/Syngas Cooling system with suitable interfaces.

■ Upcoming solutions – eFuels, rWGS , methane pyrolysis, high temperature preheating, beyond steam applications

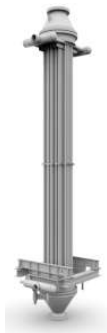
- Schmidtsche Schack continuously work to apply a century of knowledge and to develop the technology platform
- For rWGS including gasifier and syngas cooling systems as applicable



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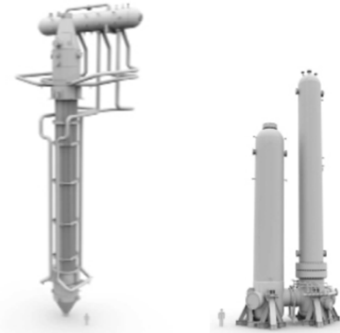
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SCS INSIGHTS

REALIZED WEIGHTS AND DIMENSIONS

Syngas Coolers

up to 700 t

Reformer/Gasifiers

up to 300 t

Plant sizes

from single-digit MWth

up to 10 GWth



GASIFICATION

CLIENTS OR PARTNERS TO SCHMIDTSCHESCHACK

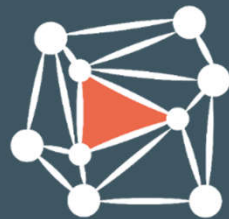


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SCHMIDTSCHESCHACK
Media - Hub

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Ragnar Stare

Ragnar.stare@arvos-group.com

Michael Schoetz

Michael.Schoetz@arvos-group.com

Kapil Girotra

Kapil.girotra@arvosindia.com

Shailesh Bade

Sahilesh.Bade@arvosindia.com

www.schmidtsche-schack.com

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