The Novel VESTA Process for Substitute Natural Gas Production

Gasification Technologies Conference 2012 - Washington
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Foster Wheeler and Clariant (Süd-Chemie) jointly developed the novel VESTA process to solve your SNG problem
Solid Fuel to SNG

The Methanation Reactions are Highly Exothermic

\[
\begin{align*}
\text{CO} + 3 \text{H}_2 & \rightarrow \text{CH}_4 + \text{H}_2\text{O} \quad \Delta \text{H} = -205 \text{ kJ/mole} \\
\text{CO}_2 + 4 \text{H}_2 & \rightarrow \text{CH}_4 + 2 \text{H}_2\text{O} \quad \Delta \text{H} = -165 \text{ kJ/mole}
\end{align*}
\]
Solid Fuel to SNG – Available Technologies

The recycle of CH₄ product to syngas is the standard process. CO dilution with CH₄
Solid Fuel to SNG– VESTA Technology

VESTA - Can we do more for you?

• Can we avoid high temperatures?
• Can we avoid recycle compressors?
• Can we avoid brick lined vessels?
• Can we avoid high alloyed steel?
Solid Fuel to SNG– VESTA Technology

**Highlights**

- No recycle of CH$_4$ product to the syngas
- Dilute with CO$_2$
- Dilute with Water

- **Dilution with CO$_2$ and water**
  - No Recycle Stream
- **Temperature cannot exceed 550°C**
  - No uncontrolled reaction possible
- **Flexibility of syngas composition**
  - No need for sour gas shift (SGS)
Solid Fuel to SNG – VESTA Technology

Process flow scheme

The Foster Wheeler SNG process uses CO$_2$ and water to control the heat of reaction.

Gasification
- Full flexibility in gasification technology
- Steam quench versus WHB

Removal of S impurities

Removal of CO$_2$
Solid Fuel to SNG – VESTA Technology

Summary features

The novel VESTA process has a number of significant benefits over other technology routes:

- Low temperature process: MAXIMUM 550°C
- No coke formation
- No metal dusting risk
- Once-through operation: NO RECYCLE COMPRESSOR
- Low severity steam boiler
- No brick-lined vessel
- No high alloyed steel
- High quality CO₂ recovery
Solid Fuel to SNG – VESTA Technology

**Reactor material**

**Reactor Cost**
- Material
- Inner Diameter → Wall thickness
- Reaction temperature → Brick Lining

.... and we are developing a new reactor concept to reduce costs
Coal to SNG – VESTA Technology

Steam flexibility

VESTA provides full flexibility of steam quality
Temperature: 450 to 500°C
Pressure: For all industrial applications
Coal to SNG – VESTA Technology

Summary

The VESTA SNG Process

- **Primary** Process to produce SNG from any syngas
- **Includes** Efficiency to recover heat of reaction
  - Temperature profile over the scheme
  - Flexibility in steam production
- **Facilitates** Production of export steam
- **Enables** Full flexibility of gasification technology
  - Utilization of low-quality coal
Solid Fuel to SNG– VESTA Technology

*Ideal for…*

**China:**
- Coal to SNG
- Coke oven gas to SNG

**Middle East:**
- Petcoke to SNG

**Europe:**
- Biomass to SNG
Foster Wheeler and Clariant can tailor the VESTA process to meet your specific SNG project requirements.
Examples of VESTA Technology application

- Biomass to SNG
- Coal to SNG
- Petcoke to SNG
Biomass to SNG – VESTA Technology application

SNG production via biomass gasification is an opportunity for a greener world; main technologies are available and sufficiently mature for commercial application. Recently Foster Wheeler’s assessments showed that a biomass-to-SNG plant can be economically attractive, even without financial support from local governments.

TECHNICAL DATA

Feedstock: wood chips and forest residues and limited amount of back pellets/demolition wood

Flowrate: 100 t/h as received
SNG production: 16,900 Nm³/h
SNG plant cold gas efficiency: 68.5 % (*)
Electrical power import: 20 MWe

(*) Including biomass to power plant (1.5 ton/h) necessary to close steam balance
Biomass to SNG – VESTA Technology application

**Feedstock Preparation & Drying** → **CFB Gasification** → **TAR Removal** → **Syngas Cooling & Compression**

**Flue Gas** → **Power Island**

**Power Island**

**CO₂ Removal** → **Pure CO₂ to ATM**

**Acid Gas Removal** → **Power Island**

**FLUE GAS**

**POWER ISLAND**

**ASH**

**ASU**

**OXYGEN**

**LIMESTONE / SAND**

**FLY ASH**

**SNG DRYING & COMPRESSION** → **SNG VESTA** → **ACD GAS REMOVAL**

**ACID GAS TO POWER ISLAND**

**FEEDSTOCK PREPARATION & DRYING**

**SNG**

**BIO MASS**

**CLARIANT**

**ASH HP STEAM FROM GASIFICATION**

**Biomass to SNG – VESTA Technology application**
Coal to SNG – VESTA Technology application

In some areas of the world, natural gas demand cannot be satisfied by import with the consequent requirement to exploit coal reserves to produce fuel. SNG (substitute natural gas) is the solution; it is competitive in many situations if coal is processed.

TECHNICAL DATA

Feedstock: Bituminous coal: LHV equal to 25,870 kJ/kg and sulphur content of 1.1% wt (dry, ash free)
Flowrate: 100 t/h
SNG production: 34,800 Nm³/h
Electrical power production: 0 MWe net (*)

(*) Gross electrical power production 53 MWe
Coal to SNG – VESTA Technology application

ASU

OXYGEN

COAL

GASIFICATION

OXYGEN

ASH

SNG DRYING & COMPRESSION

SNG VESTA

CO2 REMOVAL

SULPHUR UNIT

ACID GAS

SULPHUR

ACID GAS REMOVAL

SYNGAS TO POWER ISLAND

SYNGAS FROM AGR

FLUE GAS

POWER ISLAND

POWER

ASH

HP STEAM FROM GASIFICATION

SNG VESTA

PURE CO2 TO ATM

SYNGAS

SNG DRYING & COMPRESSION

SNG

POWER ISLAND
Pet coke to SNG – VESTA Technology application in refinery environment

A solution for refineries where:

• Coke disposal may be a concern, or

• Where refineries are concerned about coke dispersal from delayed coking units

Pet coke can be gasified and SNG produced.

SNG can be used for internal consumption or distributed outside Refinery fence.

The VESTA technology can be fitted in Foster Wheeler’s PetroPower™ scheme where a number of integration possibilities can make the overall investment more profitable.
Pet coke to SNG – VESTA Technology application in Refinery environment

Considering a 200,000 BPSD refinery processing an average crude, 100 t/h of pet coke are produced.

TECHNICAL DATA

Feedstock: pet coke from a DCU, LHV equal to 32450 kJ/kg and sulphur content of 6.7% wt (dry, ash free)

Flowrate: 100 t/h (*)

SNG production: 37,800 Nm³/h (362 MWth)

Electrical Power production: 60 MWe net suitable to satisfy refinery needs

(*) Pet coke: 75 t/h to SNG production and 25 t/h to power station.
Petcoke to SNG – VESTA Technology application in Refinery environment
Conclusions

Foster Wheeler and Clariant have developed a simple concept process for SNG production. The SNG production unit is able to handle syngas coming from different production units.

The scheme is adaptable to any syngas composition: syngas conditioning is not necessary.

The VESTA technology has been proven at laboratory scale ... a demonstration unit will be constructed shortly.
Thank you
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