UTILIZING LOW GRADE COAL TO PRODUCE METHANOL : A CASE STUDY

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AGENDA

- Gasification Overview
- Coal to Methanol : Case Study
  - Methanol
  - Current Methanol Scenario
    - Global
    - India
  - Coal to Methanol-BFD
  - Economics
- Conclusion
- Fluor Gasification Experience

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GASIFICATION OVERVIEW

- Reaction of low value fuels such as coal, petroleum residues, biomass, industrial wastes, MSW, etc. with oxygen and steam at high temperature to produce H_2 + CO synthesis gas
- Primary Gasification Reactions:
  - Partial Oxidation — $2\,C + O_2 \rightarrow 2\,CO$
  - Steam Gasification (Reforming) — $C + H_2O \rightarrow CO + H_2$
  - Water Gas Shift — $CO + H_2O \rightarrow CO_2 + H_2$
  - Methanation — $3\,H_2 + CO \rightarrow CH_4 + H_2O$
- Operating Conditions: 900 – 2000°C / 0.3 – 85 barg
- Heteroatoms:
  - N converted primarily to N_2, NH_3, HCN
  - S converted primarily to H_2S, COS, CS_2
  - Many trace components (e.g. formic acid, chlorides, sulphur & nitrogen compounds, cyanides, soot, metal carbonyls and others)

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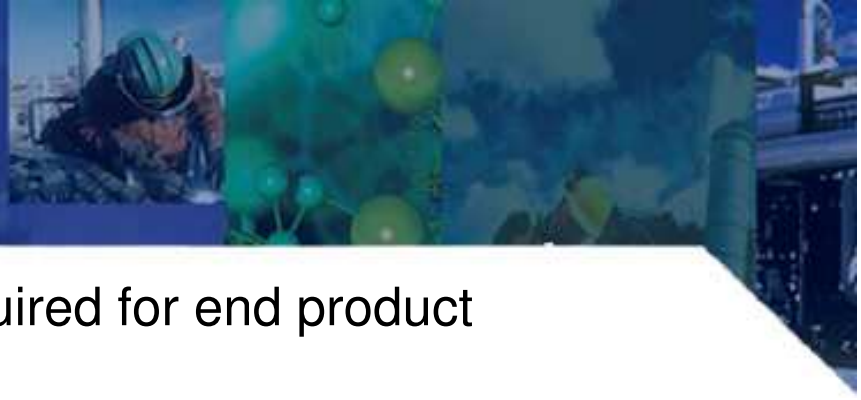
GASIFICATION OVERVIEW



- Water gas shift to adjust H_2/CO ratio as required for end product
  - $CO + H_2O \rightarrow H_2 + CO_2$
- Syngas clean up and acid gas removal to condition gas for downstream catalysts and to meet environmental regulations
- Sulphur recovery as elemental sulphur or sulphuric acid
- Potential for CO_2 capture and use for Coal Bed Methane / Enhanced Oil Recovery or Sequestration
- Gasification is a complex and challenging process
  - Project execution requires integration of technologies from several parties
  - Attention to trace components, corrosion, catalyst life and process control
  - Special attention to CAPEX and OPEX from the early stages of project development
  - Requires a highly qualified team with gasification experience
  - Frequent routine maintenance and replacement of specific component which result in downtime
  - Handling of solids

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Coal to Methanol: Case Study

METHANOL

- Methanol is a versatile chemical having a wide range of applications
- Traditional applications include production of formaldehyde, acetic acid, MTBE, Methyl Methacrylate, Methylamines, Methyl Halides, etc.
- Emerging applications are : Methanol to Olefins, Gasoline Blending, Biodiesel, DME, Methanol to Gasoline, Bunker Fuel, etc.
- Methanol is a clean burning fuel → produces no particulate matter, no soot, no SOx and NOx emissions

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Coal to Methanol: Case Study

CURRENT METHANOL SCENARIO - GLOBAL

- World has installed capacity of 120 MMTPA of Methanol and will be about 200 MMTPA by 2025
- China alone produces 65% of world Methanol and it uses its coal to produce Methanol.
- Israel and Italy have adopted the M15 blending program with Petrol and fast moving towards M85 & M100
- Japan and Korea have extensive Methanol & DME usage and Australia has adopted GEM fuels (Gasoline, Ethanol & Methanol) and blends almost 56% Methanol

Reference:

- https://pib.gov.in/PressReleseDetail.aspx?PRID=1514452
- http://vikaspedia.in/energy/energy-basics/methanol-economy-in-india

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Coal to Methanol: Case Study

CURRENT METHANOL SCENARIO - INDIAN

- India has an installed Methanol Production Capacity of 2 MMTPA which is currently produced from Natural Gas.
- As per plan by NITI AAYOG → 30 MMTPA of Methanol is required to substitute 10% of crude imports by 2030
- Presently India's import bill on account of crude stands at almost 6 lakh crores
- Government has set a goal to reduce the import bill by 10 % by the year 2022

HOW TO ACHIEVE THESE GOALS:

- India has fifth largest coal reserves in the world
- Most of these reserves have low rank coal with high ash content
- Gasification offers an alternate to use domestically available coal reserves to make value added products in an environment friendly manner

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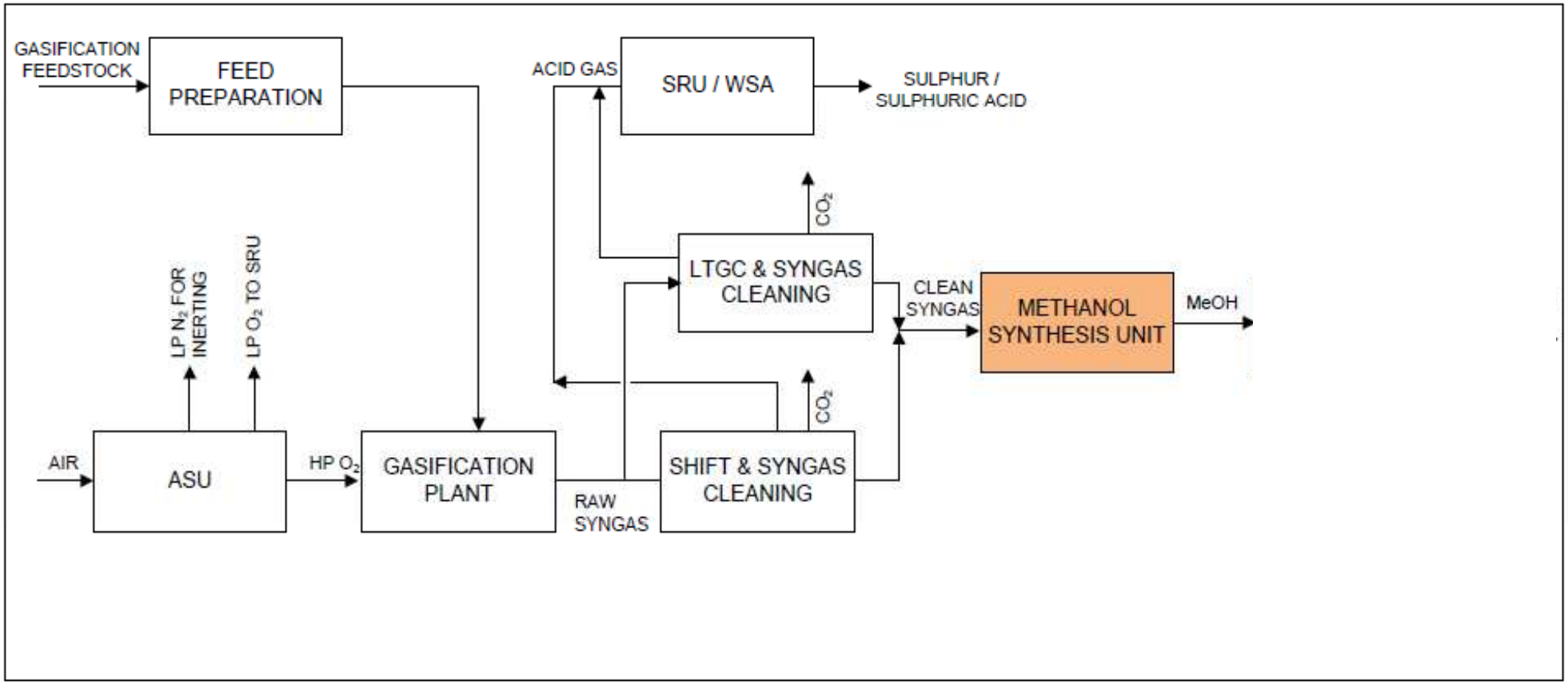
Coal to Methanol: Case Study

COAL TO METHANOL- BFD



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Coal to Methanol: Case Study

ECONOMICS

Basis and Assumptions:

- Methanol Capacity: 2250 KTA
- Coal (35-40 wt% ash) price : 20 - 40 $/MT
- Raw water price : 0.06 $/MT
- Sulphuric acid price : 78 $/MT
- Operations & maintenance cost : 2 to 3 % of CAPEX

❖Cash Cost= Raw material (coal + raw water) cost + Operations & Maintenance (incl. catalyst & chemicals) cost + Capital cost over plant design life – Revenue from other byproducts

❖This Case Study is based on certain assumptions and results may vary based on feedstock characteristics and type of gasification technology selected

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Coal to Methanol: Case Study

ECONOMICS

Results:

Coal Cost ($/MT)	Methanol Cash Cost ($/MT)	Methanol Cash Cost (Rs/liter)
20	180	10.2
30	200	11.4
40	220	12.5

Imported Methanol price in India: 290-320 $/MT

Reference:

- https://www.icis.com/explore/resources/news/2019/04/18/10350350/india-methanol-spikes-on-tight-supply-may-not-sustain-gains

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CONCLUSIONS

- Gasification is a complex and challenging process but –
  - Offers a cost effective option to convert low rank coal into **high value added products such as Methanol**
  - Coal availability in India places gasification in a strategically important position with anticipated **positive downstream product slate demand**
  - Gasification offers an alternate to use domestically available vast coal reserves to make value added products in an **environment friendly manner**
  - Can **reduce India's fuel import bill** and help in achieving Government's plan to **boost Methanol economy**
  - While challenging, several gasification projects have been successful. Must employ **best technologies** and employ **gasification experienced** design engineers

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FLUOR GASIFICATION EXPERIENCE

Client	Location	Scope	Feed	Products	Technology	Completed
Confidential	Indonesia	Pre-FEED	Coal	Polypropylene, DME and Urea	Confidential	Ongoing
Lake Charles Methanol	Louisiana	FEED	Petcoke	Methanol	GE	Ongoing
Celanese / IOCL	India	Pre-FEED	Petcoke, Coal	Ethanol, Power	Confidential	2015
Reliance Industries	India	E, P and PM Support	Petcoke, Coal	Hydrogen, SNG, Power	MDR E-Gas	Ongoing
Pertamina	Indonesia	Pre-FEED	MSW	Power	Solena	2014
Confidential	Indonesia	Pre-FEED	High Moisture Indonesian Coal	SNG, Urea, CO_2	Confidential	2012
Jindal SynFuels	India	Pre-FEED	High Ash Indian Coal	FT Liquids, Ammonia	Confidential	2012
Reliance ADAG	India	Pre-FEED	High Moisture Indonesian Coal	SNG, Power	Confidential	2012
MAK	Mongolia	Pre-FEED	High Moisture Brown Coal	MTG, Power	Confidential	2012
Fulcrum Sierra BioFuels	Nevada	FEED Refresh, EPC	MSW	Ethanol, Power	InEnTech (IET)	2012
OPTI Canada Phase II	Alberta	FEED	Residue	Hydrogen, Power, CO_2	Shell	2012
Rentech	California	FEED	Woody Waste	FT Liquids, Power	Rentech SilvaGas	2011

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FLUOR GASIFICATION EXPERIENCE

Client	Location	Scope	Feed	Products	Technology	Completed
Summit	Texas	FEED	Coal	Urea, Power, CO_2	Siemens	2011
Swan Hills	Alberta	Pre-FEED, FEED	Deep Unmineable Coal	Power, CO_2	Swan Hills In-situ Coal Gasification	2011
MSEZL	India	Pre-FEED	Petcoke	Acetic Acid, Hydrogen, Power	Confidential	2010
Eastman	Texas	FEED	Petcoke	Hydrogen, Methanol, Ammonia, CO_2	GE	2009
Confidential	Montana	Pre-FEED	Coal	Urea, Power, CO_2	Siemens	2009
Valero	Texas	Pre-FEED	Petcoke	Hydrogen, Power, CO_2	ECUST	2009
OPTI Canada	Alberta	FEED, EP	Residue	Hydrogen, Power	Shell	2008
Steelhead	Illinois	FEED	Coal	SNG	CoP E-Gas	2006
Total	France	FEED	Residue	Hydrogen, Power	GE	2004
ISAB	Italy	Owner's Eng.	Residue	Hydrogen, Power	GE	1999
Great Plains	North Dakota	Owner's Eng.	Coal	SNG	Lurgi	1988
Shell	Netherlands	FEED, EPCM	Residue	Hydrogen, Power	Shell	1997
Motiva	Louisiana	EP	Residue	Hydrogen	GE	1985
Eastman	Tennessee	C	Coal	Chemicals	GE	1986
Sasol	South Africa	EPCM	Coal	FT Liquids, Chemicals	Lurgi	1980

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STAY CONNECTED..

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