

SYNTHESIS GAS

INTRODUCTION TO PETROCHEMICAL INDUSTRIES

SYNTHESIS GAS

- Synthesis Gas also called SYNGAS, is a fuel mixture consisting primarily of hydrogen, carbon monoxide, and very often carbon dioxide.
- The chemical composition of syngas varies based on the raw materials, processes and the end use.
- Synthesis gas comes from its use as intermediates in creating Synthetic Natural Gas (SNG) and for producing ammonia and methanol.

PRODUCTION OF SYNTHESIS GASES

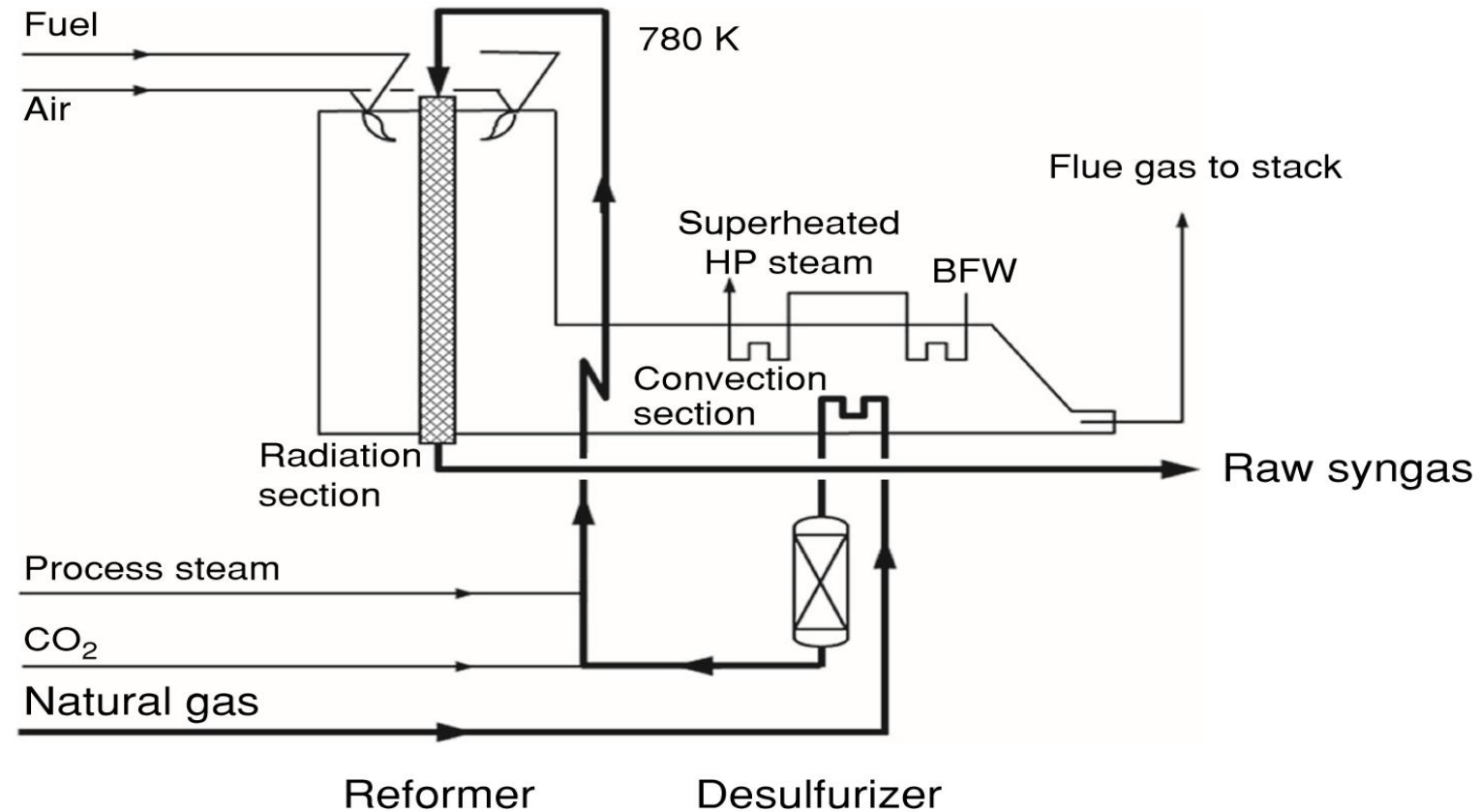
➤ Synthesis gas can be produced from many sources, including natural gas, coal, biomass or virtually any hydrocarbon feedstock, by

1. Reaction with steam (Steam Reforming)
2. Carbon dioxide (Dry Reforming)
3. Oxygen (Partial Oxidation)
4. Gasification of coal

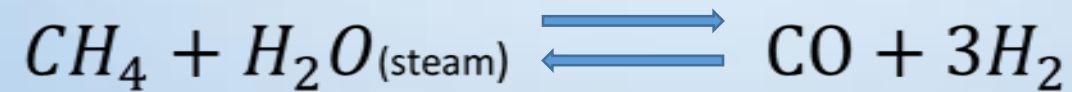
STEAM REFORMING

- This is the predominant method used in synthesis gases production.
- It means, the reaction of natural gas, hydrocarbon feedstock, coal or biomass with steam, in simple terms.
- Steam reforming of natural gas is sometimes referred to as Steam Methane Reforming (SMR).
- Steam reforming is an endothermic reaction with 206kJ/mol methane needed for conversion.

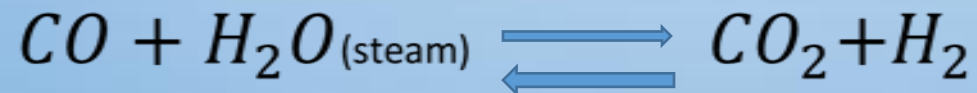
FLOW CHART OF STEAM REFORMING OF NATURAL GAS



- At high temperatures (700°C - 1100°C) and in the presence of a metal based catalyst (nickel), steam reacts with methane to yield carbon monoxide and hydrogen, that is



- Additional hydrogen can be removed by lower temperature gas-shift reaction with the carbon monoxide produced, in the presence of a copper or iron catalyst, that is



DRY REFORMING

➤ Carbon dioxide reformation is a method of producing synthesis gases from the reaction of carbon dioxide with hydrocarbons such as methane.

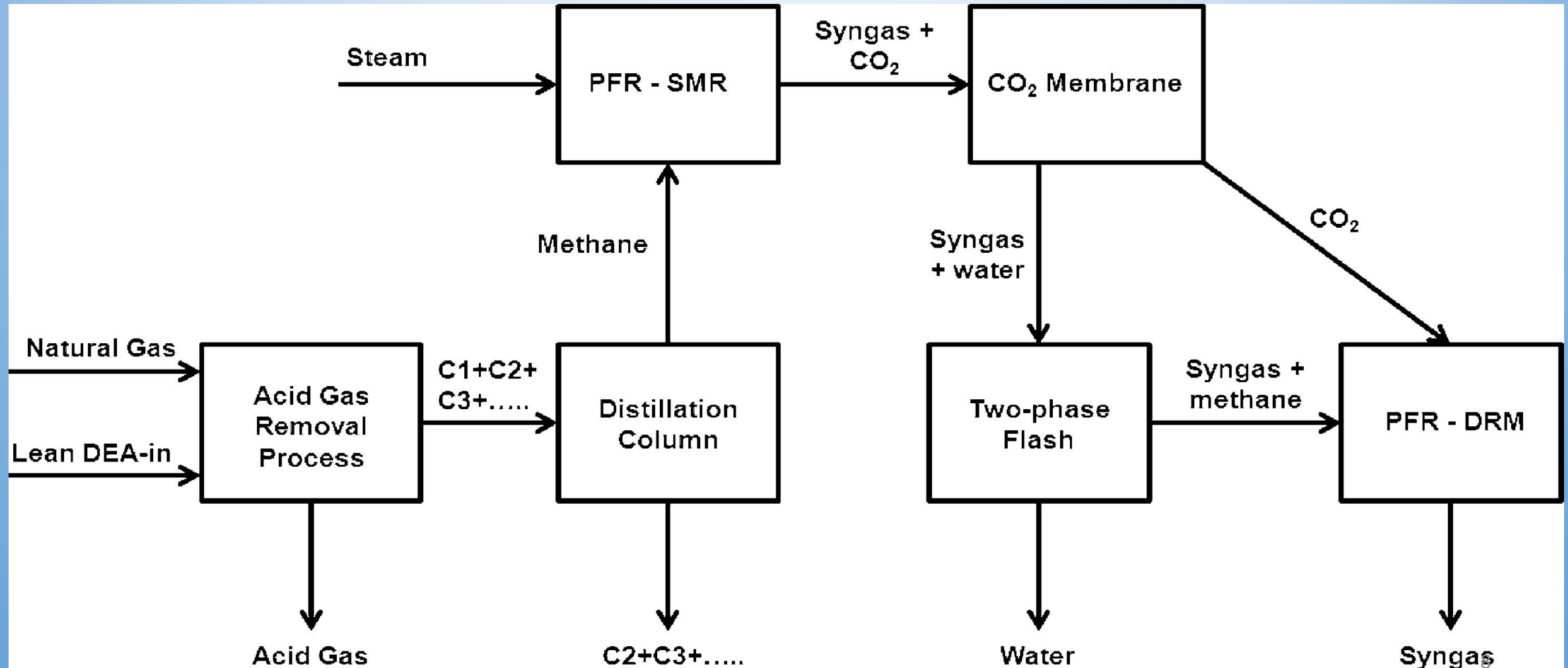
➤ The dry reforming reaction maybe represented by



➤ The gases CO_2 and CH_4 , greenhouse gases, are consumed and useful chemical building blocks such as hydrogen and carbon monoxide are produced.

➤ Typical catalysts are noble metals, Ni or Ni alloys. In addition, activated carbon can be used as an alternative catalyst.

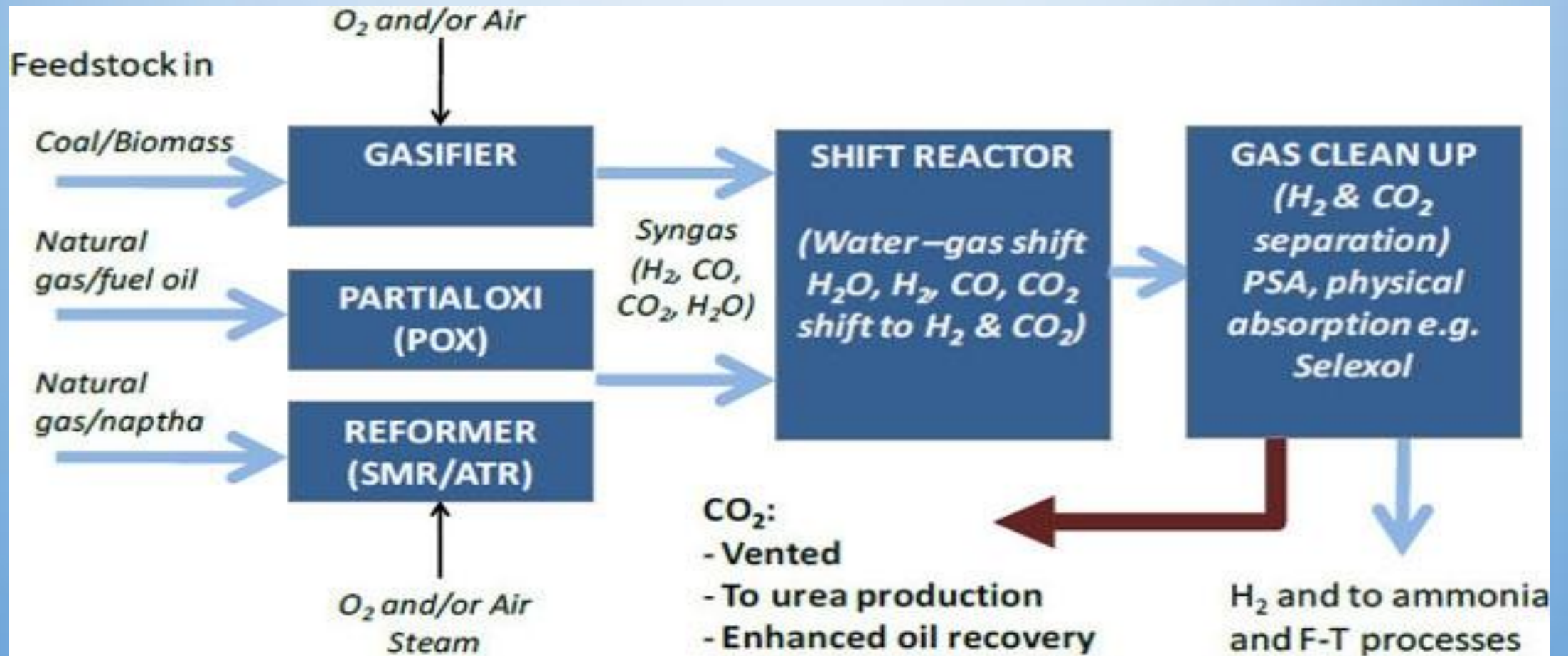
FLOW DIAGRAM FOR DRY REFORMING OF NATURAL GAS



PARTIAL OXIDATION

- It is an exothermic chemical reaction which occurs when a sub-stoichiometric fuel-air mixture is partially combusted in a reformer, creating a hydrogen-rich syngas which can then be put to further use.
- Thermal Partial Oxidation (TPOX) reactions are dependent on the air fuel ratio, which proceeds at temperatures of 1200°C and above.
- Catalytic Partial Oxidation (CPOX), the use of a catalyst reduces the required temperature to a range of about 800°C to 900°C.

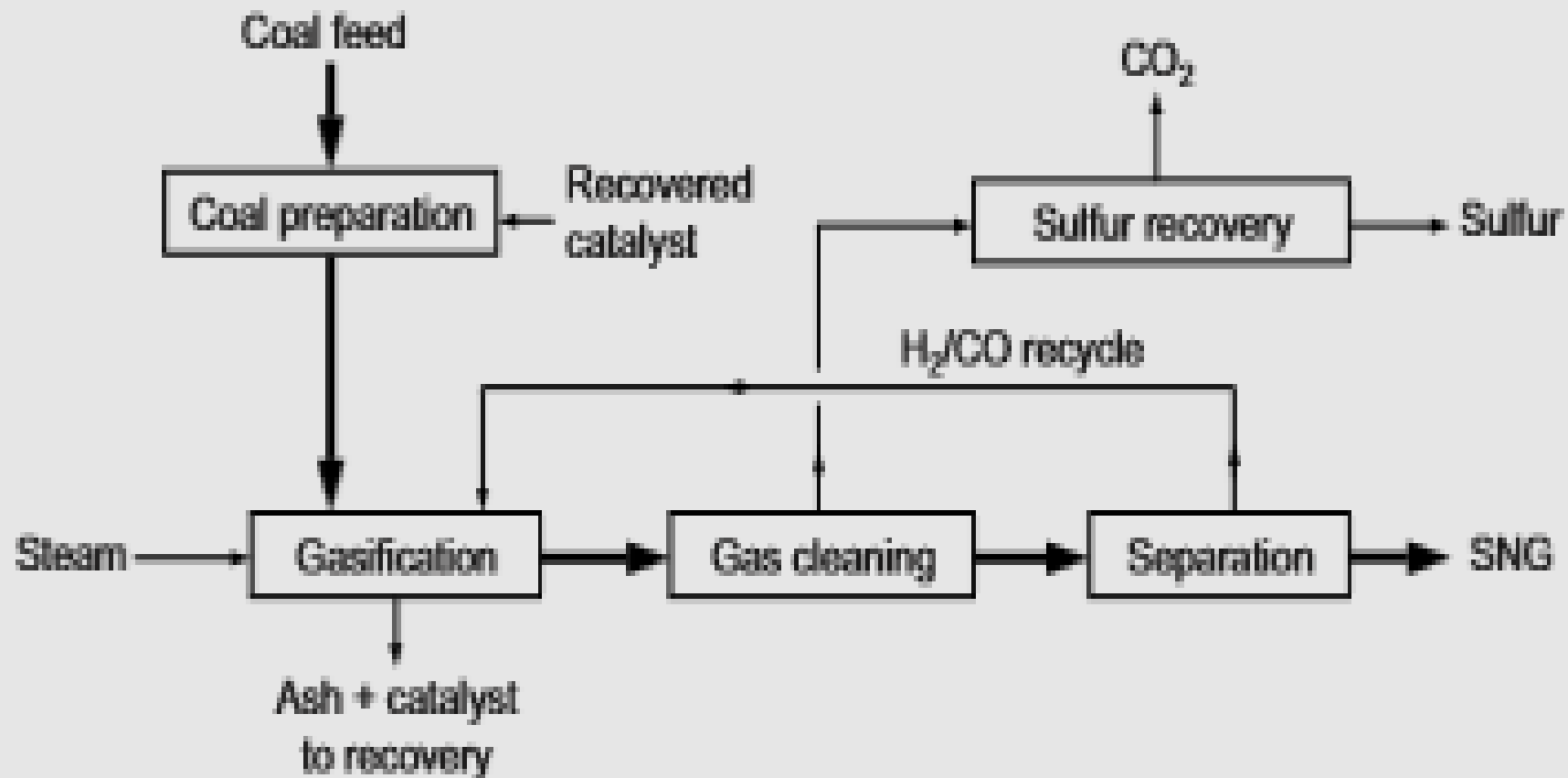
FLOW DIAGRAM FOR PARTIAL OXIDATION



GASIFICATION OF COAL

- This is simply the process used to convert coal into gas.
- Coal contains predominantly of carbon compound.
- Coal contains both the organic part and inorganic part.
- Gas produced from coal gasification contains predominantly CO and H₂.
- In the gasifier, the feedstock reacts with steam and oxygen at elevated pressure and temperature.

FLOW DIAGRAM FOR GASIFICATION OF COAL



summary

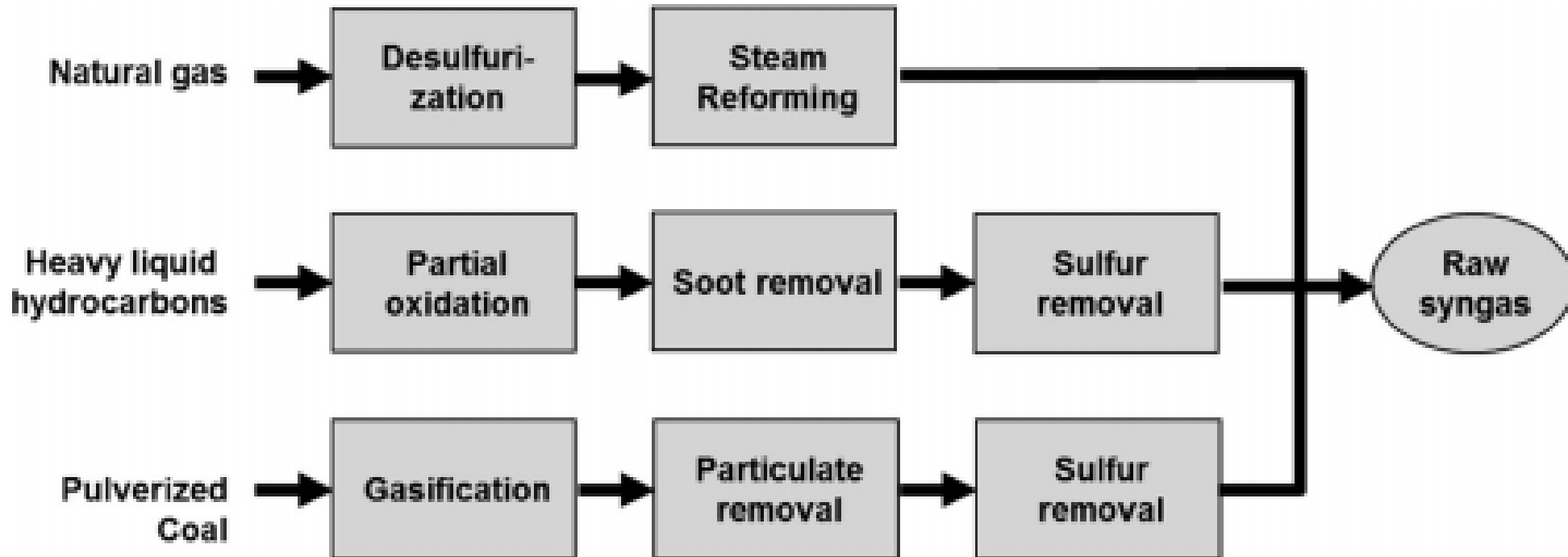


Figure 5.1 General process flow diagrams for the production of syngas.

APPLICATIONS OF SYNTHESIS GASES

1. Electricity generation
2. Use as gas engines
3. As an intermediate for other compounds (ammonia and methanol)

THANK YOU!