NON-HYDROCARBON INTERMEDIATES

HYDROGEN, SULPHUR AND CARBON BLACK

INTRODUCTION

Non-hydrocarbon intermediates are non-hydrocarbon compounds produced from natural gas, crude oils, and other fossil materials such as coal.

TERMINOLOGIES

- An intermediate is a precursor to a desired product.
- A precursor is a substance from which another substance is formed.

Simply put, other substances can be produced from these intermediates.

HYDROGEN

PROPERTIES

- Exists naturally as a gas. Occurs abundantly in nature (about 75% of the earth's elemental mass) and is the lightest known element on the planet. Very chemically reactive and therefore, rarely occurs in nature in its free uncombined form.

PRODUCTION

- Electrolysis of water
- Thermochemical decomposition of water
- Photochemical decomposition of water
- Steam reforming

STEAM REFORMING METHOD

* METHANOL

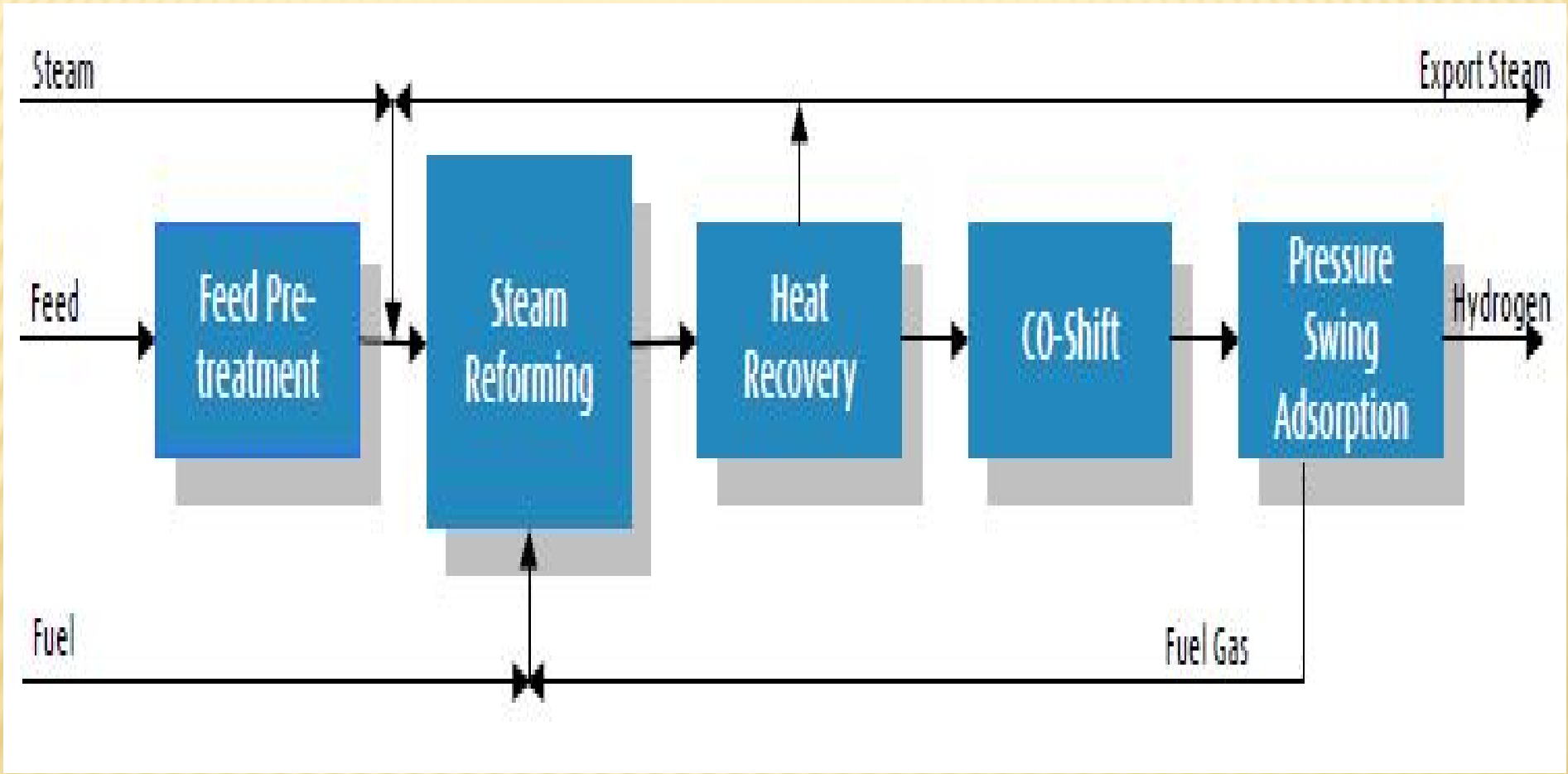
- Active catalyst is used to decompose methanol
- Carbon monoxide produced is shift converted to carbon dioxide and then removed.

$$CH_3OH + H_2O_{(g)} \longrightarrow CO_{2(g)} + 3\,H_{2(g)}$$

- Process yields relatively small amounts of highly pure hydrogen gas(0.18- 1.8 MMscfd)

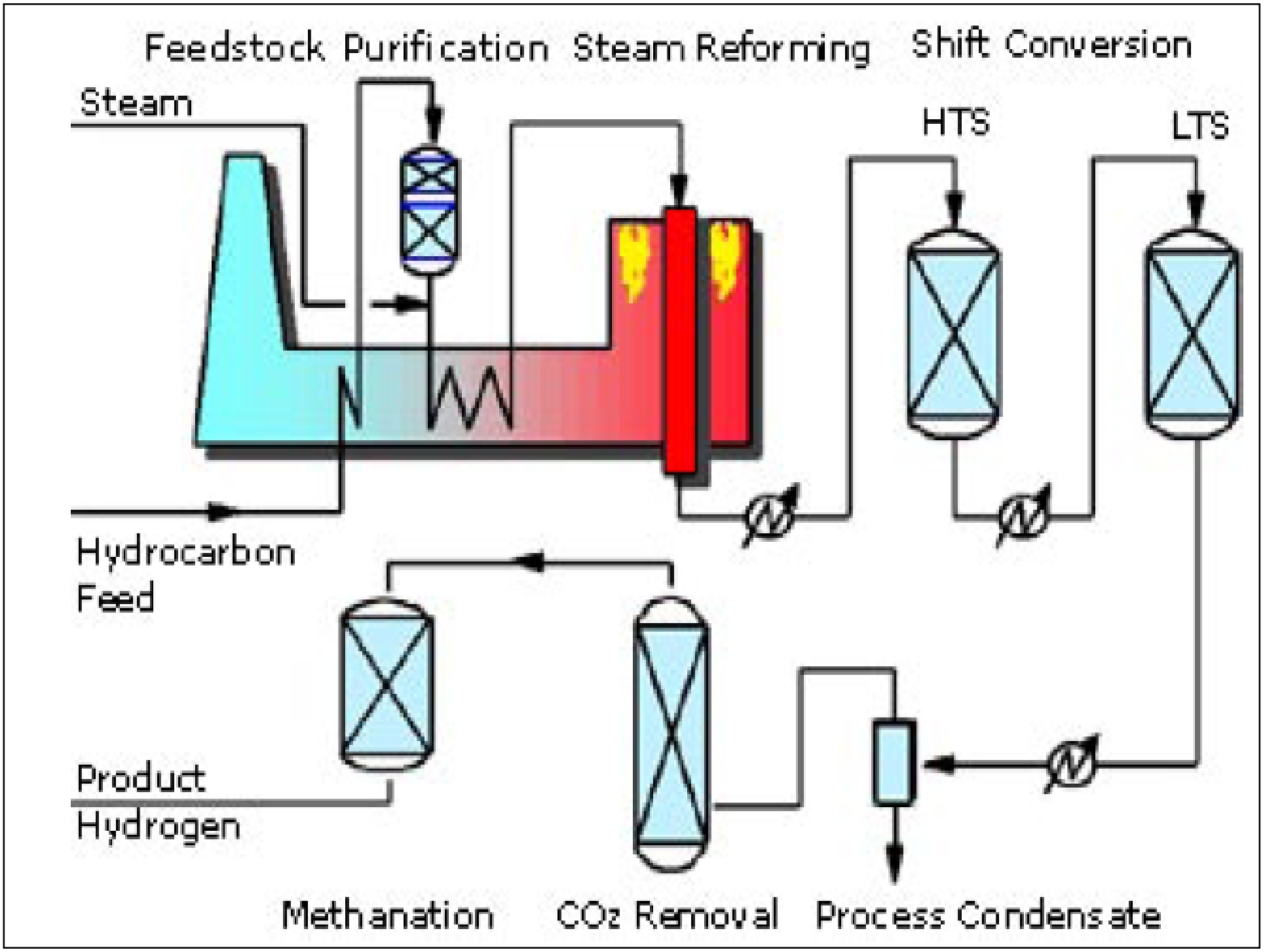
*NATURAL GAS

- Reformation of natural gas
- Water + Hydrocarbons= Synthesis gas i.e. H_2 and CO
- Shift convert CO to CO_2
- Remove carbon dioxide


Steam
Export Steam
Feed
Feed Pre-treatment
Steam Reforming
Heat Recovery
CO-Shift
Pressure Swing Adsorption
Hydrogen
Fuel
Fuel Gas

PURIFICATION

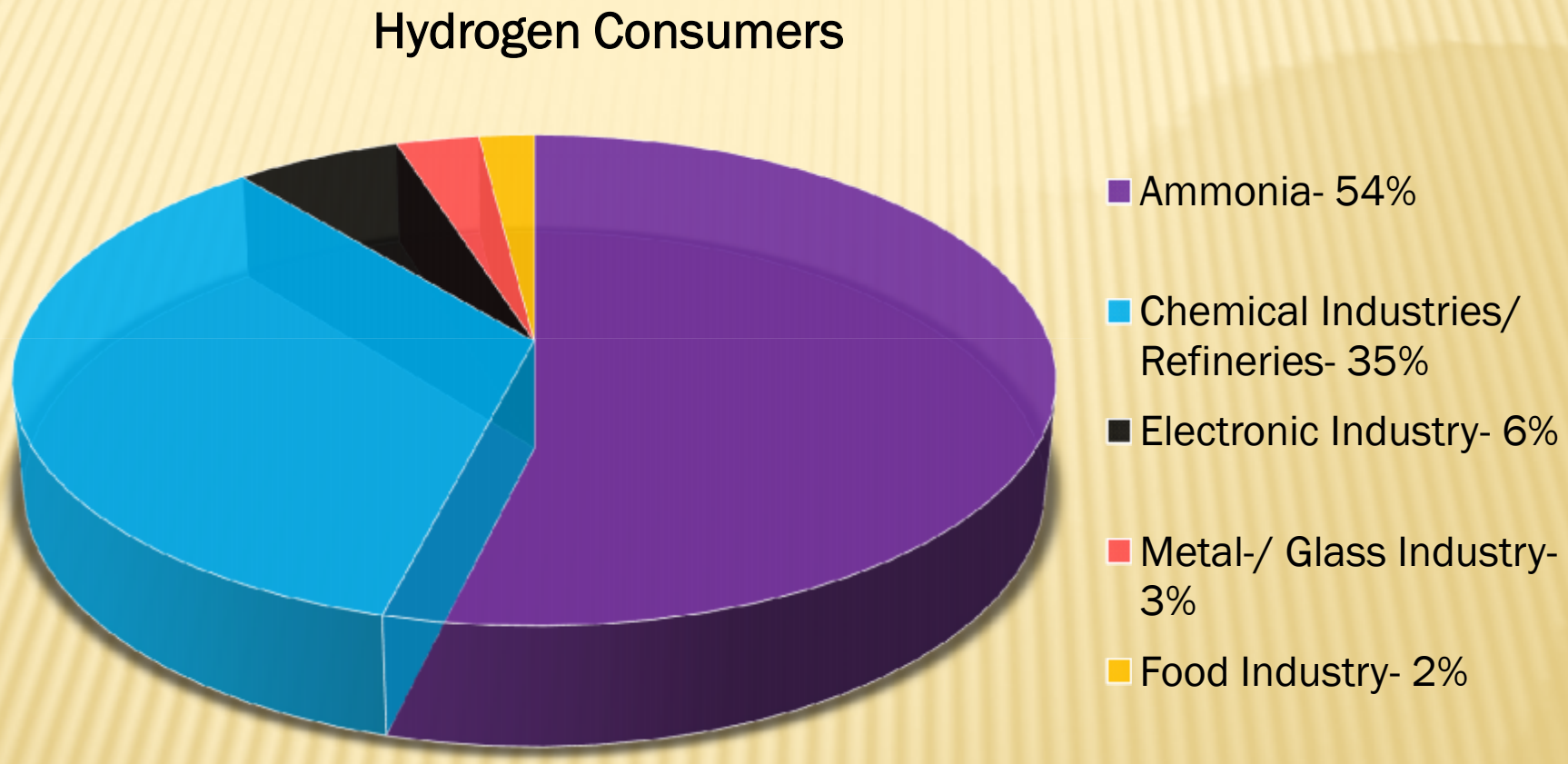
- Feedstock Purification
- Product Purification
  - Liquid absorption system
  - Pressure swing adsorption system

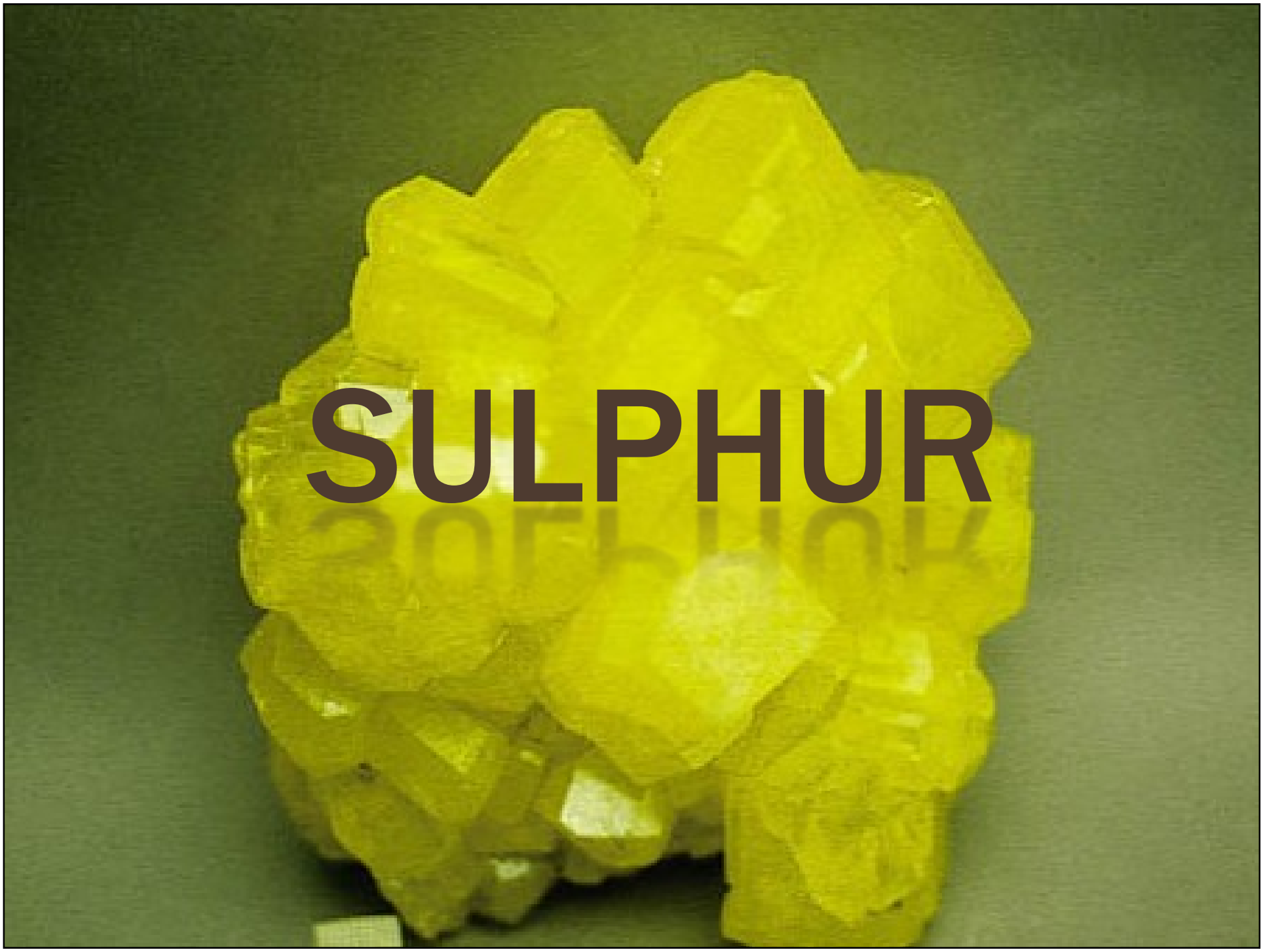

Feedstock Purification
Steam Reforming
Shift Conversion
Steam
HTS
LTS
Hydrocarbon Feed
Product Hydrogen
Methanation
CO2 Removal
Process Condensate

ADVANTAGES OF SMR

- Efficient (65- 75%)
- Economical
- Raw material (i.e. natural gas) is convenient and easy to handle
- It has a high hydrogen to carbon ratio.
- It widely available from sources in the US and Canada.

USES


Hydrogen Consumers
Ammonia- 54%
Chemical Industries/ Refineries- 35%
Electronic Industry- 6%
Metal-/ Glass Industry- 3%
Food Industry- 2%


SULPHUR

- Sulfur is naturally present in sulfide ores of metals
- A constituent of natural gas
- Present in refinery streams

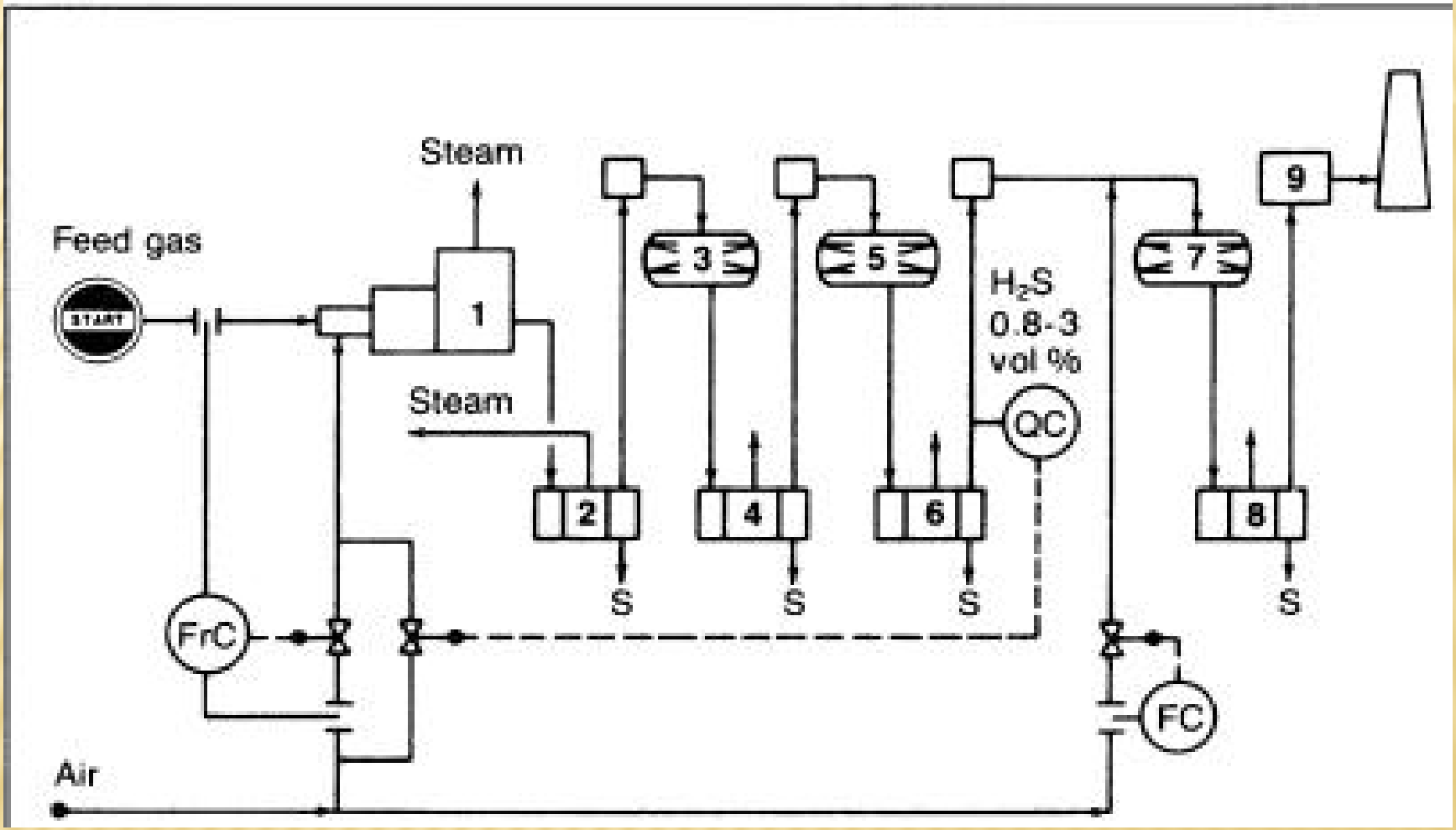
PROCESSES OF PRODUCTION

- Frasch process
- Claus process

THE CLAUS PROCESS

- This process includes two main sections:
- the burner section
- Claus reactor section.

CLAUS PROCESS



USES OF SULFUR

- Sulfuric acid production
- Rubber vulcanization
- Sulfur-asphalt pavements
- Used as an additive in high pressure lubricants


CARBON BLACK

WHAT IS CARBON BLACK?

- It is a form of amorphous carbon with high surface area to volume ratio
- It has carboxyl or hydroxyl functional groups on its surface
- It is usually in powdered form

PROPERTIES

- Properties are functions of production
- Include particle size, structure , surface chemistry, pH, surface area
- Smaller particle size results in higher blackness and low dispersion
- Generally, the increase of structure size improves dispersibility but lowers blackness.
- The affinity of carbon black with inks or paint varnishes changes depending on the type and amount of the functional groups.

PRODUCTION

- It is one of the 50 industrial chemicals manufactured worldwide based on annual tonnage(8.1 mil metric tons)
- Acetylene black process
- Channel process
- Thermal process
- Furnace black process*

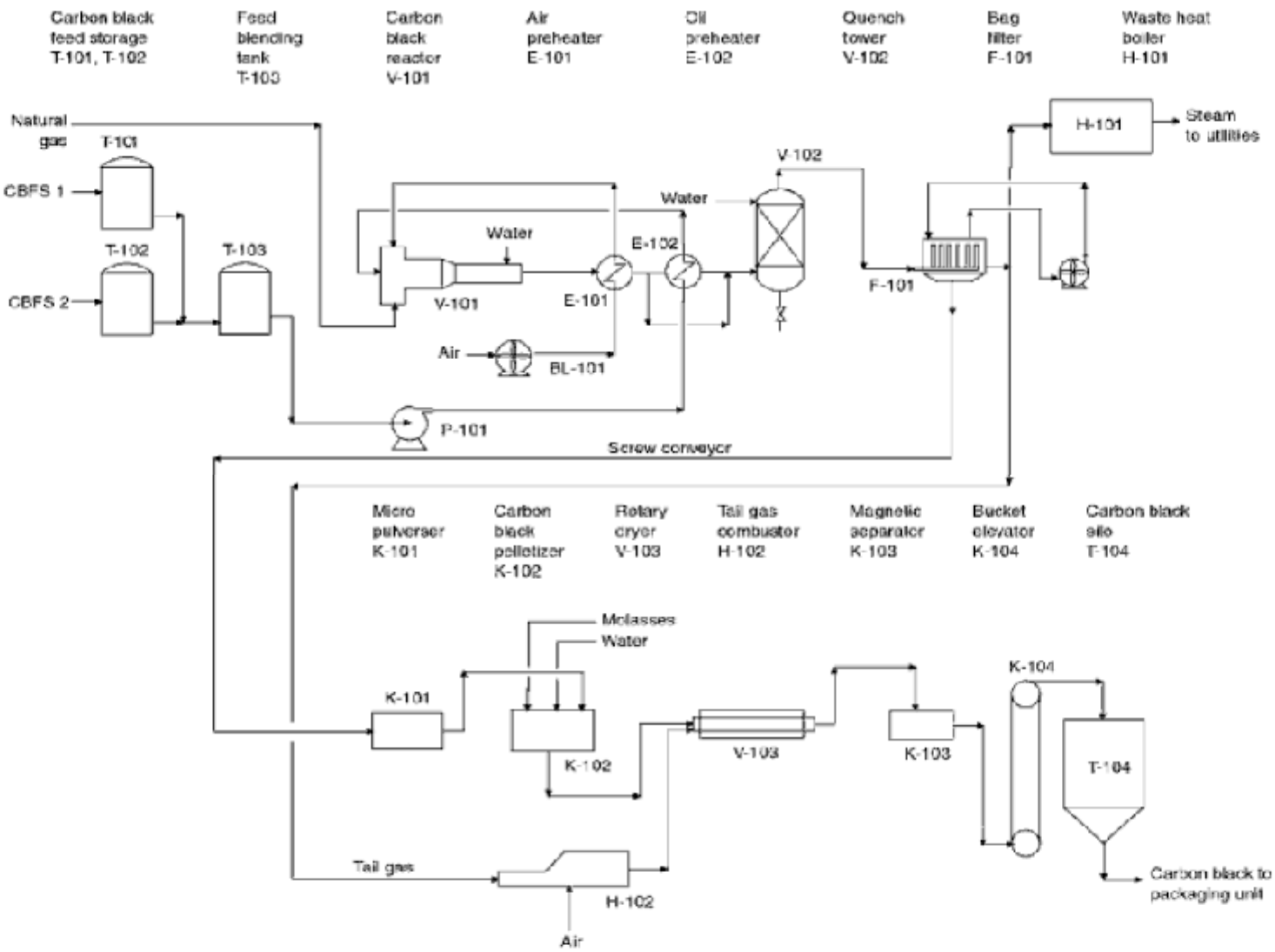
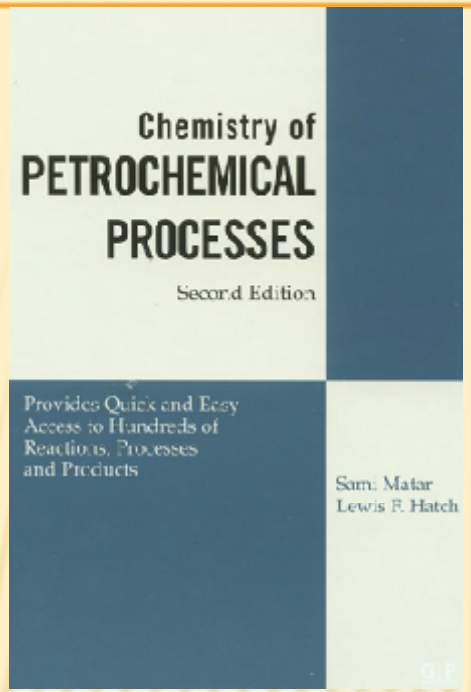


FIGURE 9-2 Carbon black manufacture furnace process.

HARMFUL EFFECTS &USES

- Cancer
- Irritates lungs and causes bronchitis resulting in severe coughing and breathing problems
- Pigments in inks, paints
- 70% used in production of tyres and vehicle components
- Solar energy absorber due to conductive properties
- Reinforcement of rubber and plastics
- Belts , hoses, footwear

REFERENCES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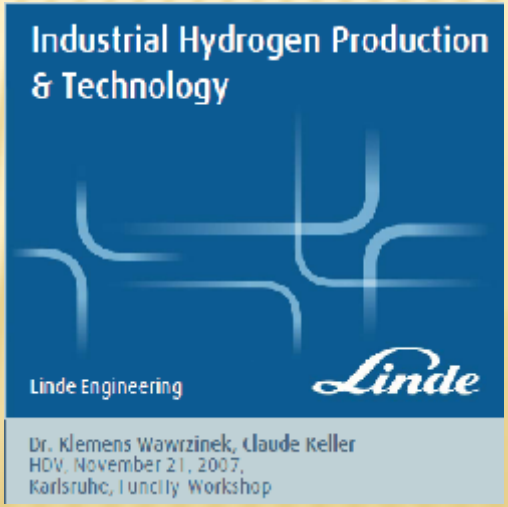
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