NATURAL GAS CLEANING AND TREATMENT

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1.1 Reasons for gas conditioning

Raw natural gas in the reservoirs contains sour components such as carbon dioxide (CO2), hydrogen sulphide (H2S) and sulphur compounds, which make the gas corrosive.

Tab. 1.1 – Typical natural gas composition

Component		Fraction
CH_4	Methane	82 - 94 Vol.%
C_2H_6 / C_4H_8 / C_6H_{10} / …	Higher hydrocarbons such as ethane, propane, butane, …	3 - 10 Vol.%
N_2	Nitrogen	0.4 – 14.0 Vol.%
CO_2	Carbon dioxide	0.1 – 1.0 Vol.%
H_2S	Hydrogen sulphide	(very different)
	Mercaptan	(very different)

Basically, the gas conditioning system comprises the following steps:

- Pressure reduction
- Separation of solids and condensate
- Purification
- Dehydration
- Gas compression
- Sulphur recovery
- Fractionation

1.2 Pre-treatment

1.2.1 Inhibition unit

To avoid gas hydrates in the wells, an inhibitor such as MEA (monoethanolamine) has to be injected into the ground of the well.

1.2.2 Separator

A separator removes solid components of the gas like sand, salts, reservoir fines, drilling sludge and corrosion products

1.2.3 Pressure reduction

A pressure reduction may be necessary for the operation of the gas conditioning system, depending on the well head pressure and the pressure required for the feed-in.

1.3 Purification

Purification combines all sweetening and desulphurization processes, where carbon dioxide (CO2), hydrogen sulphides (H2S) and mercaptans are removed.

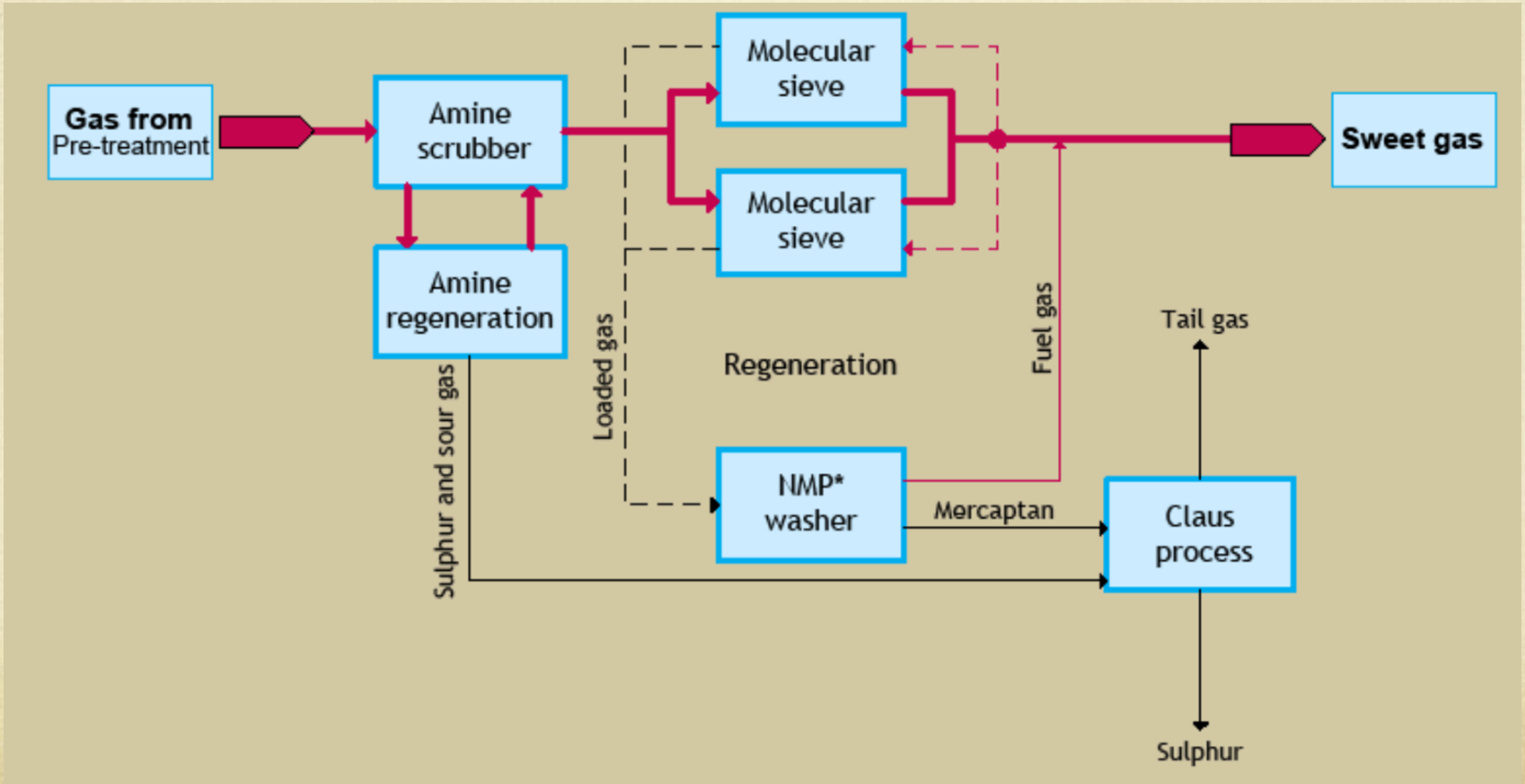


Fig. 1.1 - Sour gas conditioning

1.3.1 Amine scrubbing

The amine scrubbing is a washing process, which uses amine as purifying agent. Carbon dioxide (CO2) and hydrogen sulphide (H2S) can almost completely be removed using this technology.

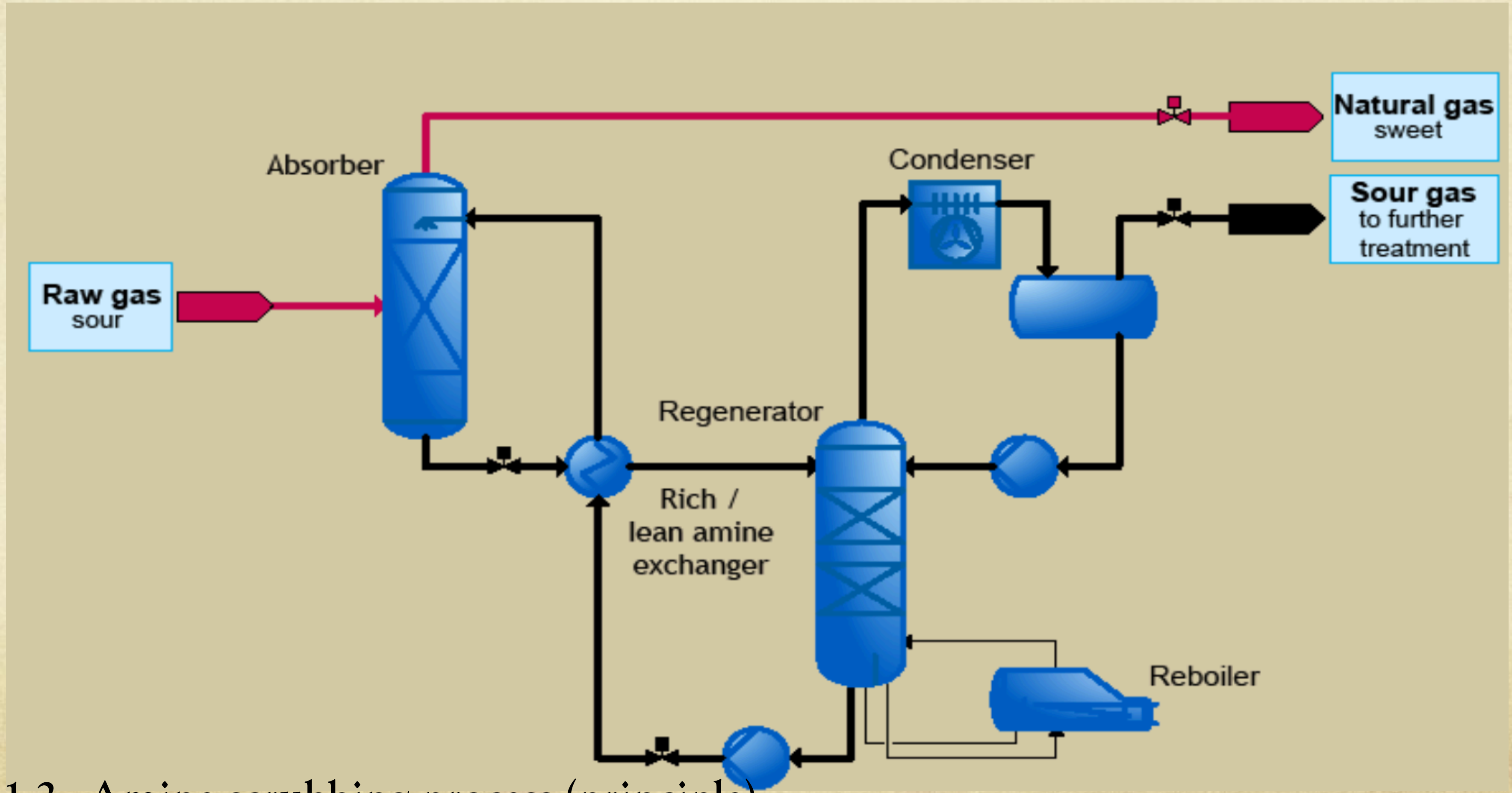


Fig. 1.2 - Amine scrubbing process (principle)

Other purifying agents such as MDEA (methyldiethanolamine), aMDEA (activated MDEA), DEA (diethanolamine) or process alternatives like Purisol, Rectisol or Selexol can be used depending on the gas composition.

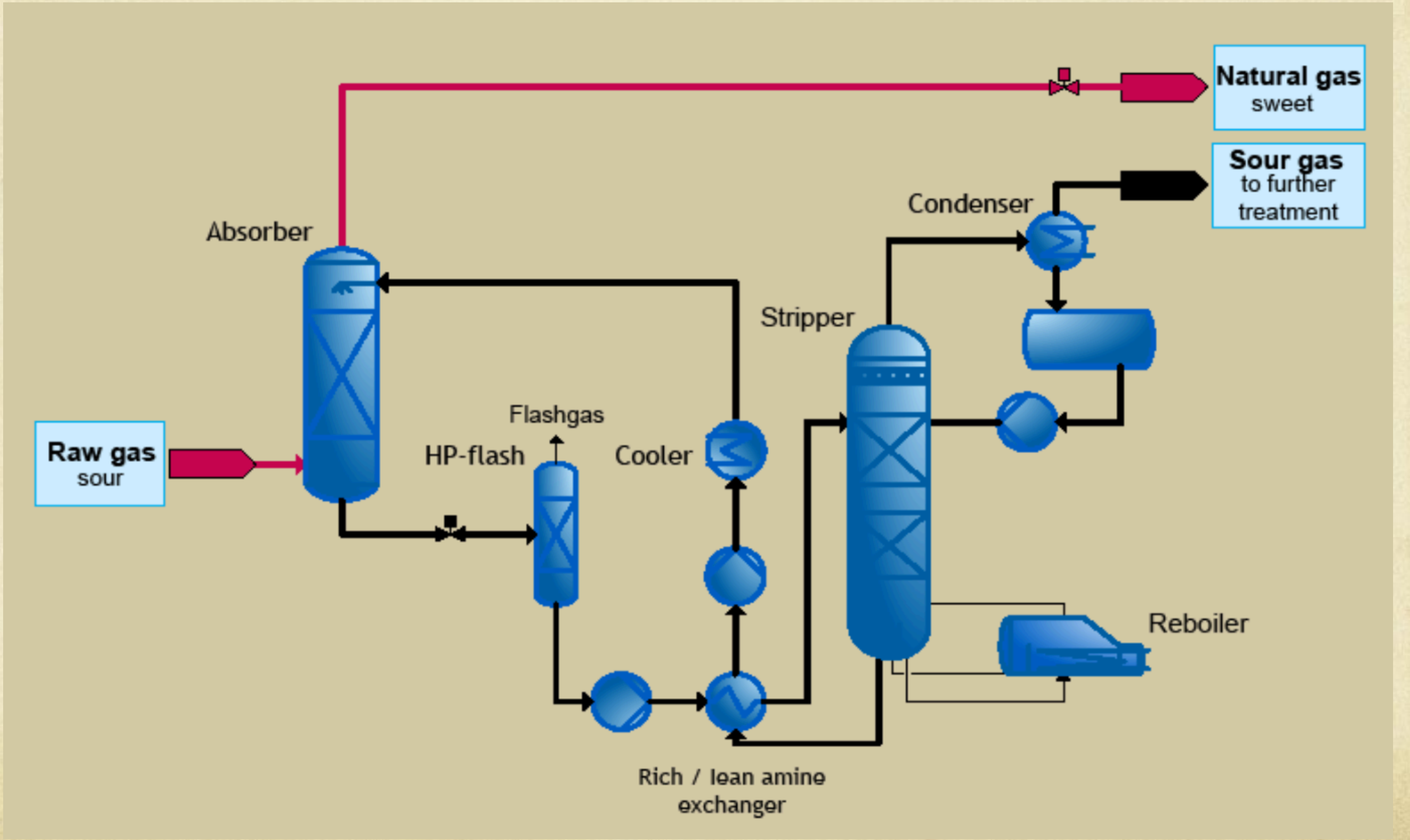


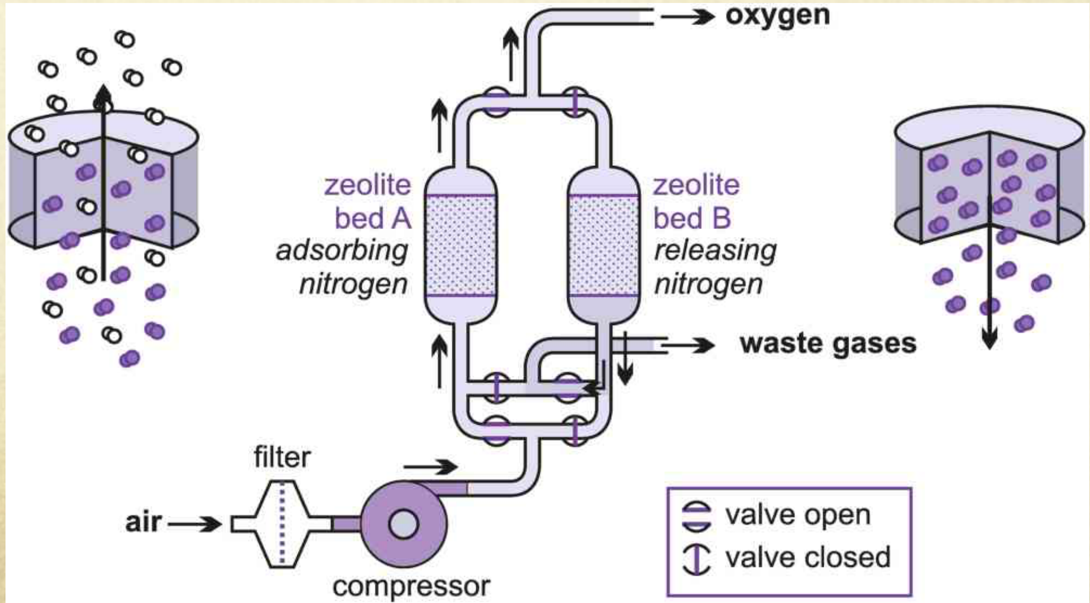
Fig. 1.3 – Single stage aMDEA process (BASF)

1.3.2 Water scrubbing process

The water scrubbing process is a washing process analogue to amine scrubbing. The difference is in the use of water instead of amine as purifying agent.

1.3.3 PSA - Pressure Swing Adsorption

A PSA plant basically comprises molecular sieves. Molecular sieves often consist of zeolites, which have open structures through which small molecules can diffuse. Depending on the kind of zeolites, CO2, mercaptans and humidity can be removed from the gas.



1.4 Dehydration

As raw gas is usually saturated with water vapor when it comes off the reservoir, and as some conditioning processes (e.g. the water scrubbing process) increase gas humidity during the process, a subsequent drying and adjustment of the water dew point of the gas is necessary before it can be supplied into the natural gas grid.

1.4.1 Molecular sieve

A typical molecular sieve dehydration plant consists of two adsorption towers filled with solid desiccant. One of the adsorption towers is used for the dehydration of wet inlet gas while the parallel installed tower aims to regenerate loaded (water saturated) desiccant.

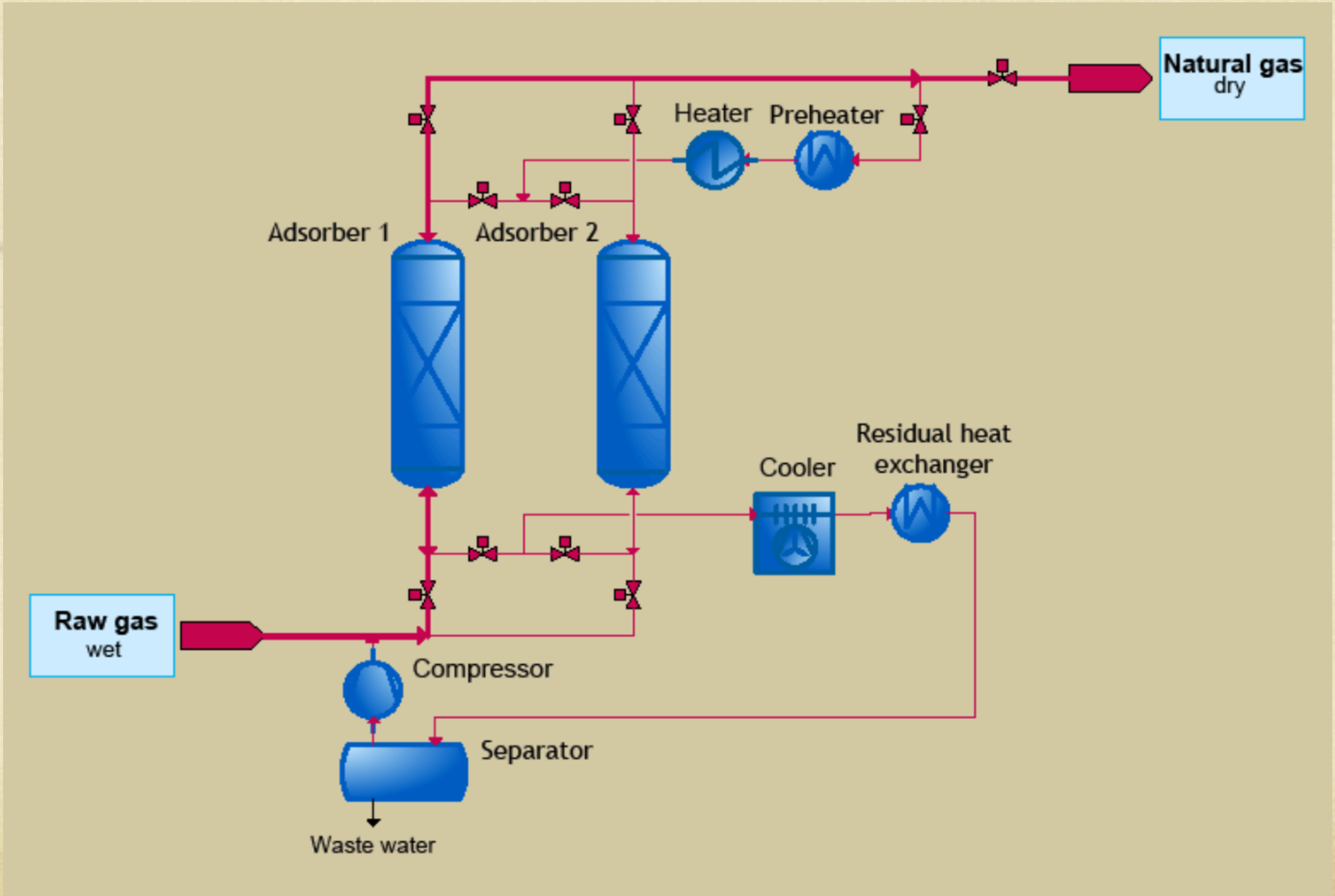


Fig. 1.4 – Molecular sieve dehydration

1.4.2 TEG dehydration

Scrubbing of wet gas with glycol (in most cases TEG - triethylene glycol) is one of the most applied dehydration technologies for natural gas. The wet gas is flowing through the column (Fig. 1.5) while the glycol in a counterflow absorbs the water.

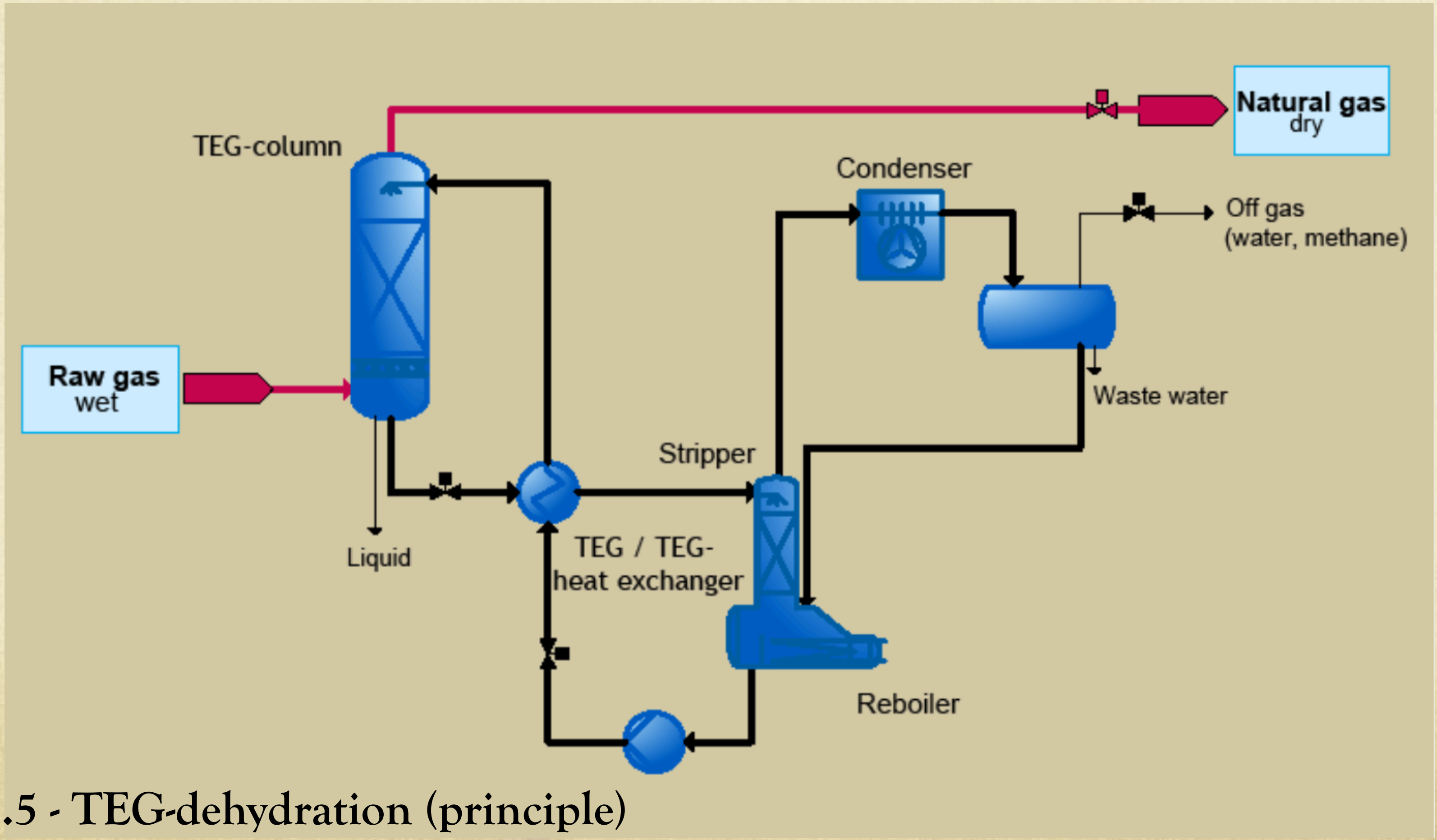


Fig. 1.5 - TEG-dehydration (principle)

1.5 Natural gas liquids (NGL) recovery

1.5.1 Joule-Thomson expansion

A possibility to remove condensed liquids from the natural gas is cooling it down, so that the condensate (water and higher hydrocarbons) will fall out and can be fractionated. Using the Joule-Thomson effect means that the gas temperature decreases during gas expansion e.g. in an expansion valve (“self-refrigeration process”).

1.5.2 Refrigeration plant

Refrigeration is the simplest and most direct process for NGL recovery. External refrigeration is supplied by a vapor compression cycle (usually using propane as refrigerant). A cold gas/hot gas heat exchanger provides the first cooling step of the inlet gas.

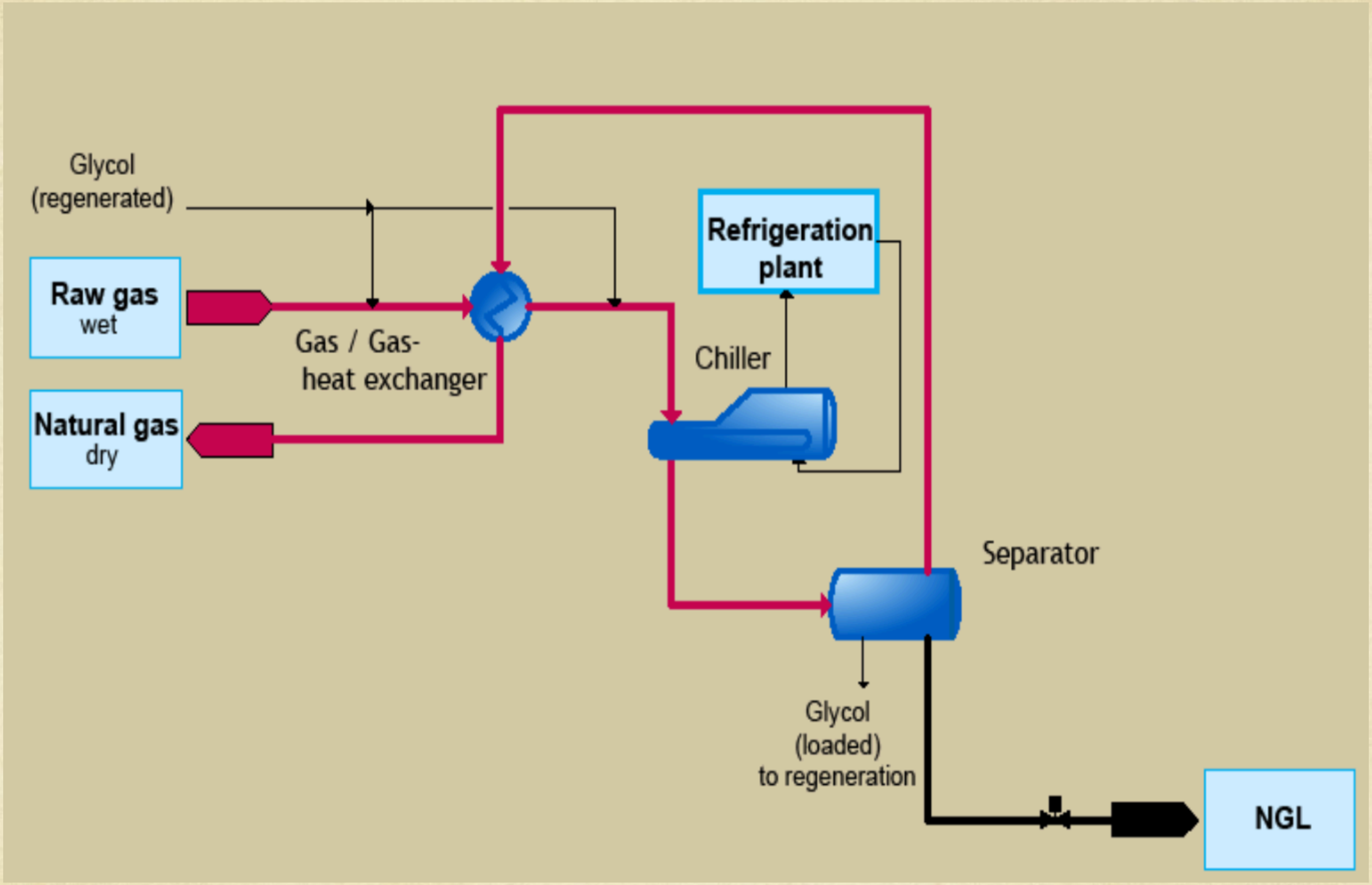


Fig. 1.6 – NGL recovery using external refrigeration (principle)

1.5.3 Turboexpander

If the gas is expanded in a turboexpander it performs work during expansion. This causes a lower temperature decrease than using the Joule-Thomson effect.

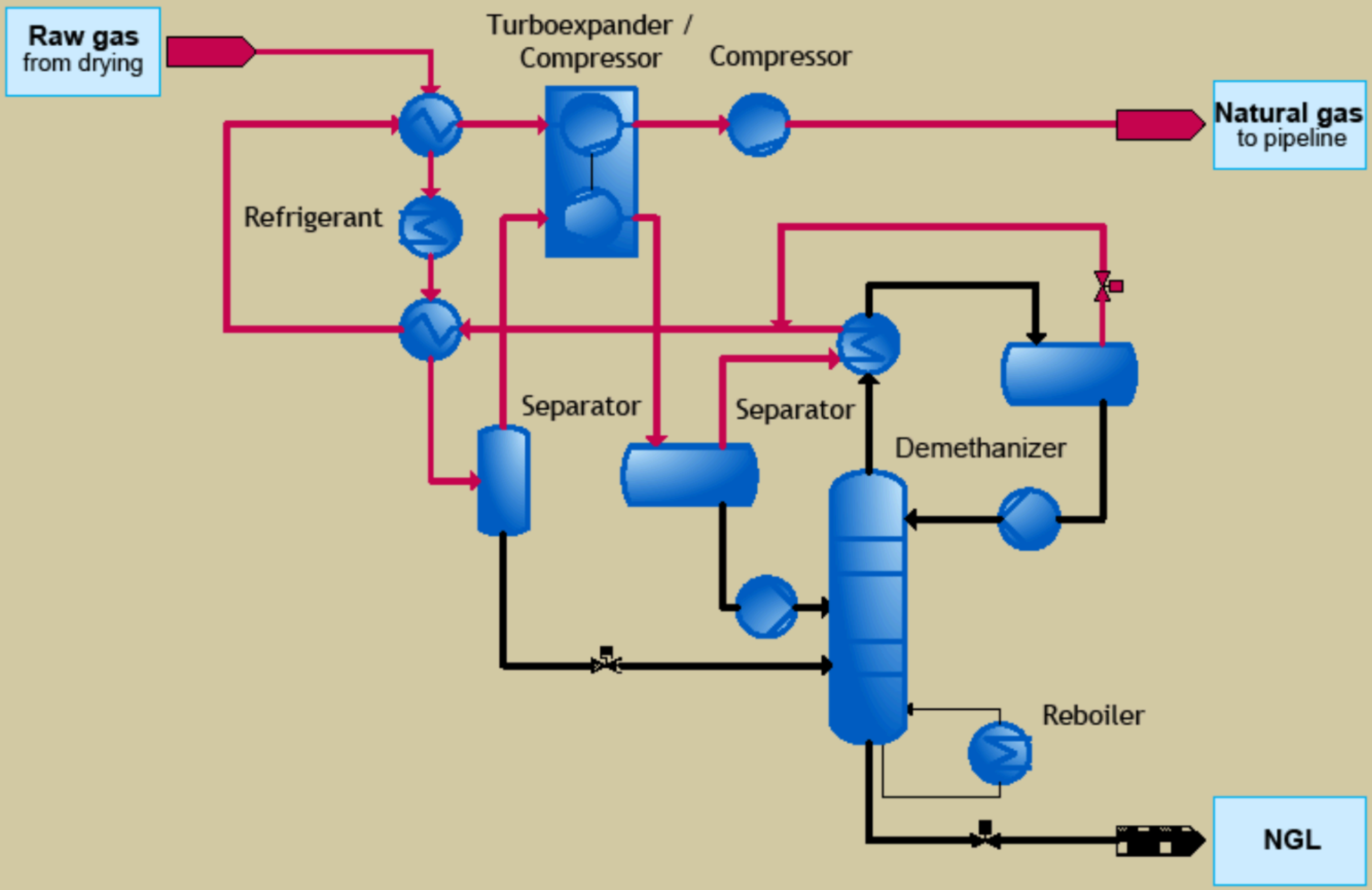


Fig. 1.7 – NGL recovery using turboexpander (principle)

1.6 Fractionation

Hydrocarbons which are falling out of the raw natural gas during dehydration and separation processes should be fractionated and/or stabilized to meet product specifications and to transfer these liquids into useable products for further applications.

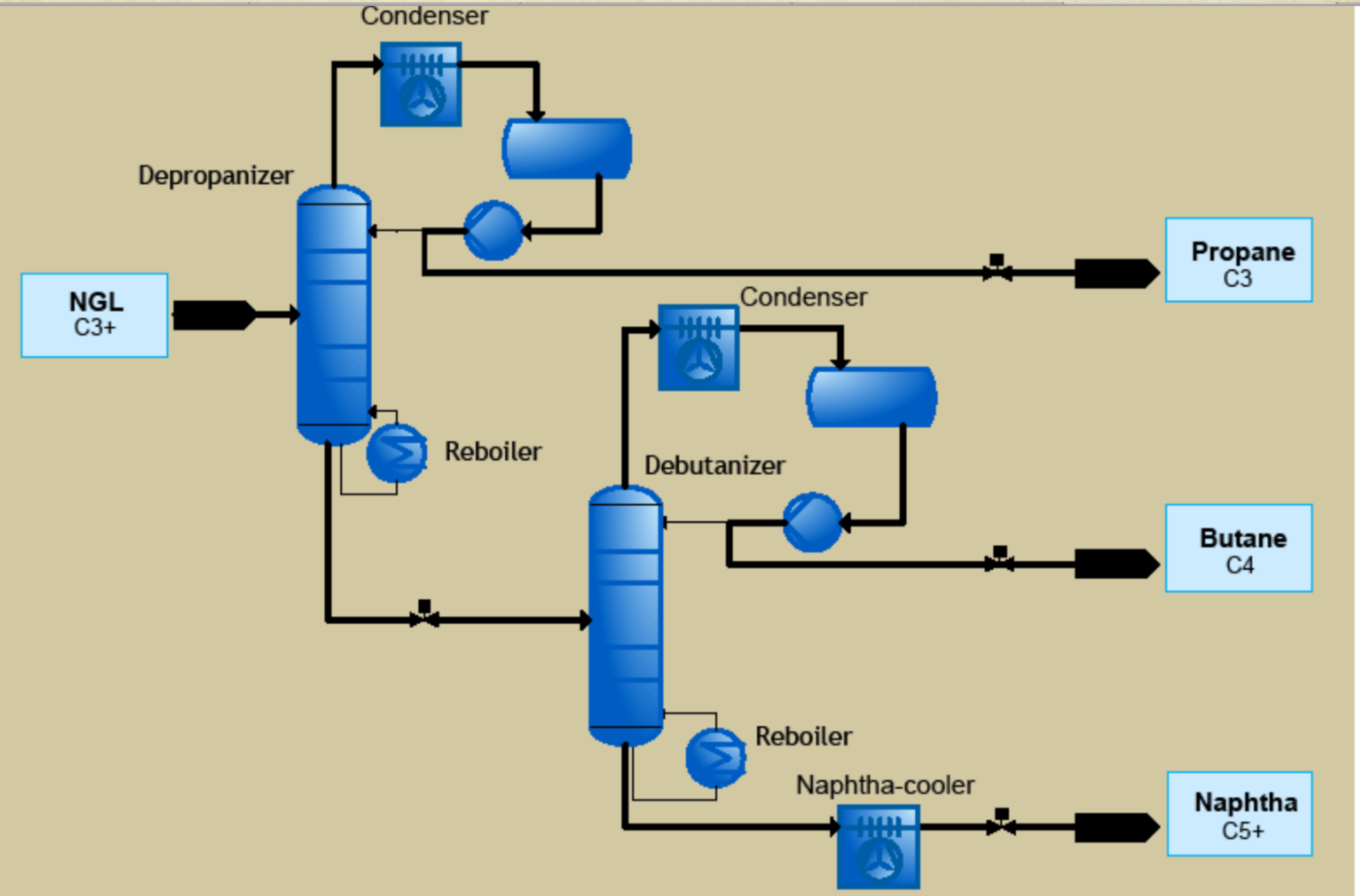


Fig. 1.8 – Liquid fractionation process

1.7 Gas compression

A gas re-compression might be necessary if the gas pressure is too low for gas supply into the natural gas grid or for other applications.