**FLUOR.**

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**PROCESSING HIGH CO₂, HIGH N₂ GAS FOR LNG PRODUCTION**

**Introduction**

In many offshore gas reservoirs, such as from South China Sea and Pre-salt regions, the produced gas has high CO₂ content ranging from 30% to 80%, and with nitrogen content higher than 5%. These gases are left untapped due to their low heating values, and difficulties in treating to meet the sales gas specifications.

The Fluor Solvent Process is an economic choice for high CO₂ gas removal. It is a non-heated physical solvent process that is energy efficient and eliminates greenhouse emissions. The process utilizes the high CO₂ content to generate cooling reducing solvent circulation. For high N₂ gas, the rejected N₂ from the NRU can be used for stripping in the solvent unit. As a result, the integrated unit can produce a dry gas with 200 ppmv CO₂ content, reducing the gas pre-treatment requirement to LNG plant.

**Physical solvent uses less energy than amine process for high CO₂ gas removal. Physical solvent can be regenerated by pressure letdown, which reduces the regeneration duty. The Fluor Solvent process should be considered when the partial pressure of the CO₂ content is higher than 50 psi.**

Physical solvent’s CO₂ holding capacity increases with partial pressure of feed gas (Henry’s law). Fluor Solvent process is a very energy efficient process for removing CO₂ gas at high pressure. Solvent circulation and power consumption decrease with increasing CO₂ partial pressure. This is contrary to amine process.

Fluor Solvent process uses propylene carbonate as the physical solvent which has the advantages on being a non-hazardous solvent, non-corrosive, non-foaming. The solvent has high affinity towards CO₂ under a mildly refrigerated temperature. Process equipment is constructed of carbon steel material.

**Terrell County Texas Fluor Solvent Plant**

The Terrell County Fluor Solvent plant, located in Terrell County, Texas, was built in 1990s. The plant was designed to treat natural gas to meet 2 mole% CO₂ specification. The original plant was designed to treat 220 MMscfd feed gas with 53 mole% CO₂ at 900 psig pressure. Today, the gas plant is processing 125 MMscfd of feed gas with 36 mole% CO₂ at 650 psig.

- Proven for variable CO₂ content gases
- Use of vacuum flash for regeneration
- Meet 2 mole% CO₂ specification
- Hydrocarbon loss of 2%

**Woodward Oklahoma Fluor Solvent Plant**

The Woodward Oklahoma Fluor Solvent plant was built in 1997 for ammonia production. The process was used to treat 148 MMscfd syngas operating at 1,868 psig. The process removes CO₂ from 22 mole% and can achieve 200 ppmv CO₂ specifications.

- Proven for 1900 psig pressure operation
- Dry air stripping for regeneration
- Meet 200 ppmv CO₂ specification
- Hydrogen loss of 1%

**Offshore High CO₂ Gas**

Two offshore platform gases, with 100 MMscfd feed gas at 1530 psig, are evaluated. The result shows the same circulation can be used for the two different CO₂ gases. No refrigeration is required for the higher CO₂ case, due to the larger cooling from flash regeneration. With dry air or nitrogen stripping, the process can meet 200 ppmv CO₂ spec. No heating is required. Power consumption is low.

**Integrated Fluor Solvent for LNG Plant**

The integrated process can be used in treating high CO₂ gases to meet the CO₂ and N₂ specification for LNG production. The main features are:

- H₂S scavenger and dehydration - produces a dry and sulfur free gas for the unit.
- Two absorbers design - the upper absorber produces a semi-lean solvent which is cooled and re-used in the lower absorber.
- Heat integration - refrigeration generated from flash solvent cools the feed gas and semi-lean solvent. Heating of rich solvent enhances solvent regeneration.
- Hydraulic turbine - recovers power from pressure drop while generating refrigeration.
- Flash gases recycle - minimizes hydrocarbon loss to 1%

**Advantages**

- Produce a treated gas with 10 ppmv H₂O water and 200 ppmv CO₂. Only a polishing unit is required to meet the specification for LNG plant feed.
- Avoid the high costs of amine unit and molecular sieve dehydration unit.

**Conclusions**

The innovation of the integrated process results in lower capital and operating cost by utilizing the high CO₂ gas to generate refrigeration, efficient heat integration, and power recovery by hydraulic turbines. When integrated with an NRU, the rejected N₂ can be used for solvent stripping. The process can reduce the CO₂, nitrogen and water content to very low levels, consequently eliminating the traditional amine treating unit and the molecular sieve dehydration unit.

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