Fujifilm Apura™ FG Case Study

West Texas Compressor Station Uses Fujifilm Apura™ FG to Increase Fuel Gas Quality

Challenge:	Excessive compressor engine wear and increased compressor maintenance due to engine pre-detonation issues resulting from high BTU content fuel gas. Also, excessive Volatile Organic Compounds (VOC) emissions resulting from high BTU content fuel gas and causing failed emission tests conducted by US Environmental Protection Agency (EPA). Originally installed fuel gas membranes by other membrane supplier continuously declined in performance, resulting in higher BTU content fuel gas and required frequent, expensive membrane module replacement.
Solution:	Installation of Apura™ FG modules
Results:	Apura™ FG membrane modules consistently reduced the fuel gas BTU content from approximately 1250-1300 BTU/SCF (Lower Heating Value, LHV) to approximately 1050 BTU/SCF (LHV) for a period of over 18 months. Elimination of pre-detonation issues leading to measurable increases in compressor run-time and decrease in previous observed maintenance issues. Compressor VOC emissions reduced by more than 30-35% as compared to compressor emissions before Apura™ FG modules were installed and placed in operation, resulting in easily passed compressor emission testing by the US EPA.

Non-Performance Original Fuel Gas Membrane Modules :

A West Texas operator installed a new compressor station back in 2018. This compressor station was designed to compress and dehydrate approximately 65 MMSCFD of associated gas (from local oil production) to approximately 1150 psig with the use of (8) gas engine driven reciprocating compressors. The new compressor station also included a 2-tube membrane fuel gas conditioning skid, supplied with fuel gas membrane modules manufactured by another gas membrane module supplier.

The 2-tube membrane fuel gas skid was installed to treat a slipstream from the final discharge header (after TEG dehydration) at a pressure of approximately 1150 psig. The slipstream gas is then expanded to approximately 700-800 psig, flows through a pre-heater and coalescing filter/separator before entering the 2-tube membrane skid. (See Figure 1.)

The 2-tube fuel gas membrane skid was originally designed to process 1250-1300 BTU/SCF (LHV) feed gas and yield approximately 2 MMSCFD of 1100-1150 BTU/SCF (LHV) fuel gas.

From the initial commissioning of the 2-tube fuel gas membrane skid, the operator was never able to produce fuel gas at 1100 BTU/SCF (LHV) and over time observed degradation of the original gas membrane flux, resulting in less BTU removal or higher BTU content fuel gas over time. The higher BTU content fuel gas resulted in compressor engine pre-detonation issues leading to increased compressor downtime, increased maintenance issues related to compressor engine valves, and increased VOC emissions failing to pass US EPA specifications. In order to counter the negative effects of the original gas membrane flux decline, the operator was forced to replace the original membrane modules on multiple occasions, at significant replacement costs.

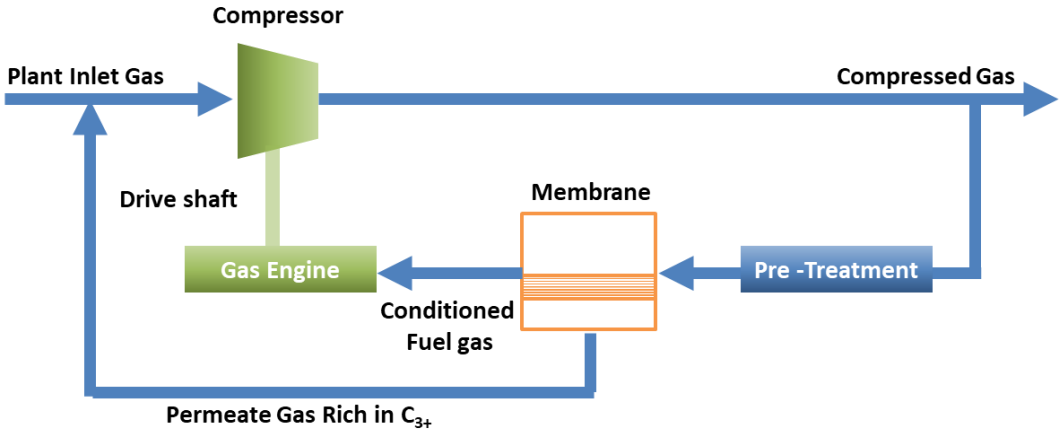

Figure 1: Flow Diagram of Membrane Fuel Gas Conditioning Unit

Replace Original Fuel Gas Membrane Modules With Apura™ FG Membrane Modules:

Apura™ gas membrane technology was originally commercialised for natural gas sweetening applications in 2014 by Fujifilm. The Apura™ flat sheet membrane is a composite membrane comprising of multiple layers, to include a relatively inert substrate support layer. The composite Apura™ platform, specifically the use of an inert substrate and highly selective top dense active layers, yields a very stable, robust membrane designed to provide very stable membrane permeance and superior selectivity over time.

Using the same Apura™ platform (inert substrate material), Fujifilm developed Apura™ FG membrane in 2019 to selectively remove C2/C3+ hydrocarbons preferentially over C1 hydrocarbons in an effort to reduce the BTU content of fuel gas.

A 1-tube membrane skid containing Apura™ FG modules was installed at the subject West Texas compressor station in March of 2020. (See Figure 3.) The 1-tube membrane skid and Apura™ FG membrane modules operated stably for more than 20 months (at a pressure of 700 psig and feed gas temperature of 100-110 F), providing the sole source of fuel gas for the compressor station. The C2+ permeance of the Apura™ FG modules remained good and stable, consistently reducing the BTU content of the feed gas from 1250-1300 BTU/SCF (LHV) to <1050 BTU/SCF (LHV). Further, the Apura™ FG membrane C3+/C1 selectivity also remained very good and much higher than the original fuel gas membrane modules, resulting in substantially less permeate gas and feed gas volumes to produce the required 2 MMSCFD of fuel gas.

Figure 2: Fujifilm Apura™ Gas Separation Membrane Module

Figure 3: Apura™ FG Skid Installed at the West Texas Compressor Station

Customer/Operator Feedback:

The Apura™ FG membrane modules produced lower BTU content fuel gas (<1050 BTU/SCF) than had previously been reached by the original fuel gas membrane modules. According to the Operator, the lower BTU content gas resulted in significantly less compressor engine pre-detonation issues providing the Operator with great runtime and reduced maintenance costs.

The lower BTU content fuel gas produced by Apura™ FG membrane modules also resulted in approximately 30-35% less VOC emissions, allowing the Operator to routinely pass US EPA emissions tests (that previously did not pass).

Apura™ FG membrane modules performed with stable permeance and selectivity over a period of time when several sets of the original fuel gas membrane modules had to be replaced.

Based on the above performance, the Operator concluded Apura™ FG membrane modules were superior in flux, selectivity, and membrane life/stable performance.