BCCK's Nitech™ Nitrogen Rejection Process Provides Solution to Meeting Tighter US Pipeline Restrictions

As the demand for natural gas continues to escalate in the US and around the globe, unconventional gas sources are receiving more attention as viable energy options. Global environmental pressure is fueling demand for natural gas as a clean-burning, environmentally friendly power generation alternative to aging coal–fired power plants. Natural gas facilities have relatively low emissions of sulfur dioxide and particulate matter and far lower levels of "greenhouse" gas emissions, an advantage which politically supports a global shift from oil and coal to natural gas. In addition, current economic conditions in the United States have sparked an interest in becoming less dependent on foreign energy markets, with a preference for finding a proven and reliable energy source within the continental US. With US storage volumes of natural gas currently well above the five-year average, the abundance of natural gas readily available is politically appealing in a society intent on shifting energy dependence away from foreign sources. Various sources of natural gas are found throughout the United States and the infrastructure required to handle an increase in the demand for natural gas is sound and accessible.

Unconventional Sources of Natural Gas

One fundamental issue facing natural gas producers is the question of how to fill the gap between the potential demand for natural gas and the current supply. Worldwide, the demand for natural gas is projected to increase at a moderate yet sustainable rate of 1.6% per year from 2006 to 2030.[1] LNG technology is emerging as a supplement to piped gas, with new markets previously blocked due to lack of available gas pipelines opening, particularly in Africa. However, given the global economic situation, particularly in the credit markets, companies are reluctant to spend the capital required to make significant LNG contributions. The emergence of LNG as a viable energy source would not appreciably affect the United States' dependence on foreign energy markets.

According to the US Energy Information Association's Annual Energy Outlook 2009, unconventional sources of natural gas such as shale gas, tight sands, coal bed methane and low BTU gas, should account for the majority of the increase in the domestic natural gas supply from 2007-2030.[2] Despite production declines in conventional natural gas sources, available drilling and processing technologies for unconventional sources should allow the US to increase natural gas production by more than 4 trillion cubic feet over the next twenty years. Natural gas in tight sand formations is the largest source of unconventional production, accounting for 30 percent of total U.S. production by 2030, but production from shale formations is the fastest growing source.[2] Coal bed methane and coal mine methane are also garnering second looks as viable energy sources with the added bonus of being environmentally friendly and improving the safety of mining operations.

An unconventional source of natural gas that is receiving attention due to its availability and processing cost effectiveness is low BTU gas. According to the Gas Research Institute (GRI), over 19 TCF of low-BTU gas is available in the continental US.[3] Pipeline specifications defining low BTU gas vary by producer and location, but have historically ranged from 4-6 mole percent total inerts. Recently, however, pipeline companies have imposed tariffs on natural gas sources with as little as 2 mole percent inerts, ostensibly due to the increase in natural gas demand and competition for pipeline capacity with the increased volumes of natural gas being produced from tight sands and shale plays. In the past, natural gas streams exceeding the inert specification were blended with other sources if available, resulting in a decrease in value to the producer or in the worst case scenario, the gas was shut-in due to the high cost of removing the contaminants from the gas stream. Recent technological advances have been proven effective in "cleaning" the low-BTU streams to meet even the most stringent pipeline standards.

Bringing Low BTU Gas to Market – A Case Study

BCCK Engineering, Inc. was met with one such scenario when approached by a client in Oklahoma with a naturally occurring low BTU gas source containing 6.0–10.0 mole percent nitrogen in the inlet gas stream. For the past several years, the client had been able to market their gas to a nearby pipeline with little regard to inert specification. Increasing pressure from the pipeline company to comply with a more stringent 3 mole percent total inert specification made the gas source increasingly difficult to market. The client was seeking a simple and efficient method of treating the gas stream to meet the more stringent requirements. Conventional nitrogen rejection units (NRUs), which are a derivative of air separation technology, use nitrogen to reflux the low-pressure column of the unit. For this case, an inlet feed stream with this low of an inlet inert content was not a viable candidate for processing because of insufficient nitrogen available for reflux. BCCK's Nitech™ technology, which is not a derivative of air separation, was capable of treating the client's low BTU gas stream to meet the pipeline's more recent, stringent requirements despite the low concentration of nitrogen present in the inlet stream.

Reduction in Capital and Operating Expenses

To limit facility costs and compression requirements typically associated with nitrogen rejection, only a portion of the low BTU gas stream was treated to a total inert specification of less than 1 mole percent. The treated stream was then blended with the remaining inlet stream to produce a comingled stream meeting the pipeline's 3 mole percent inert standard.

Because of the ability of the Nitech™ process to deliver the residue gas with less than 1.0 mole percent nitrogen, up to 30 MMSCFD of the high nitrogen gas may be bypassed and blended with the NRU residue gas to meet the 3 mole percent specification. This allowed the client not only to save in capital costs due to smaller equipment sizing, but also in compression requirements, a driving factor in operating costs typically associated with nitrogen removal. One other

significant advantage for the client, related to operating expenses, was the simplicity of the Nitech™ process. The simplicity of the Nitech™ process, which utilizes only three major components and no cryogenic rotating equipment, did not require any additional operation personnel. The existing staff that operated the existing turbo expander facility was adequate to handle the additional requirements of the Nitech™ NRU.

Flexibility

Since the NRU was going to be operated downstream of an existing turbo-expander facility, integration was a key requirement. The presence of the turbo-expander facility mandated that the NRU be flexible with regard to ethane present in the feed stream. The Nitech™ unit was designed to operate downstream of the expander plant while operating in either ethane rejection, or ethane recovery mode. This flexibility is inherent in the Nitech™ process and requires no modifications to the operation of the NRU equipment.

The facility is also flexible with respect to inlet nitrogen concentrations. This facility was designed to handle a wide range of inlet nitrogen concentrations while maintaining less than 1 mole percent nitrogen in the residue product. This flexibility is important for the project as it helps to minimize operating costs by allowing some gas to bypass the NRU, even at higher nitrogen concentrations. Without the ability to deliver the residue product with less than 1.0 mole percent nitrogen, all of the inlet gas would have to be processed, thus increasing operating expenses. This flexibility is important for all NRU projects as the nitrogen content is almost guaranteed to change over time. It is also particularly appealing in the case of a nitrogen flood where inlet nitrogen concentrations for the feed stream would substantially increase over the life of the project. Nitech™ allows for flexibility with regard to inlet composition changes with minimal operational set-point changes and no modifications to the facility equipment.

Hydrocarbon Recovery

As with any hydrocarbon processing facility, overall hydrocarbon recovery was vitally important to the overall project economics. Non-cryogenic nitrogen rejection technology, although capable of removing nitrogen from the inlet gas stream to acceptable levels of 3-4 mole percent total inerts, typically suffers significant inefficiency in terms of lost hydrocarbon and compression requirements: a significant monetary loss when compared to conventional cryogenic facilities and the Nitech™ process. The Nitech™ process is capable of sustaining hydrocarbon recoveries in excess of 99.5 percent. For the Oklahoma client, this efficiency was an important feature, and this facility is currently operating with a 99.6 percent overall hydrocarbon recovery. The Nitech™ facility is able to achieve these rates, typically associated with cryogenic nitrogen extraction, without the complexity usually associated with cryogenic nitrogen extraction.

Conclusions

Despite the reluctance to adopt a global referendum on environmental quality, growing concerns about "greenhouse" gas emissions among other factors has generated interest in increased utilization of natural gas. Natural gas is seen as an environmentally friendly alternative to coal and oil, particularly in the electrical power generation sector which currently accounts for more than 30 percent of the world's natural gas consumption and is expected to continue on an upward trend through 2030.[1] In addition, current economic conditions and political concerns in the United States also favor a stronger natural gas market to allow for a reduction in the dependence on foreign sources for energy needs. In order to maintain pace with demand, producers are increasingly turning to unconventional sources for natural gas. As demand increases and different markets for natural gas strengthen or emerge, producers will reexamine low-BTU natural gas sources as a supplement to the conventional natural gas supplies. In response, pipeline companies will become increasingly vigilant with total inert specifications.

Technology for upgrading the low-BTU gas is available and proven allowing a winning solution for both producer and supplier.

References

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