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Optimization Of Energy Consumption: As Utility In City Gate Station

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Abstract- *A method of natural gas pressure reduction at a city gate station providing an elimination of the station's energy consumption for gas flow heating together with the creation of a cooling duty for future utilization which comprises connection a vertex tube inlet with a gas flow line for Appling the whole gas flow entering the city gate, connecting a cold fraction gas flow outlet for the vortex tube with a heat exchanger for warming the cold fraction gas, and out letting the warmed cold fraction gas, connecting a vortex tube's hot fraction outlet with the warmed cold fraction. The extent to which these advantages are realized depends on the cycle configuration, the fluid properties, the operating conditions, and the behavior of the vortex tube. A semi-empirical model of the vortex tube is presented using one hypothesis regarding its underlying physics. Predictions made using this model are found to compare favorably with the limited experimental data that are available. The vortex tube model is integrated into a model of a vapor compression refrigerator and a Joule-Thomson cryogenic refrigerator. More complex cycles are discussed in which the vortex tube can be used to simultaneously perform phase and energy separation.*

Keywords- *Introduction - Materials and methods - Survey questionnaire - Develop pipeline infrastructure and remove obstacles - Sectorial reforms for accelerating gas usage - Three critical factors for enabling the development of CGD - Research Challenges – Reference.*

INTRODUCTION

High-pressure gas enters the tube through one or more nearly tangential nozzles. Colder, low-pressure gas leaves via an orifice near the centerline adjacent to the plane of the nozzles and warmer, low-pressure gas leaves near the periphery at the end of the tube opposite the nozzles. This device was described and examined experimentally in the 1940's.

The vortex tube requires no work or heat interaction with the environment to operate. Consequently the energy separation effect must be attributable to an energy interaction that is internal to the tube, occurring between the two exiting flows. The exact mechanism of this interaction is not well understood due to the lack of reliable measurements of the temperature, pressure, and velocity distributions. Because of the strong recirculating nature of the flow field, the presence of invasive instruments strongly affects the entire flow field and the high velocity, swirling flow within a vortex tube presents a significant. Challenge to traditional, non-invasive flow visualization techniques as the large radial pressure gradients prevent any seeding particle from faithfully following the flow; instead these markers are quickly centrifuged to the tube outer diameter

Despite the simplicity of vortex tube's geometry, the energy separation phenomenon is quite complex and this has led to the publication of several, semi-conflicting theories regarding its operation. Some researchers have suggested that energy is transferred as work due to viscous shear between a fast moving, inner core and a slower moving outer annulus that is characteristic of a free vortex

In this paper the behavior of the vortex tube is modeled more simply – as a nozzle in series with a counterblow heat exchanger, an idea originally attributed to Sheper (1951). A semi-empirical model of the vortex tube is described based on this concept and predictions made using this model are shown to agree well with some experimental data. Recently the vortex tube has received some interest as a potential component in a cryogenic Joule-Thomson (Nash, 1991) or traditional vapor compression refrigeration cycle.

This paper uses the semi-empirical model of the vortex tube to evaluate the potential cycle efficiency improvement that can be attained when a conventional expansion valve is replaced with a counter-flow vortex tube in these refrigeration cycles.

Exploration: In this stage, the issue of how natural gas is found and how com ponies decide where to drill wells for it is addressed.

Extraction: This stage deals with the drilling process, and how natural gas is brought from its underground reservoirs to the surface.

Production: In this stage the processing of natural gas once is brought out from the underground takes place.

Transport: The natural gas is transported from the processing plant to local distribution companies across a pipeline network in this stage.

Storage: This stage accounts for the storage of natural gas.

Distribution: In this stage, natural gas is delivered from the major pipelines to the end users.

Marketing: This stage involves the buying/selling activity from the natural gas marketers.

Contents a specialized sour gas gathering pipe must be installed. Sour gas is corrosive, thus its transportation from the wellhead to the sweetening plant must be done carefully. The field of Operations Research has taken a major role in the natural gas industry as a number of important and relevant problems in design, extraction, production, transportation, storage, distributing, and marketing, have been successfully tackled by OR models and techniques over the past 40 years. provide a recent survey on optimization models in the natural gas industry while focusing on three specific aspects: production, transportation, and market.

The authors basically discuss a mathematical formulation of the underlying problem and provide a literature revision of the existing optimization techniques that solve it.

Materials and methods

In the monitoring campaign, the features of stations (shelters, room, outdoor) and the following operating parameters were considered Separately :

- Energy consumption (kWh)
- Indoor Station Temperature (°C)
- Outdoor Station Temperature(°C)
- Noise (dBA)
- Global Radiation(W/m2)

Survey questionnaire

The survey was divided into five different sub-topics to align with the themes of the conference. Each of these subtopics (listed below) consisteed of eighteen questions:

1. Perspective on gas supply
2. Infrastructure development
3. Developments in liquefied natural gas (LNG)
4. Policy and regulatory reforms
5. End use sector-specific reforms
2. Infrastructure development
3. Developments in liquefied natural gas (LNG)
4. Policy and regulatory reforms
5. End use sector-specific reforms.

Develop pipeline infrastructure and remove obstacles

The survey results suggest that the approach for gas market development should also be based on the 'carrier first, commodity later' principle. Globally, countries with well-developed gas markets are characterized by the creation of infrastructure such as LNG terminals and gas transmission pipelines. Infrastructure creation will de-risk gas importers, gas marketers and LNG terminal investors. Over time, the network will provide a push to setting up gas-based industries and promote the development of industrial zones, corridors and clusters.

Most of the respondents have proposed the development of additional LNG terminals to supply degasified liquefied natural gas (RLNG) and equitable gas transmission pipeline infrastructure to cater to the shortfall/demand/new areas. There are obvious reasons why 6% of the respondents disagree with the 'carrier first, commodity later', which, in India, has historically been the principle behind the growth of the gas market. The supply of gas as a commodity paved the way for infrastructure development, including gas pipelines and LNG storage-cum-regasification terminals. In fact, the infrastructure was created only to handle the existing gas supplies.

Investors are skeptical about developing infrastructure first as there is a risk of this infrastructure remaining unutilized or underutilized in the absence of firm tie-ups both on the gas sourcing and gas off take front. In the last two years, with the tapering of domestic gas production, the existing gas infrastructure is grossly underutilized. The LNG regasification terminals to be developed are the only hope for increasing the utilization of these pipelines.

Sectorial reforms for accelerating gas usage

A host of reforms are required in the power and fertilizer sectors to boost gas sector development. The maximum consumption of natural gas is in the fertilizer and power sectors, accounting for about 59% of gas consumption in 2014–15.

Hence, questions were posted on the type of reforms that would boost gas sector development in these anchor consumer sectors. As mentioned in the table below, among the power sector reforms, most of the survey respondents are of the view that time of day (ToD) tariff is the need of the hour. This will enhance the affordability of gas as a fuel for the power sector. Transmission loss is another huge factor. If energy audits are done at regular intervals, timely feedback, which is critical, will become available on the terms of equipment efficiency and ways to improve. The respondents have stated that as the power sector has been an anchor consumer in gas markets worldwide, sufficient domestic gas to match the country's full requirement of installed gas-based station capacity should be allocated to the power sector on top priority. Further, the respondents go on to state that to make RLNG viable for power generation, the generation utility/entity should be allowed to blend RLNG power with cheaper power from other sources like coal from its own portfolio.

Three critical factors for enabling the development of CGD

Most of the survey respondents have cited the following as the critical factors for CGD development:

1. Expediting the process of granting permissions by state/municipal/local state authorities: Multiple clearances and permissions are required from many agencies—various departments of municipalities, railway authorities, highway authorities such as National Highway Authority of India (NHAI), Public Works Department (PWD), traffic police, and state road transport departments, other local authorities, etc. These procedural delays tend to impact the pace of development of the CGD network. Providing single window clearances for the CGD network is a key factor for the expeditious implementation of the CGD networks. Further, there is a need for a single-window mechanism at the district level.

2. Government mandate to shift to PNG and CNG: From an environmental sustainability standpoint, natural gas scores the highest among all competing fuels. However, in terms of affordability to end consumers, in the peak commodity cycle phases, natural gas may not be able to compete with alternative fuels on price. Also, consumer perception of uninterrupted availability of PNG or CNG is hard to build. Thus, a government mandate may be required to promote CNG and PNG usage.

3. Reforms in tariff regulations: The criteria for tariff based bidding for CGD need a relook. There have been instances of near-zero tariff bidding witnessed in bidding rounds. Also, respondents have suggested the reintroduction of cross-subsidies between the marketing margin and network tariff, which were recently scrapped with stringent implementation.

Research Challenges

In steady-state models, the gas flow is considered isothermal at an inlet average effective temperature. This is a common practice in which authors assume that a heat transfer with the surroundings in the pipeline system causes the temperature to remain constant. Works on this area pose a significant challenge due to the inherent complexities associated to the gas temperature.

In these works, it is also assumed that the transmission lines are composed of horizontal pipelines. In practice, these systems have frequent changes in their elevation. Hence, a special attention must be paid into the necessary correction factors to compensate the changes in elevation. The majority of the works discussed here are based on deterministic models, i.e., where each parameter is assumed known in advance.

There is an evident need of stochastic programming models and approaches to handle those cases where the variant ion of the parameters (such as demand or supply) is so high that deterministic assumptions no longer hold. In this paper, we have reviewed some of the few works starting to face this challenge, particularly in compressor station optimization networks and pooling systems.

Additionally, we have seen some works in natural gas marketing problems for a review on some of these problems); nonetheless, we believe this is a tremendous area of opportunity for problems in natural gas transmission systems.

Final remark: One of the major challenges to efficiently exploit the natural gas supplies arises from the limitation of the optimization techniques, which are already developed in theory, but to less extent applicable in practice due to considerably strong assumptions.

For success in the increase in the demand, more than a few successful optimization tools capable of responding to changing conditions in a rational manner are required. This would certainly make more efficient the use of existing natural gas transmission systems, thus resulting in significant economic compensations beyond the expected levels for the natural gas industry.

We may expect that this trend will speed up towards a more promising future with the continual contribution of the scientific community.

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