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Efficient Reduction of LIN Production in a Waste Expansion Plant

The TGN series plants produce high purity gaseous nitrogen (GAN) and a small amount (5-10% of GAN) of liquid nitrogen (LIN) by cryogenic distillation of atmospheric air via a waste expansion refrigeration cycle. This expansion cycle is common and cost effective, however, it inherently produces a fixed amount of refrigeration. The fixed amount of refrigeration is set by the customer's pipeline pressure, nitrogen recovery, and nitrogen required for regeneration. Normally there is more refrigeration than required to make up for heat leak, and this excess amount determines how much LIN is produced.

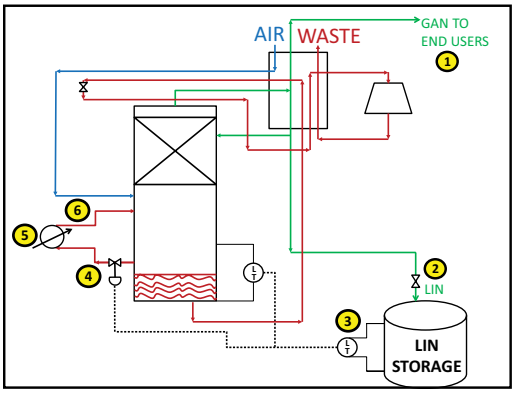

Figure 1: Waste Expansion Cycle

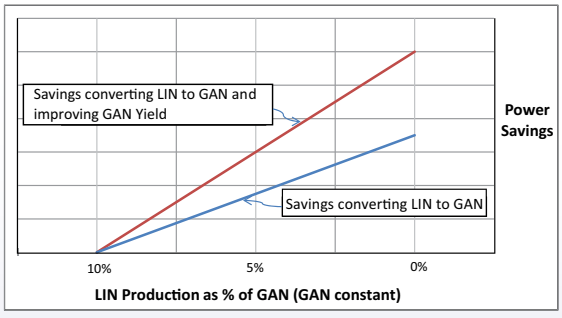

Figure 2: Power Savings As LIN Production Decreases

Waste expansion nitrogen plants are especially effective in remote industrial areas where it is uneconomical to deliver LIN by tanker truck and where LIN for back-up is required (see Figure 1). While GAN is being consumed in the facility (1), the small amount of LIN is stored for a multitude of uses (2) including back-up when the plant is off-line, to supplement GAN flow when there are peaks in demand, or when the plant is taken off-line to avoid peak power rates. Yet, there are instances when the storage tanks fill up because there are no uses for LIN. For this condition, Cosmodyne invented a simple design modification that eliminates LIN production and saves power, while continuing to produce GAN, without interrupting the overall operation. This patented technology works automatically and includes the following steps: sensing a full storage condition (3), on full storage, routing cryogenic liquid from the bottom of the nitrogen column to an external vaporizer (4), converting the liquid to gas (5), introducing the gas back to the column (6), and using the heat in the returning gas to remove excess refrigeration (7), thereby stabilizing the column at this new design point. The benefits of this design are two-fold: first, the unwanted LIN is converted to GAN and used in the facility without a pump and vaporizer as it would be coming from the storage tank. Converting the LIN to GAN allows the air compressor to be turned down, thus saving power (blue line on Figure 2). Secondly, this modification results in a higher GAN to air yield which allows the air compressor to be turned down even further and produce the same amount of GAN (red line on Figure 2).

Figure 3: Typical TGN Installation

Without this modification, a customer's only solution for a full storage condition would be to (a) vent LIN through a disposal vaporizer, (b) turn-down the air compressor to make less GAN and LIN while vaporizing and compressing LIN from storage, or (c) shut down the plant while vaporizing and compressing LIN from storage. All of these options result in a higher overall power consumption than the power consumption obtained using the modification.

For more information on this article, please reference US Patent No.: US 7,555,918 B1 or call Melania Charles at Cosmodyne LLC at 562-590-7995 or mcharles@cosmodyne.com.