BIO-LNG - The development of small-sized Liquefied Natural Gas (LNG)

In the context of new technologies related to green chemistry and circular economy, in recent years attention and interest in applications that use Liquefied Natural Gas (LNG) have been growing.
LNG is obtained, after appropriate purification and dehydration treatments, by subjecting natural gas to subsequent cooling and condensation phases.

LNG - Origins
The origins of the technology date back to the early 1920s, when the first air liquefaction techniques were developed.
In the 1930s the recovery of helium from natural gas through liquefaction was started for military purposes, and in the subsequent 1940s the first applications were made to store combustible gas in liquid form.
In the 1960s, therefore, the first large liquefaction plants for the export of fuel were built.

LNG - Applications
Liquefied Natural Gas can be used in transport as an ecological fuel to power heavy vehicles (LNG trucks).
Even the maritime sector, from small boats to ferries and up to the most important means, can make its environmental footprint lighter, without decreasing the power and autonomy of the missions.
Furthermore, LNG can be obtained from biomethane, a gas compliant with the natural gas network specifications, which in turn can derive:

- from the purification - upgrading - of the biogas produced by the anaerobic digestion of biomass (organic fraction of urban waste, agricultural or food industry by-products, water purification, etc.);
- from CO2 methanation, as in the first Italian plant of this type, inaugurated in Troia (FG), in September 2018 (EU project H2020 STORE & GO).

In these cases, applications using bio-LNG have an environmental impact comparable to an electric vehicle powered by renewable electricity.

LNG - Cryogenerators
In the context of the development of new applications more compatible with the environment, there is the opportunity to produce LNG on a smaller scale than the typical sizes of large oil & gas terminals.
These are cryogenerators capable of providing the cooling necessary for the liquefaction process on sizes of interest for local LNG production.
In particular, the technology in question is very competitive due to its greater energy efficiency than traditional larger processes (Linde, Claude, Joule-Thompson, Brayton cycles) over the daily production range from 1 ton to 30 tons.

Stirling Cryogenerator - History and applications
The Stirling cryogenerator was born in 1938 at Philips research laboratories, which at the time were working to generate electricity for the purpose of powering radios in remote areas.
The hot air engine (conventional Stirling cycle) had attracted attention for its extreme flexibility in the use of fuels of any type.

In 1946 Philips began the development of the cryogenerator intended as a cold gas refrigerator, i.e. the inverse machine of the hot air engine.
In 1990, the commercial success made Stirling Cryogenics BV independent, which, thanks to continuous innovation and considerable investments in research and development, today supplies on the market for special applications a technologically advanced machinery for the cooling of gases and liquids at extremely low temperatures (from 200 K to 15 K).

Stirling Cryogenerator - Features and benefits
The Stirling cycle is a closed cycle, which means that the cryogenerator working gas (He in a gaseous state) never comes into contact with the substance (gas or liquid) which cools in the main process. This also eliminates contamination of the working gas, resulting in increased operational safety.
The closed Stirling cycle also offers additional advantages:

- the Stirling cryogenerator is extremely ecological: it does not cause in any way the depletion of the ozone layer, it does not contribute to the greenhouse effect and it does not discharge harmful or toxic gases;
- the Stirling cryogenerator is extremely efficient, especially when compared to other cryogenic processes. Stirling is the only company in the world that successfully manufactures Stirling cycle cryogenerators with cooling power of 1,000-4,000 watts (at 77 K).

The Stirling cycle involves alternately compressing and expanding a fixed amount of a near-perfect gas (also known as an ideal gas) in a closed cycle. Helium is used for this.
Compression occurs at room temperature to facilitate the discharge of heat caused by compression, while expansion occurs at the required low temperature.

Stirling Cryogenerator - Applications
The first step on industrial applications of natural gas liquefaction using the Stirling cycle was on the recondensation of LNG vapors in storage or barges (bunkering barges). In this case, the condensation of natural gas is essential for controlling the pressure inside the LNG storage tanks.
The characteristics of reliability, compactness and modularity have made the Stirling cryogenerator a technically first level solution.
The fields of application cover the liquefaction of gases such as N2, O2, Ar, Ne, H2 and also CH4. Furthermore, the same cycle can also be used in sensitive cooling (e.g. under cooling of cryogenic liquids, such as sub-cooled LNG) or in conjunction with the Joule-Thomson expansion for cooling He down to 2K (-271 ° C).
Installations such as the “Clean Jacksonville” in Florida, USA, built by CONRAD and operated by FOSS, used in the refueling of TOTE container ships; the “LNG London” built by VICTROL and SOGESTRAN, used in refueling on behalf of SHELL; are among the first successful examples of Stirling technology in the field of LNG at an industrial level.
Stirling Cryogenics is now a global specialist in cryogenic technology and boasts a reference list with over 3,000 installations worldwide.
Since 2018 Stirling Cryogenics has been owned by the HYSYTECH group.

Biofuels - HYSYTECH’s commitment
Not only Bio-LNG: HYSYTECH has been at the forefront of biofuels for years.
On the subject of Biomethane, in 2014 HYSYTECH, together with Acea Pinerolese Industriale, built the first biogas upgrading plant in Italy obtained from the anaerobic digestion of MBW.
In 2016, together with EGEA, FCA and CNH, it inaugurated the first full tank of biomethane intended for the refueling of bio-CNG vehicles.

In 2020, thanks to the continuous collaboration with Acea Pinerolese Industriale, a new biomethane plant came into operation, which treats up to 1,500 Sm3 / h of biogas and feeds the biomethane into the natural gas distribution network for automotive use.
The first plant for the production of bio-hydrogen from biogas produced by the anaerobic digestion of the organic fraction of waste from separate collection (FORSU) was put into service by HYSYTECH in 2020, thus further enriching the Turin company's experience in field of biofuels.

Hysytech S.r.l. is an engineering company founded in 2003, specialized in the design, development and industrial implementation of new turn-key process technologies and equipment. Our skills start from the know-how in chemical and process engineering, up to commissioning, monitoring and maintenance. We operate mainly in the field of generation, treatment and recovery of industrial gases, organic liquids and energy, according to the best engineering practices, also through the implementation of our technologies.

Stirling Cryogenics B.V. is a company founded by Philips and acquired in 2018 by Hysytech S.r.l. The head office is in Eindhoven, The Netherlands. The company designs and builds cryogenic solutions based on the different cryogenerators based on the Stirling thermodynamic (inverse) cycle.

Bio-LNG - Link:
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