Small scale LNG plant: perspective and technology

Methanizing the Mediterranean Area
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The first large-scale transport of LNG from Algeria has begun about 50 years ago.

Since then we have seen a growth in the world market both demand and production of LNG.

In parallel we have developed along the supply chain areas of application alternative to regasification, but also attention to small plants and starting from non-traditional products.

In perspective it is estimated for the business of small systems development with the creation of more than 100 plants in the next 10 years.
Small scale LNG plant

LNG plants:
- In the world operate many small and medium size plants
- Growing sector with an estimated average of 10% over the next 10 years
- The installed capacity of the plants is about 100-3000 m³/day
- Objective of the plant is to produce for niche areas with respect to big chain of liquefaction plants.

Working on niche areas means working with:
- Sources of raw material diversified
- Different target markets
- Unconventional technologies
Raw materials

Use in food to the liquefaction of non-standard products such as:

- Biogas digesters or water treatment
- Gas pipeline
- Associated gas
- Landfill gas

The typology of the raw material implies the need to work with products of different composition and with a specific production not defined:

| Raw Material    | 0  | 5  | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| METHANE         |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WATER           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| CARBON DIOXIDE  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| NITROGEN        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

Fonte: [http://www.prometheusenergy.com](http://www.prometheusenergy.com)

We need to use new and flexible technologies
The availability of LNG in a widespread manner and relocated allows us to develop new applications:

- Micro distribution networks (distribution pipe in small urban conglomerates decentralized)
- Dedicated fleets of heavy vehicles (freight transport vehicles from the quarry, ...)
- Peak demand in manufacturing (support for users requiring high fuel consumption can not be managed by traditional network)
- Use as fuel in engines with less environmental impact (ships, trains and planes)
The main reasons behind a small scale plant for production of LNG are:
- Relocation of production
- Diversification resources
- Environmental impact of fuel
- Environmental impact of the plant
- Reduced risk investments
- Rapid implementation
- Extended participation to investment

The main problems that remain about the project are:
- Infrastructural barriers
- Higher cost due to the scale factor
- Regulatory indecision
- Uncertainty of the availability of the product for the development of consumption
- Impact of falling oil prices
- Economic incentives for the initial phase
- Lack of a regulatory framework and reference standards
In the case of installations of small scale, compared to that of greater dimensions, we can speak of a **value network**.
SIAD Group operates in the industrial gases, engineering, healthcare, industrial goods and service sectors in Europe and in the world with production sites, commercial branches and service centers.

SIAD Macchine Impianti, the Group’s engineering company, is a leader in the production of ASUs (Air Separation Unit), with over 500 plants installed worldwide. Thanks to the wide experience and skills gained in the context of cryogenic technologies, SIAD Macchine Impianti has developed the new line of SMART LNG plants for the production of liquefied natural gas.
SMART LNG plants are the first and only system solution proposed in Italy for the liquefaction of natural gas (LNG) on a small and medium scale.

The LNG produced in this way can be used locally in filling stations for vehicles or for micro-distribution systems.
Natural gas at ambient pressure liquefies at -162 °C. This temperature is reached by means of the cryogenic technology, widely consolidated by SIAD Macchine Impianti.

SMART LNG plants have two main process phases:

1. Pretreatment for removing contaminants from natural gas, such as:
   - Water, hydrogen sulphide, heavy hydrocarbons, carbon dioxide and ammonia

2. Liquefaction, implemented through:
   - a heat exchanger, which exploits the frigories released by the evaporation of liquid nitrogen and by its subsequent heating to ambient temperature
   - or
   - a heat exchanger integrated in a nitrogen recycle liquefaction process comprising compressors and turbines.
Advantages

The technology and system

- Reliable and consolidated technology
- Easy plant startup, operation and shutdown
- High reliability and efficiency of the machines (compressors and turbines) that treat nitrogen

The process

- Simple process and control system
- Low influence of changes in the natural gas composition
- Particularly efficient with high-pressure network natural gas
- Flexible liquefaction process: easy load variation and the possibility of continuous operation.
Safety and environmental impact

- Safety in operation: the process refrigerant fluid in the machines is nitrogen, an inert gas, instead of a mixture of hydrocarbons
- No chemicals used
- Absence of liquid hydrocarbon storage systems for refrigerant mixture
- Personnel with specific experience in the management of hydrocarbon mixtures not required
- Absence of unavoidable hydrocarbon leakages from the seals of the machines.
SIAD Group develop few case of SMART LNG application. Today we consider two cases:
- LNG produce from NG gas network
  - Capacity 240 Nm$^3$/h
- LNG from Biogas produced from FORSU
  - Capacity 2000 Nm$^3$/h
The presented plant, which is SMART LIN-LNG type, consists of:

- Filtration, measurement and pressure reduction system
- Purification from sulphur compounds
- Liquefier cold box using liquid nitrogen
- Liquefied natural gas storage tank
- Liquid nitrogen storage tank
- Liquefied natural gas truck filling pump
- Flare
LNG from natural gas network

Technical specifications

- LNG production: 240 Nm$^3$/h = 170 kg/h = 4.1 t/d
- Natural gas pressure: 16 bar
- Carbon dioxide content: 0.4 mol%
- Electric power specific consumption: 0.05 kWh/Nm$^3$ LNG = 0.07 kWh/kg LNG
- Liquid nitrogen specific consumption: 1.42 Nm$^3$ nitrogen/ Nm$^3$ LNG
- Cooling water flow rate with deltaT 10 ° C: not required
- LNG minimum storage pressure: 3 bar
- LNG storage volume: 40 m$^3$ for 3 day endurance
- Liquid nitrogen storage volume: 50 m$^3$ for 3 day endurance.
The presented plant, which is SMART MP-LNG type, consists of:

- Hydrocarbon adsorption and ammonia scrubbing system
- Carbon dioxide and hydrogen sulphide separation system with selective solvent
- Biomethane compressor with aftercooler
- Drying and decarbonating system to eliminate residual water and carbon dioxide from biomethane
- Cold box liquefier
- Nitrogen recycle compressor
- Turbine/booster unit
- Booster aftercooler
- Liquefied natural gas storage tank
- Liquid nitrogen storage tank
- Liquefied natural gas truck filling pump
- Flare
LNG from biogas produced from FORSU

Technical specifications

- LNG production: 2000 Nm$^3$/h = 1430 kg/h = 34 t/d
- Biogas specific consumption (with 64% methane in biogas): 1.52 Nm$^3$ biogas / Nm$^3$ LNG
- Biogas hydrocarbon content: 1 g/Nm$^3$
- Electric power specific consumption for purification: 0.25 kWh/Nm$^3$ LNG = 0.35 kWh/kg LNG
- Electric power specific consumption for liquefaction: 0.56 kWh/Nm$^3$ LNG = 0.78 kWh/kg LNG
- Liquid nitrogen specific consumption: 0.16 Nm$^3$ nitrogen / Nm$^3$ LNG
- Steam specific consumption: 1.7 kg vap/Nm$^3$ LNG
- Cooling water flow rate with deltaT 10° C: 290 m$^3$/h
- LNG minimum storage pressure: 3 bar
- LNG storage volume: 250 m$^3$ for 3 day endurance
- Liquid nitrogen storage volume: 50 m$^3$ for 3 day endurance.