

**Abstract.**

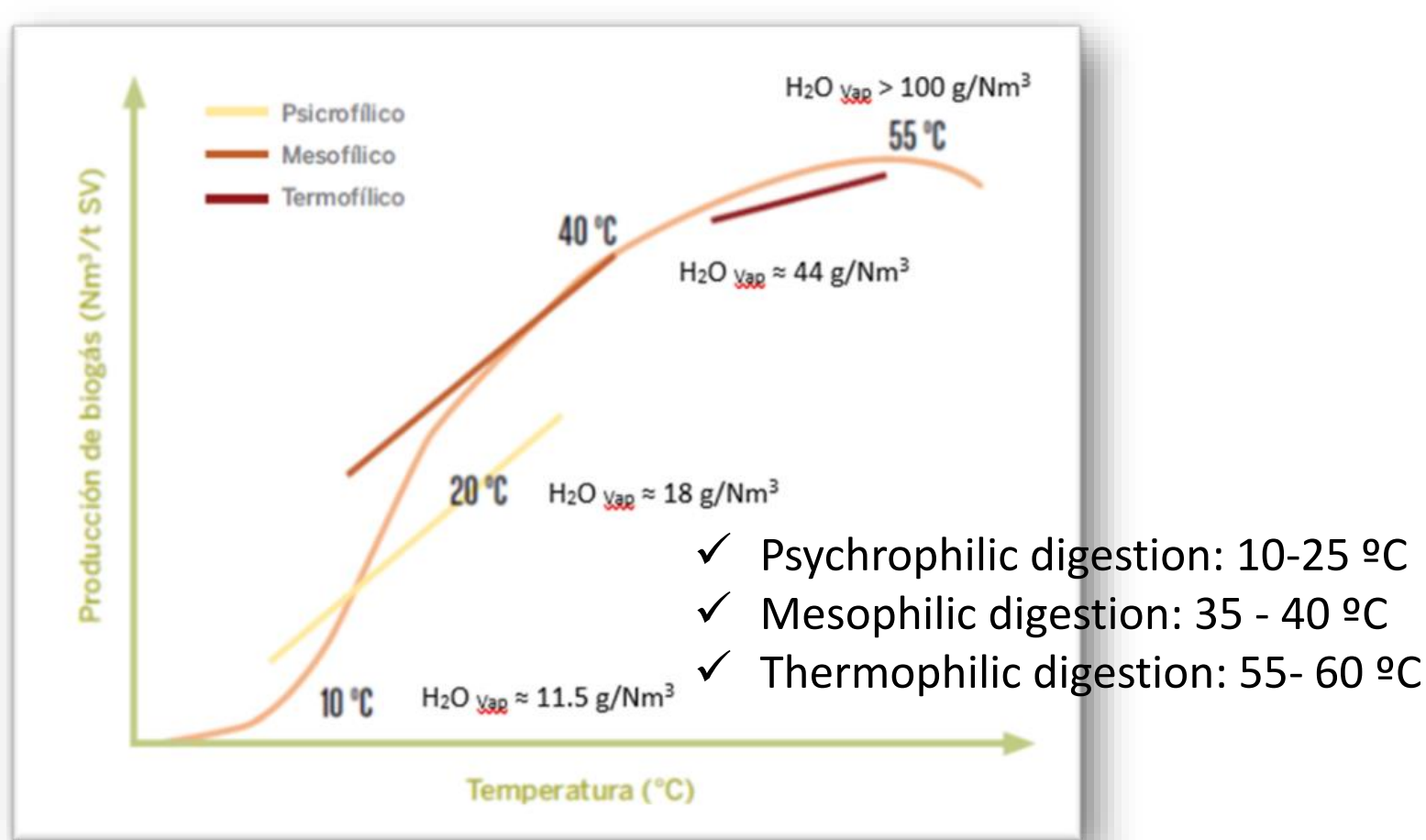
In the biogas production process, water is an intrinsic part of the material to be digested (biomass) and the process in which biogas production take place (medium). Regardless of whether the digestion process is dry or wet, the biogas produced will contain water vapor. The amount of water vapor contained in the biogas generated in the digester is a function mainly of the temperature at which the anaerobic digestion process (psychrophilic, mesophilic, and thermophilic) takes place and the pressure at which it is found in the digester (reactor). Other factors can be considered as part of the level of water vapor. The level of foam and the kind of agitation system applied. The biogas in the digester is saturated with water vapor. In general, the absolute humidity of the biogas ranges between 2.5 and 7% of its volume at room temperature.

Water vapor belongs to the Internal impurities; that is, it is part of the biogas flow. It is one of the last to be removed. There are many technologies in the biogas drying market one of them is the BTS-Dry which is a multipurpose technology developed by BGasTech based on operation combination that guarantees a high quality of the biogas cleaning with low OPEX.

**Introduction.**

Water vapor belongs to the Internal impurities, it is part of the biogas flow. It is one of the last to be removed.

**What is the level of moisture content in the biogas?**

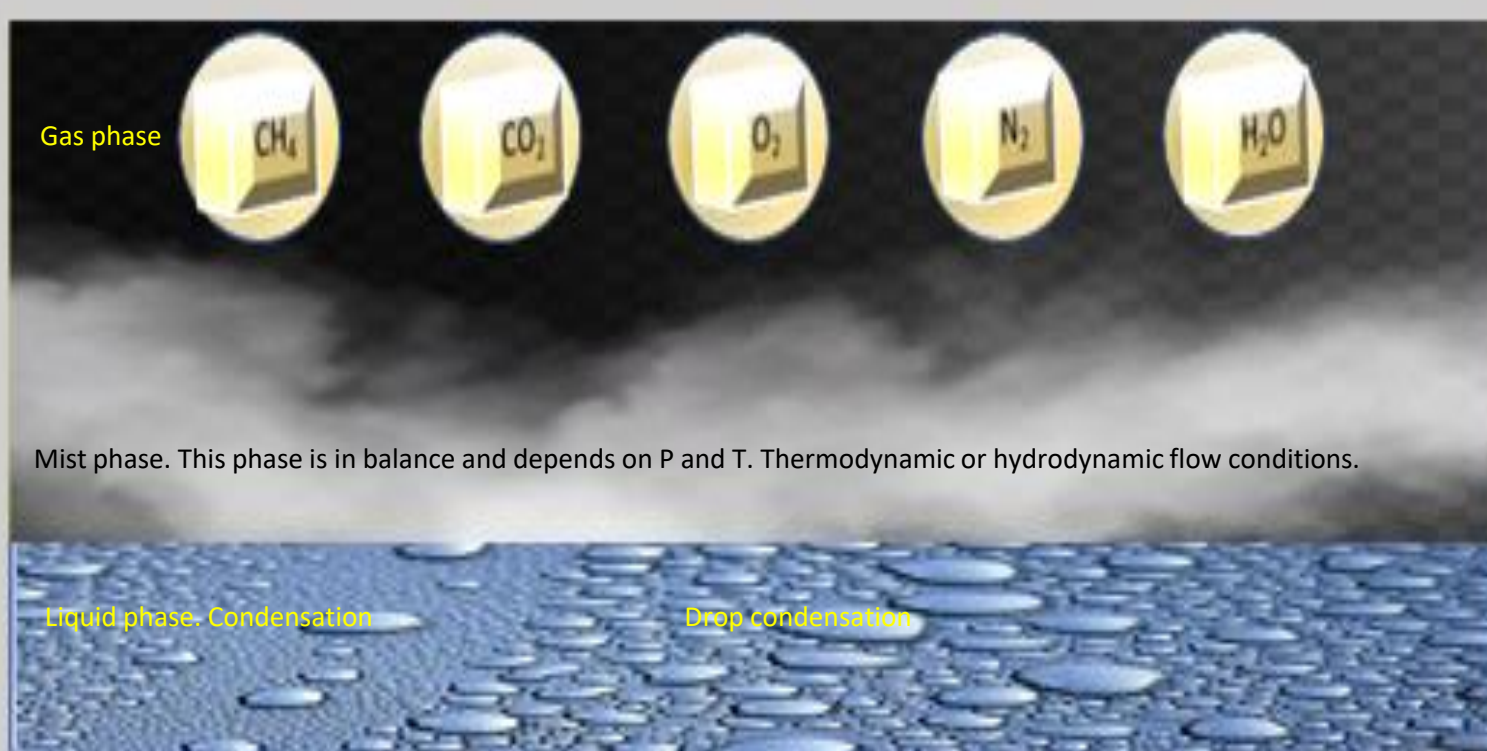


Figures 1. Water vapor level vs temperature

**What does the effect of moisture?**

- Water vapor decreases the LHV of biogas.
- It allows the formation of corrosive acids, such as H<sub>2</sub>Saq.
- Can cause blockage in the pipes.
- Promotes ice formation. When working at low temperatures.

**What does happen during the biogas drying by cooling?**



Figures 2. Phase appearing during biogas cooling

**Kind of equipment for biogas drying.**

Currently, there are two basic kind of equipment in the biogas drying market, according to the position where the heat exchanger is located. The horizontal position and the vertical position.



Figure 3. Dryer. Horizontal position



Figures 4. Dryer. Vertical position with energy recovery

The vertical biogas drying equipment presents the following advantages.

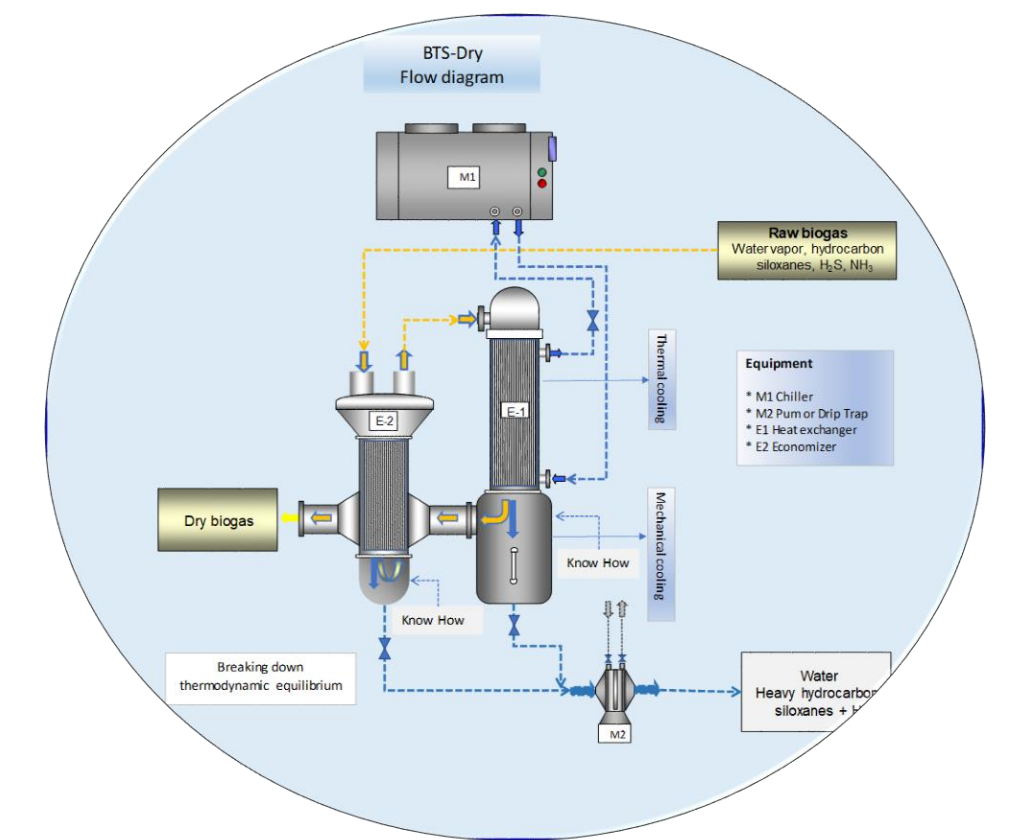
- ✓ Less space requirement it's mounting.
- ✓ Better removal of the condensates.
- ✓ Less probability of tube freezing when working at low temperatures.
- ✓ Better heat transfer coefficients.
- ✓ High yield on removing moisture and other contaminants.

**Case study.**

BTS-MPdry technology for biogas cleaning is a multipurpose technology with two main steps: biogas drying and polishing. Figure 6 shows how the biogas drying step work.



Figures 5. BTS-MPdry. Alcalá Oeste. WWTP made by BGasTech



Figures 6. Flow diagram BTS-DRY

All tests were done under follow operating conditions.  
Flow = 360 Nm<sup>3</sup>/h Δpressure = 270 mbar Temperature = 38 °C, working temperature = 2°C. Target. Moist, removal.

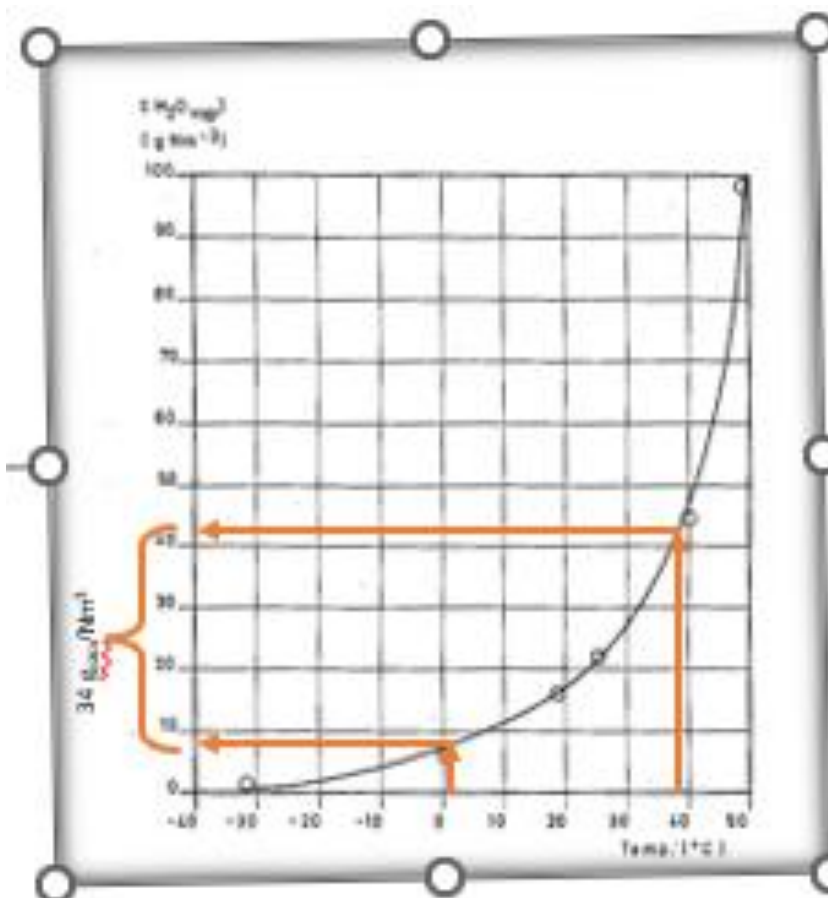


Figure 7. Biogas temperature vs Moisture content

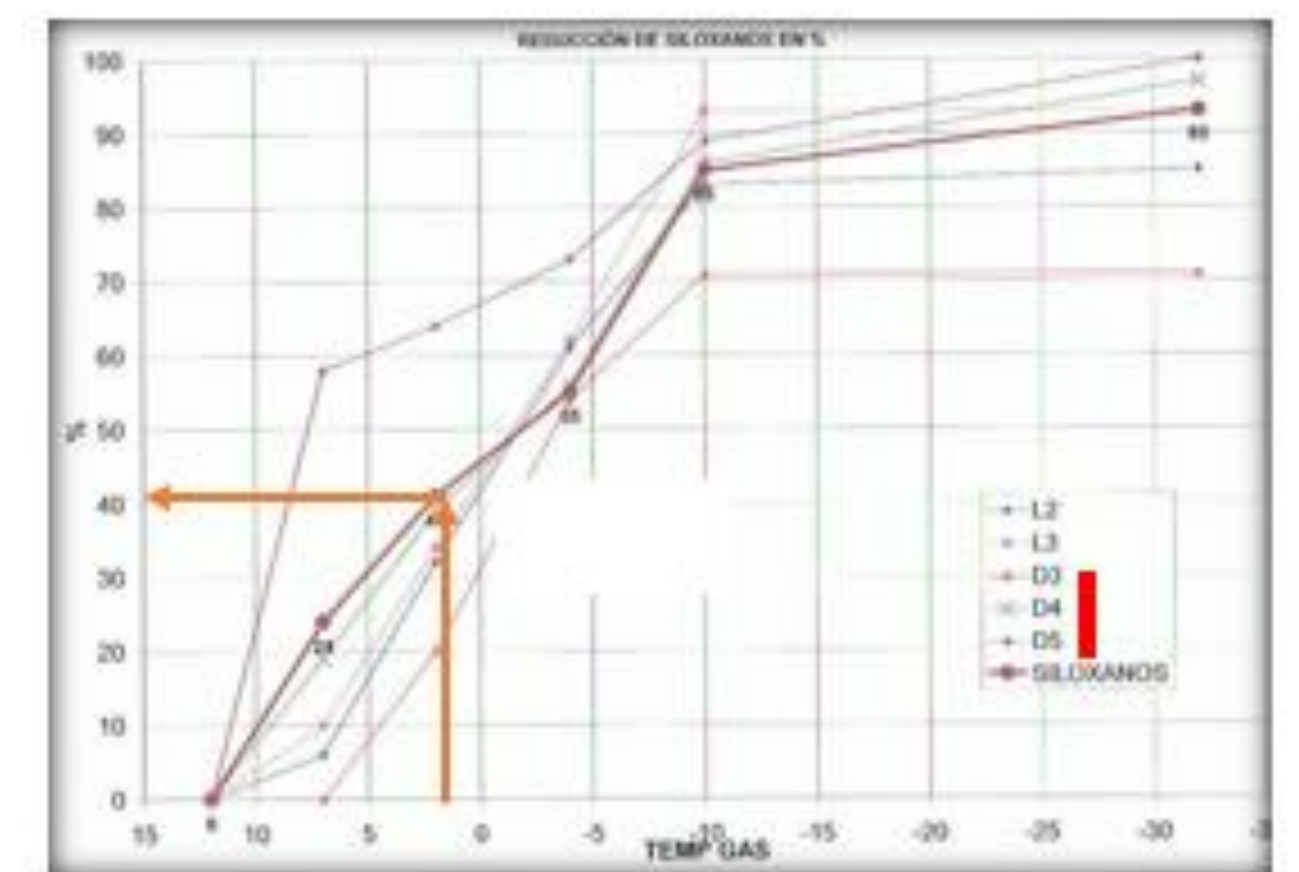


Figure 8. Siloxane removal % vs biogas T °C

**Result.**

**Table 1.** Biogas composition before and after of water removal system (drying step).

Components	In	Out.
CH <sub>4</sub> [%-vol]	59.86	62.1
CO <sub>2</sub> [%-vol]	31.76	33.95
H <sub>2</sub> O <sub>vap</sub> [%-vol]	3.56	0.3
Others [%-vol]	4.82	3.65

**Table 2.** Show the (%) of increase and decrease of the main components.

Components	Increase	Decrease
CH <sub>4</sub> [%-vol]	3.74	
CO <sub>2</sub> [%-vol]	6.90	
H <sub>2</sub> O <sub>vap</sub> [%-vol]		91.57

**Conclusions.**

- ✓ The BTS-DRY technology based on the operations combination is a suitable facility for biogas drying to produce a high biogas quality for any use of this kind of gas.
- ✓ Based on the results of the study, it can be seen that reducing the absolute humidity of biogas not only favors the increase in biogas quality but also prevents failure problems both in machines and in the biogas transport facility.
- ✓ On the other hand, by reducing the temperature of the biogas below 5°C, not only is moisture eliminated, but also siloxanes, mainly type D, and VOCs can be eliminated.