

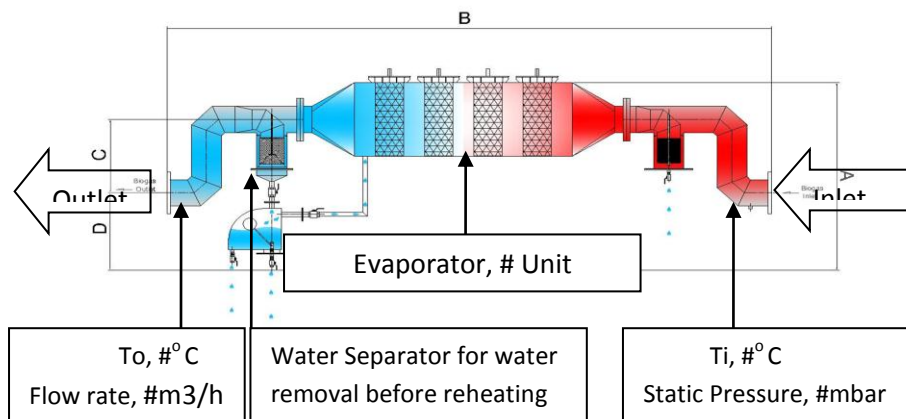
BKE Biogas Dryer

The Principle

BKE biogas dryers are machines for reducing water content in biogas. The water content can be a form of vapor or liquid (condensate). The water vapor content in the biogas can be calculated as they are in the form of atmospheric air. Therefore the psychrometric chart is applied to find the amount of water vapor in the biogas by the units of relative humidity (%RH) or absolute humidity (kg water/kg dry biogas). As long as there is no specific psychrometric chart for biogas, the chart for atmospheric air is close enough and applicable.

As you remove water from the biogas you reduce the biogas temperature below the dew point. At that reduced temperature, some vapor will condense and turn to liquid (condensate). Please note that the lower the temperature, the more condensation may take more electricity consumption.

To remove condensate from the biogas handling system, a water separator is used as shown in the diagram below.



How it works...

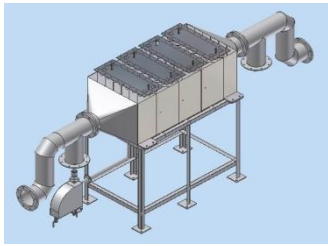
The following table the remaining condensate after biogas temperature reduction.

Example Table 1

	Temp. (T) °C	Wet Bulb Temp (T _{wet}) °C	Absolute Humidity (w) kg water/kg dry biogas	Relative Humidity (phi) %	Dew Point Temp (T _{dew}) °C	Excess Water /condensate (w - w _{sat}) kg water/kg dry biogas
Initial Temp.	40	40	0.048960	100	40	0
Reduced Temp.	20	20	0.015	100	31	0.03396
After water separator	20	20	0.015	100	20	0
After Reheating	40	26.5	0.015	35	20	0

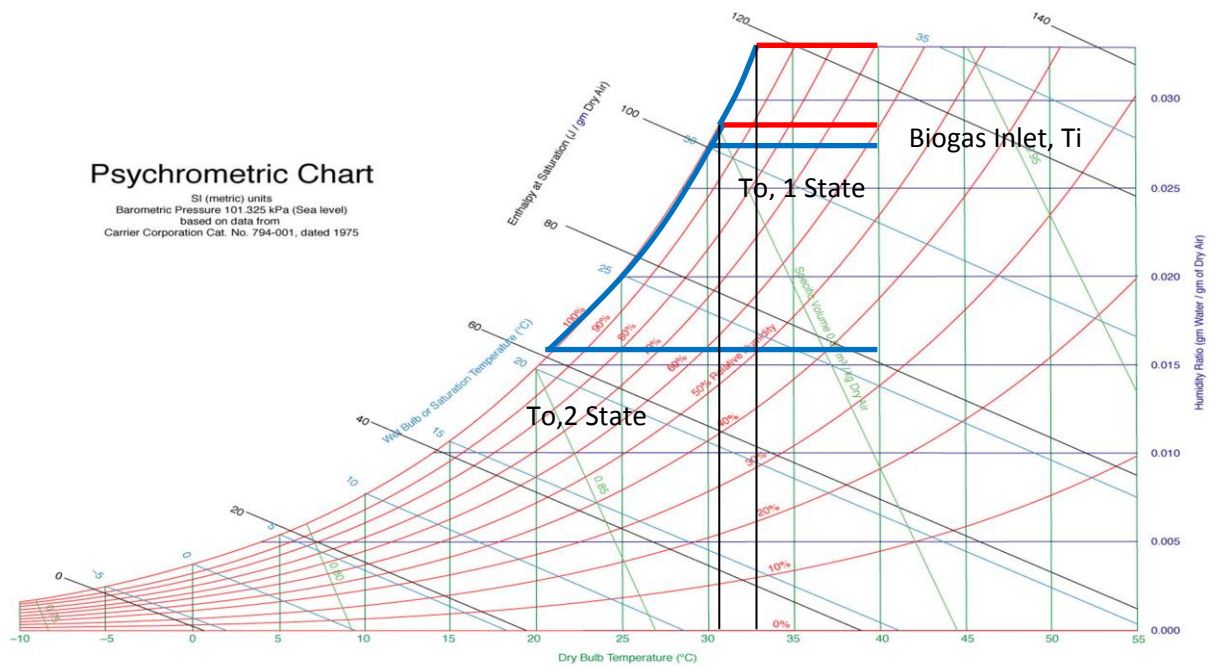
At the starting, point the biogas temp is 40°C with 100% RH. At this stage the absolute humidity is 0.048960 kg water/kg dry biogas.

After the biogas temperature is reduced, the relative humidity is still the same at 100% RH but the absolute humidity is reduced to 0.015 kg water/kg dry biogas. The balanced amount of water is the excess water of $0.048160 - 0.015 = 0.03396$ kg water/kg dry biogas. The excess water or condensate will be removed by the water separator. So the stage after the water separator is still keeping the relative humidity at 100% RH but minus the excess water.



The next stage is to recover the biogas temperature by reheating which can be done by natural heat transfer depending on the ambient temperature, the length of the biogas supply piping and the pipe wall conductivity. We can also force reheating by using blower(s) to boost the biogas pressure. As the example in Table 1 shows, if the reheated biogas is 40°C, then the relative humidity will be reduced to fewer than 35% RH which is beyond the basic requirement (around 85% RH).

The following chart shows the saturation points relative to Humidity and Temperature.



Benefits:

Condensate is removed from the system thus removing the conditions for the existence of H₂S allowing for maximum biogas utilization:

- Avoid the damage from corrosion. The equipment (Blower, Valves, Gen set and piping system) will have a longer operating life.
- Increase the heating value
- Increased combustibility to reduce wasted excess gas

Reference:



A BKE 400 m³/h Biogas Dryer (BD400) @ Sarawak, Malaysia

Sample Video: <http://www.youtube.com/watch?v=N107mxoCAqc>