Noise Impact Report of a 44 kW Biolectric Installation

October 2019

Content

1   Description of assessment.

The sound power level of a newly produced 44kW Biolectric CHP container was determined by means of intensity measurements on the various sides of the container and the two air intakes and exhausts of the CHP-unit.

Based on these measurements, the sound pressure level at any distance from the container can be calculated with the IMMI noise mapping simulation software.

Moreover a few sound pressure level measurements at known distances were done to validate the model.

All measurements were carried in compliance with EU directives and in accordance with the ISO 9614-2 norm.

2   Measurement conditions.

2.1 Devices

The following measurement equipment was used to carry out the sound pressure measurements:

Description	Type	Serial No
Hand-held Analyser	2270	3002263
Microphone 1/2" prepolarised	4189	2839657
Sound Intensity Probe	3599	2683971
Sound Intensity Microphone Pair	4197	2672336
Sound level calibrator Brüel & Kjaer	4297	2762478

All equipment was calibrated prior to measurements.

2.2 Measurement period

The sound measurements were executed on Thursday October 17th, 2019 between 14.00 and 19.00.

2.3 Meteorological conditions

During the sounds measurements, the weather conditions were:

- Wind direction SSW, with average speed between 3 and 4 m/s.
- Cloudy, no rain
- Temperature of 14°C

3 Description of the Biolectric Installation.

The noise measurements were carried out on the 20 foot container, attached to a Biolectric biogas plant, with the following specifications:

- Type: 44 kW + S4
- Year of construction: 2019
- Electrical output power: 2 x 22 kW

The biogas plant consists of a digester tank where the fermentation of the manure takes place and one standard 20ft shipping container, containing two CHP units that convert the produced biogas into electrical energy and heat.

The majority of the sound pressure is generated by these CHP-units that are individually sound proofed with a noise absorbing casing. In the ventilation path of these casings, a noise damping setup is foreseen.

The CHP units are mounted on a floating structure, eliminating the vibration path from the engines to the container floor. To further attenuate vibration, a concrete block is foreseen in the structure below the engine, as seismic mass.

The 20 foot container has a double access door on the front side and various vents on both sides. This entrance door is closed during normal operation.

The Biolectric installations are intended to be operational 24/7, year round with occasional standstill e.g. for maintenance.

The pictures below show the relevant items of the biogas plant.

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Figure 1:Overview of the full installation

Figure 2: Inside view of the 20 foot container, with the engine enclosures opened and removed

Figure 3: Single 22 kW CHP unit, mounted on a floating frame, with seismic mass (concrete block) below the engine

4 Results of the sound measurements.

4.1 Sound intensity measurements

In order to determine the sound power level of the biogas plant, intensity measurements were carried out, according to the ISO 9614-2 norm. This technique directly determines the sound intensity by means of a directional measuring probe.

The sound intensity is the radiated sound energy per unit of surface on a plane, perpendicular to the measuring probe, and is thus a vector characterized by both magnitude and direction.

By integration of the sound intensity over a closed periphery, surrounding the source, one can determine the sound power of this source. This technique allows the determination of the sound power of a source, even in the presence of other noise sources.

Scanning of the different sub-planes of a particular sound source can also determine the sound power level of each sub-source individually.

An A-weighted sound power level LwA of all the sub-sources, as their percentage contribution is displayed in the below table:

Description	LwA in dBA re 1 pW		Percentage contribution
Side wall (East)	61,8	63,7	11%
Opening under side wall (East)	59,1		
Side wall (West)	63	63,8	11%
Opening under side wall (West)	56,2		
Side wall (South)	61,3	64,4	13%
Opening under side wall (South)	61,4		
Side wall (North)	66,5	67,2	24%
Opening under side wall (North)	59,1		
Container roof		63,1	9%
Exhaust CHP 1	64,8	68,1	30%
Exhaust CHP 2	65,4		
Air intake CHP 1	52,2	55,7	2%
Air intake CHP 2	53,1		
Complete biogas installation	**73,4**		**100%**

Based on the intension measurements, the global A-weighted sound power level of the full biogas installation (with both CHP units running) is **73,4 dB(A)** re 1 pW. Whereof about 30 % originates from the exhaust.

4.2 Sound pressure measurements

Besides above mentioned intensity measurements, sound pressure measurements were conducted at a known distance from the biogas installation, during operation (both CHP-units producing nominal power – 22 kW electrical power) and inactivity (determination of the background noise). Measurements were done at a height of 1.5 meter for a length in time of no less than 1 minute.

The static analysers were programmed for the calculation of the following static parameters: L_{Aeq}, L_{A50} and L_{A95}. To be able to interpret the results correctly, a brief explanation on the meaning of the calculated static parameters:

L_{AN}: is the sound pressure level in dB(A) that was exceeded for N% of the measuring time. For the calculated parameters this means:

- L_{Aeq}: the equivalent sound pressure level – the energetic average level. This is the constant A-weighted sound pressure level that, during the measuring time T would cause the same sound energy as the actually measured A-weighted sound pressure level during the same measuring time interval T.
- L_{A50}: the sound pressure level that was exceeded during 50% of the measuring time T – giving an average value.
- L_{A95}: the sound pressure level that wat exceeded during 95% of the measuring time T. This parameter, expressed in dB(A) is usually the guide value in environmental quality standards for ambient noise in open air.

All sound pressure levels are expressed in dB(A) re. 20µPa with the fast dynamic characteristic.

The following table provides an overview of the measurements at a distance of 16m from the container of the biogas installation and a height of 1,5 m. 'In operation' indicates that both CHP-units are producing the nominal electrical output of 22 kW; 'Inactive' indicates a state where the main fuse of the installation was in the off-position and only the background noise was recorded.

File N°	L_{Aeq}	L_{A50}	L_{A95}	Description
014	45,0	42,1	40,7	On 16m south of the container - In operation
010	41,7	41,2	40,3	
008	42,0	41,0	39,8	On 16m north of the container - In operation
009	40,6	40,5	39,3	
001	36,6	35,7	33,0	On 16m south of the container - Inactive
002	34,6	34,1	32,7	
003	36,2	35,4	33,4	On 16m north of the container - Inactive
004	37,9	36,6	34,5	

Based on the above measurements of the installation producing the nominal electrical power output of 2 x 22 kW and the background noise, the individual sound impact of the installation at a distance of 16m can be determined. This is calculated based on the logarithmic difference between the results 'in operation' and 'inactive'.

Bearing in mind the continuous and stable sound emission of the biogas installation, parameter L_{A95} is the most suited for this purpose.

Basis on the calculated sound pressure level at a distance of 16m from the container, the sound power level can be calculated for the biogas installation (taking into account the geometric expansion over a hemisphere, taking only a distance reduction into account).

The results of these calculations are summarized in the below table:

Description	L_{A95} in dB(A)
Average sound pressure level at 16m from the container - In operation	40,1
Average sound pressure level at 16m from the container - Inactive (background noise)	33,5
Individual sound impact of the installation at 16m (in dB(A) re. 20µPa)	39,0
Distance reduction	32,0
Total sound power level of the biogas installation (in dB(A) re. 1pW)	**71,0**

The results in previous table show that the calculated sound power level, based on the sound pressure measurements are 2.3 dB lower than the results achieved with the intensity measurements. This small deviation is within the expected fault margins of the measurements and can be attributed to small variations in for instance wind.

![Biolectric logo]

5 Transfer calculations

Based on the sound power levels of the biogas installation, described in chapter 3, the specific sound of the biogas installation at the level of a few reference point in close proximity of the installation was calculated. This sound pressure level is the own individual contribution of a sound source to the ambient sound at a point in the surrounding.
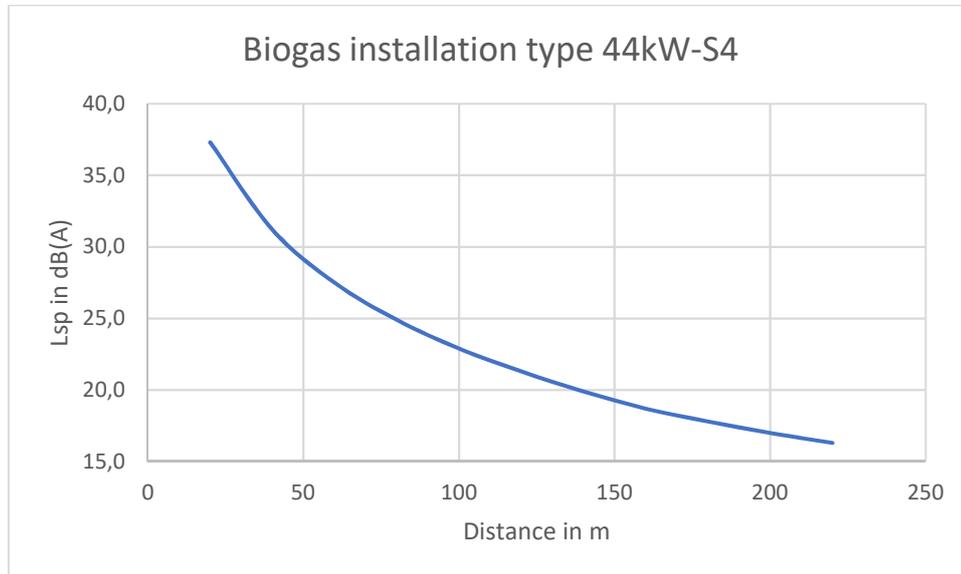
Sound transfer calculations were done in accordance with the ISO 9613-2 norm, using computer software 'IMMI' for the normalized 1/3 octave band between 25 and 10.000 Hz. The height of the immission points, was set to 4m (first floor level). In the calculations, the exact location of the different sound sources, the distance from source to immission point, air absorption, soil dampening and reflection were taken into account.

The calculations were executed under the most critical, down-wind condition: this means wind from source to immission point, at a temperature of 10 °C and a relative humidity of 70%. A soil dampening factor G of 0.6 for agricultural areas was used.

All calculations are summarised in the below table for various distances. The table indicates the individual sound pressure level (Lp) of the installation in the most critical direction (in this case north of the container). In the calculations no shielding of potential obstacles in close proximity of the container (for instance the reactor were the biogas is produced) was taken into account.

Distance from container	Lp in dB(A)
20	37,3
40	31,2
60	27,5
80	24,9
100	22,9
120	21,3
140	19,9
160	18,7
180	17,8
200	17,0
220	16,3

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A graphic representation of the results is indicated in the figure below:

Biogas installation type 44kW-S4

If we make these calculations at an immission point, 16 meters north of the container (G=0.6), we get a sound level of 39.3 dB(A). This is in line with the measured values in paragraph 4.2.

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The below figure shows a 2D sound map representation, calculated on a 5m x 5m grid: