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STAZIONI SPERIMENTALI
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STAZIONE SPERIMENTALE
PER I COMBUSTIBILI
SEDE OPERATIVA:
Via Galileo Galilei, 1
20097 San Donato Milanese MI
Tel +39 02.8515.3500
sales.innovhub@mi.camcom.it
www.innovhub-ssi.it

Customer:

COMMISSIONE EUROPEA JOINT RESEARCH CENTRE
Via Enrico Fermi, 2749
21027 ISPRA (VA)

Test Report N°: RPT-SSC-220261

Sampling, volumetric determination and compositional analysis of fuel gases.

Issue date: 13/07/2022

Reference: JRC/IPR/2022/VLVP/1181

Report on sample(s):

S-SSC-2202173: UCambridge gas sampling bag (1 l) – reactor named "LR3" sampling date 07/07/2022 – sampling time 12:45 - at JRC ISPRA (VA).

S-SSC-2202174: UCambridge gas sampling bag (1 l) – tank named "LT2" sampling date 07/07/2022 – sampling time 13:18 - at JRC ISPRA (VA).

S-SSC-2202175: UCambridge gas sampling bag (1 l) – reactor + tank named "MRT1" sampling date 07/07/2022 – sampling time 13:31 - at JRC ISPRA (VA).

Start date of the test: 07/07/2022

End date of the test: 08/07/2022

Laboratory Manager

Gabriele Migliavacca

Area Manager

Angelo Lunghi

Dott. Davide Faedo

The Laboratory is responsible for all information provided in the Test Report, except for information provided by the Customer. The results relate only to the sample tested. The results refers to the sample as received when sampling is not performed by the Laboratory. When applicable, sample remnant is retained for three months from the date of issue of the Test Report. The partial reproduction of this Test report is allowed only after written permission of the Laboratory Manage

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Commissioned by the Joint Research Center of the European Commission (order n. C.B689014, 2022-05-18), Innovhub SSI conducted the sampling and analysis of combustible gases at the Ispra (VA) site.

Specifically, on July 7th 2022, gas samples were collected in bags (SupelTM inert foil gas sampling bag screw cap valve, 1l by Supelco) from pilot plants for the implementation of artificial photosynthesis. The collected samples were transferred to the Innovhub-SSI laboratories in San Donato Milanese (MI) and analyzed by gas chromatography (GC) according to the standardized analytical method ASTM D1946-90(2019). The total volume of gas produced by each pilot plant and the high calorific value (HCV) and low calorific value (LCV) have been estimated as well.

Gas sampling

For the plant by the University of Cambridge, the gas was displaced from four different containers using the hydrostatic pressure of the water by means of a connection between the container and a tank of water placed at a higher altitude. The outcoming gas was collected in several different bags, the volume of the gas was measured using a TSI 4100 Series gas meter and checked by comparison with the amount of displacing water used. Three bags (1 l each) were held by Innovhub-SSI to be transported to the laboratory, while the others remained on site for subsequent tests. The container were named as follows:

- Large Reactor (LR), a transparent plastic box partially filled with water
- Large Tank (LT), a plastic tank connected to the LR and partially filled with water
- Medium Reactor (MR), a transparent plastic box partially filled with water (smaller than the LR)
- Medium Tank (MT), a plastic tank connected to the MR and partially filled with water

In the Table below the overall volume of gas is reported for each container as long as the composition of the analyzed bag; the gas from MR and MT were collected together in the same bag, named MRT. The number associated with the code refers to the progressive order of the bags taken from each container (eg. LR-3 indicates the third bag sampled by LR)

Results

PARAMETER	Value	Units	Method
Sample LR3			
Gas Volume	4939	cm ³ (@21,1°C-101,3KPa)	-
CH ₄	< 0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
CO ₂	1.61	% V/V (renormalized)	ASTM D 1946-90(2019)
O ₂ + Ar	20.08	% V/V (renormalized)	ASTM D 1946-90(2019)
N ₂	76.87	% V/V (renormalized)	ASTM D 1946-90(2019)
CO	0.64	% V/V (renormalized)	ASTM D 1946-90(2019)
H ₂	0.80	% V/V (renormalized)	ASTM D 1946-90(2019)
LCV	158	KJ/m ³	Calculated @ 15 °C
HCV	173	KJ/m ³	Calculated @ 15 °C



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PARAMETER	Value	Units	Method
Sample LT2			
Gas Volume	701	cm ³ (@21,1°C-101,3KPa)	-
CH4	< 0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
CO2	0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
O2 + Ar	21.66	% V/V (renormalized)	ASTM D 1946-90(2019)
N2	77.32	% V/V (renormalized)	ASTM D 1946-90(2019)
CO	0.43	% V/V (renormalized)	ASTM D 1946-90(2019)
H2	0.58	% V/V (renormalized)	ASTM D 1946-90(2019)
Unidentified HC	< 0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
LCV	111	KJ/m3	Calculated @ 15 °C
HCV	122	KJ/m3	Calculated @ 15 °C

PARAMETER	Value	Units	Method
Sample MRT1			
Gas Volume	550	cm ³ (@21,1°C-101,3KPa)	-
CH4	0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
CO2	0.05	% V/V (renormalized)	ASTM D 1946-90(2019)
O2 + Ar	19.70	% V/V (renormalized)	ASTM D 1946-90(2019)
N2	78.53	% V/V (renormalized)	ASTM D 1946-90(2019)
CO	0.15	% V/V (renormalized)	ASTM D 1946-90(2019)
C2H4	< 0.01	% V/V (renormalized)	ASTM D 1946-90(2019)
H2	1.56	% V/V (renormalized)	ASTM D 1946-90(2019)
LCV	181	KJ/m3	Calculated @ 15 °C
HCV	211	KJ/m3	Calculated @ 15 °C