

Combined pre-treatment technologies for cleaning biogas before its upgrading to biomethane: an Italian full-scale anaerobic digester case study

#### Supplementary materials

**Table S1:** analytical details (pg. 2 – 4)

**Table S2:** bio-CH<sub>4</sub> specification (pg. 5)

**Table S1:** analytical details

#		analyzed compound	CAS number	formula	unit	method	LOQ <sup>a</sup>
1		methane	74-82-8	CH <sub>4</sub>	%	on-line measurement	0.01
2		carbon dioxide	124-38-9	CO <sub>2</sub>	%	on-line measurement	0.01
3		oxygen	7782-44-7	O <sub>2</sub>	%	on-line measurement	0.01
4		hydrogen sulfide	7783-06-4	H <sub>2</sub> S	ppmv	on-line measurement	1
5	terpenes	limonene	5989-27-5	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
6		α-pinene	80-56-8	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
7		β-pinene	127-91-3	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
8		p-cymene	99-87-6	C <sub>10</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
9		m-cymene	535-77-3	C <sub>10</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
10		camphene	79-92-5	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
11		myrcene	123-35-3	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
12		phellandrene *	99-83-2, 555-10-2	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
13		Δ-3-carene	13466-78-9	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
14		terpinene *	99-86-5, 99-84-3, 99-85-4	C <sub>10</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
15		camphor	76-22-2	C <sub>10</sub> H <sub>16</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
16		menthol *	2216-51-5, 89-78-1	C <sub>10</sub> H <sub>20</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
17	aliphatic hydrocarbons	propane	74-98-6	C <sub>3</sub> H <sub>8</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
18		butane	106-97-8	C <sub>4</sub> H <sub>10</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
19		pentane	109-66-0	C <sub>5</sub> H <sub>12</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
20		hexane	110-54-3	C <sub>6</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
21		heptane	142-82-5	C <sub>7</sub> H <sub>16</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
22		octane	111-65-9	C <sub>8</sub> H <sub>18</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
23		decane	124-18-5	C <sub>10</sub> H <sub>22</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
24		cyclopentane	287-92-3	C <sub>5</sub> H <sub>10</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
25		2-methylpentane	107-83-5	C <sub>6</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
26		cyclohexane	110-82-7	C <sub>6</sub> H <sub>12</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
27		methylcyclohexane	108-87-2	C <sub>7</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
28		isoprene	78-79-5	C <sub>5</sub> H <sub>8</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
29	aromatic hydrocarbons	benzene	71-43-2	C <sub>6</sub> H <sub>6</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
30		toluene	108-88-3	C <sub>7</sub> H <sub>8</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
31		ethyl-benzene	100-41-4	C <sub>8</sub> H <sub>10</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
32		xylene *	1330-20-7	C <sub>8</sub> H <sub>10</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
33		styrene	100-42-5	C <sub>8</sub> H <sub>8</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
34		4-vinyltoluene	622-97-9	C <sub>9</sub> H <sub>10</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
35		trimethyl-benzene *	108-67-8, 526-73-8, 95-63-6	C <sub>9</sub> H <sub>12</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
36		tetramethyl-benzene *	488-23-3, 95-93-2, 527-53-7	C <sub>10</sub> H <sub>14</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
37	ketones	cumene	98-82-8	C <sub>9</sub> H <sub>12</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
38		acetone	67-64-1	C <sub>3</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
39		methyl ethyl ketone	78-93-3	C <sub>4</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
40		methyl propyl ketone	107-87-9	C <sub>5</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
41		methyl isopropyl ketone	563-80-4	C <sub>5</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
42		methyl butyl ketone	591-78-6	C <sub>6</sub> H <sub>12</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
43		cyclohexanone	108-94-1	C <sub>6</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1

44	halocarbon compounds	chloromethane	74-87-3	CH <sub>3</sub> Cl	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
45		vinyl chloride	75-01-4	C <sub>2</sub> H <sub>3</sub> Cl	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
46		chloroethane	75-00-3	C <sub>2</sub> H <sub>5</sub> Cl	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
47		dichloromethane	75-09-2	CH <sub>2</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
48		dichloroethane *	75-34-3, 107-06-2	C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
49		dichloroethylene *	75-35-4, 540-59-0	C <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
50		dichloropropane *	78-87-5, 142-28-9, 594-20-7	C <sub>3</sub> H <sub>6</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
51		1,3-dichloropropene	542-75-6	C <sub>3</sub> H <sub>4</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
52		dichlorobenzene *	95-50-1, 541-73-1, 106-46-7	C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
53		chloroform	67-66-3	CHCl <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
54		trichloroethane *	71-55-6, 79-00-5	C <sub>2</sub> H <sub>3</sub> Cl <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
55		trichloropropane	96-18-4	C <sub>3</sub> H <sub>5</sub> Cl <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
56		trichloroethylene	79-01-6	C <sub>2</sub> HCl <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
57		tetrachloroethylene	127-18-4	C <sub>2</sub> Cl <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
58		tetrachloroethane *	630-20-6, 79-34-5	C <sub>2</sub> H <sub>2</sub> Cl <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
59		carbon tetrachloride	56-23-5	CCl <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
60		pentachloroethane	76-01-7	C <sub>2</sub> HCl <sub>5</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
61		hexachloroethane	67-72-1	C <sub>2</sub> Cl <sub>6</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
62		tribromomethane	75-25-2	CHBr <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
63		dibromoethane *	557-91-5, 106-93-4	C <sub>2</sub> H <sub>4</sub> Br <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
64	esters	bromodichloromethane	75-27-4	CHBrCl <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
65		dibromochloromethane	124-48-1	CHBr <sub>2</sub> Cl	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
66		ethyl acetate	141-78-6	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
67		methyl acetate	79-20-9	C <sub>3</sub> H <sub>6</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
68		butyl acetate	123-86-4	C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
69		methyl propionate	554-12-1	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
70		ethyl propionate	105-37-3	C <sub>5</sub> H <sub>10</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
71		methyl butanoate	623-42-7	C <sub>5</sub> H <sub>10</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
72		ethyl butanoate	105-54-4	C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
73		methyl pentanoate	624-24-8	C <sub>6</sub> H <sub>12</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
74		ethyl pentanoate	539-82-2	C <sub>7</sub> H <sub>14</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
75		ethyl isovalerate	108-64-5	C <sub>7</sub> H <sub>14</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
76		2-methoxyethyl acetate	110-49-6	C <sub>5</sub> H <sub>10</sub> O <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
77		acetonitrile	75-05-8	C <sub>2</sub> H <sub>3</sub> N	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
78	alcohols	methanol	67-56-1	CH <sub>4</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
79		ethanol	64-17-5	C <sub>2</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
80		propanol *	71-23-8, 67-63-0	C <sub>3</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
81		buthanol *	71-36-3, 75-65-0, 78-83-1	C <sub>4</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
82		pentanol *	71-41-0, 6032-29-7, 584-02-1	C <sub>5</sub> H <sub>12</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
83		2-methoxyethanol	109-86-4	C <sub>3</sub> H <sub>8</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
84	nitro compounds	nitromethane	75-52-5	CH <sub>3</sub> NO <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
85		nitroethane	79-24-3	C <sub>2</sub> H <sub>5</sub> NO <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
86		nitropropane *	108-03-2, 79-46-9	C <sub>3</sub> H <sub>7</sub> NO <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
87		nitrobenzene	98-95-3	C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
88		dinitrobenzene *	25154-54-5	C <sub>6</sub> H <sub>4</sub> N <sub>2</sub> O <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1

89	ethers	tetrahydrofuran	109-99-9	C <sub>4</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
90		1,4-dioxane	123-91-1	C <sub>4</sub> H <sub>8</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
91		dimethyl ether	115-10-6	C <sub>2</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
92		diethyl ether	60-29-7	C <sub>4</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
93		methylfuran *	534-22-5, 930-27-8	C <sub>5</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
94		ethylfuran *	3208-16-0, 67363-95-5	C <sub>6</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
95		dimethylfuran *	625-86-5, 3710-43-8	C <sub>6</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
96		methyl tert-butyl ether	1634-04-4	C <sub>5</sub> H <sub>12</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
97	siloxanes	hexamethylcyclotrisiloxane	541-05-9	((CH <sub>3</sub> ) <sub>2</sub> SiO) <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
98		octamethylcyclotetrasiloxane	556-67-2	((CH <sub>3</sub> ) <sub>2</sub> SiO) <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
99		decamethylcyclopentasiloxane	541-02-6	((CH <sub>3</sub> ) <sub>2</sub> SiO) <sub>5</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
100		dodecamethylcyclohexasiloxane	540-97-6	((CH <sub>3</sub> ) <sub>2</sub> SiO) <sub>6</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
101		pentamethyldisiloxane	1438-82-0	C <sub>5</sub> H <sub>16</sub> Si <sub>2</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
102		hexamethyldisiloxane	107-46-0	C <sub>6</sub> H <sub>18</sub> Si <sub>2</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
103		octamethyltrisiloxane	107-51-7	C <sub>8</sub> H <sub>24</sub> Si <sub>3</sub> O <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
104		decamethyltetrasiloxane	141-62-8	C <sub>10</sub> H <sub>30</sub> Si <sub>4</sub> O <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
105		dodecamethylpentasiloxane	141-63-9	C <sub>12</sub> H <sub>36</sub> Si <sub>5</sub> O <sub>4</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
106	aldehydes	acetaldehyde	75-07-0	C <sub>2</sub> H <sub>4</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
107		propanal	123-38-6	C <sub>3</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
108		butanal	123-78-8	C <sub>4</sub> H <sub>8</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
109		pentanal	110-62-3	C <sub>5</sub> H <sub>10</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
110		hexanal	66-25-1	C <sub>6</sub> H <sub>12</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
111		heptanal	111-71-7	C <sub>7</sub> H <sub>14</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
112		octanal	124-13-0	C <sub>8</sub> H <sub>16</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
113		benzaldehyde	100-52-7	C <sub>7</sub> H <sub>6</sub> O	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
114	sulfur compounds	dimethyl sulfide	75-18-3	C <sub>2</sub> H <sub>6</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
115		dimethyl trisulfide	3658-80-8	C <sub>2</sub> H <sub>6</sub> S <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
116		dimethyl tetrasulfide	5756-24-1	C <sub>2</sub> H <sub>6</sub> S <sub>3</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
117		carbon disulfide	75-15-0	CS <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
118		methanethiol	74-93-1	CH <sub>4</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
119		ethanethiol	75-08-1	C <sub>2</sub> H <sub>6</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
120		propanethiol	107-3-9	C <sub>3</sub> H <sub>8</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
121		buthanethiol *	109-79-5, 75-66-1	C <sub>4</sub> H <sub>10</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
122	inorganics	thiophenol	108-98-5	C <sub>6</sub> H <sub>6</sub> S	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
123		nitrogen	7727-37-9	N <sub>2</sub>	mg/Nm <sup>3</sup>	UNI CEN/TS 13649	0.1
124		hydrogen chloride	7647-01-0	HCl	mg/Nm <sup>3</sup>	Ministerial Decree 2000/08/25	0.001
125		hydrogen fluoride	7664-39-3	HF	mg/Nm <sup>3</sup>	Ministerial Decree 2000/08/25	0.001
126		ammonia	7664-41-7	NH <sub>3</sub>	mg/Nm <sup>3</sup>	UNICHIM 632	0.01

\* Sum of isomers. <sup>a</sup> Limit of quantification.

Analytical instrumentation:

- # 1 – 4: stationary biogas analyzer, SWG 100 – MRU.
- # 5 – 103: portable micro GC-MS, micro-GC Fusion – Inficon
- # 104 – 105: ion chromatograph, 930 Compact IC Flex - Metrohm
- # 106: UV-VIS spectrophotometer, V-630 - Jasco

**Table S2:** bio-CH<sub>4</sub> specification

trace compounds concentration in bio-CH <sub>4</sub> exiting the upgrading unit and injected in the natural gas grid						
trace compound	formula	unit	method	LOQ <sup>a</sup>	content in bio-CH <sub>4</sub>	legislation limit
hydrogen	H <sub>2</sub>	%	UNI EN ISO 6974	0.0001	≤ LOQ	≤ 0.5
oxygen	O <sub>2</sub>	%	UNI EN ISO 6974	0.0001	0.0330	≤ 0.6
nitrogen	N <sub>2</sub>	%	UNI EN ISO 6974	0.0001	0.2550	not provided
carbon oxide	CO	%	UNI EN ISO 6974	0.0001	0.0021	≤ 0.1
carbon dioxide	CO <sub>2</sub>	%	UNI EN ISO 6974	0.0001	1.6620	≤ 2.5
hydrogen sulfide	H <sub>2</sub> S	mg/Sm <sup>3</sup>	UNI EN ISO 6974	0.0001	0.0075	≤ 5
total sulfur	S	mg/Sm <sup>3</sup>	UNI EN ISO 19739	0.01	≤ LOQ	≤ 6
total silicon	Si	mg/Sm <sup>3</sup>	UNI CEN/TS 13649	0.0001	0.0010	≤ 1
ammonia	NH <sub>3</sub>	mg/Sm <sup>3</sup>	UNICHIM 632	0.01	0.17	≤ 10
total amines	//	mg/Sm <sup>3</sup>	NIOSH 2010	0.001	≤ LOQ	≤ 10
fluorine	F <sub>2</sub>	mg/Sm <sup>3</sup>	Ministerial Decree 2000/08/25	0.001	≤ LOQ	≤ 3
chlorine	Cl <sub>2</sub>	mg/Sm <sup>3</sup>	Ministerial Decree 2000/08/25	0.001	0.011	≤ 1
water Dew Point at 70 bar	//	°C	UNI EN ISO 6327	0.01	-60.05	≤ -5

<sup>a</sup> Limit of quantification