

APPLICATION NOTE

LD17-04



Trace impurities in Carbon Dioxide for beverage and food packaging industry



With regards to the beverage industry, the dissolved Carbon Dioxide which is used as carbonic acid gives a pleasantly acidic flavour and a nice mouth-feel when drinking. When it is not present, the drinks taste flat. Being used in many different fields of food and beverage, the CO₂ quality management is essential to meet the market requirements.

The CO₂ is produced from different techniques such as fermentation, combustion, ammonia/hydrogen production and others. It is required by the industry, especially for bottlers to control the supply chain by monitoring the CO₂ purity allowing maintenance of the product quality.

LDETEK SOLUTION:

Following the application note LD16-12 this application note shows another configuration of the MultiDetek2 with PlasmaDetek2 also related to the beverage industry where the analysis of different components in carbon dioxide is realized.

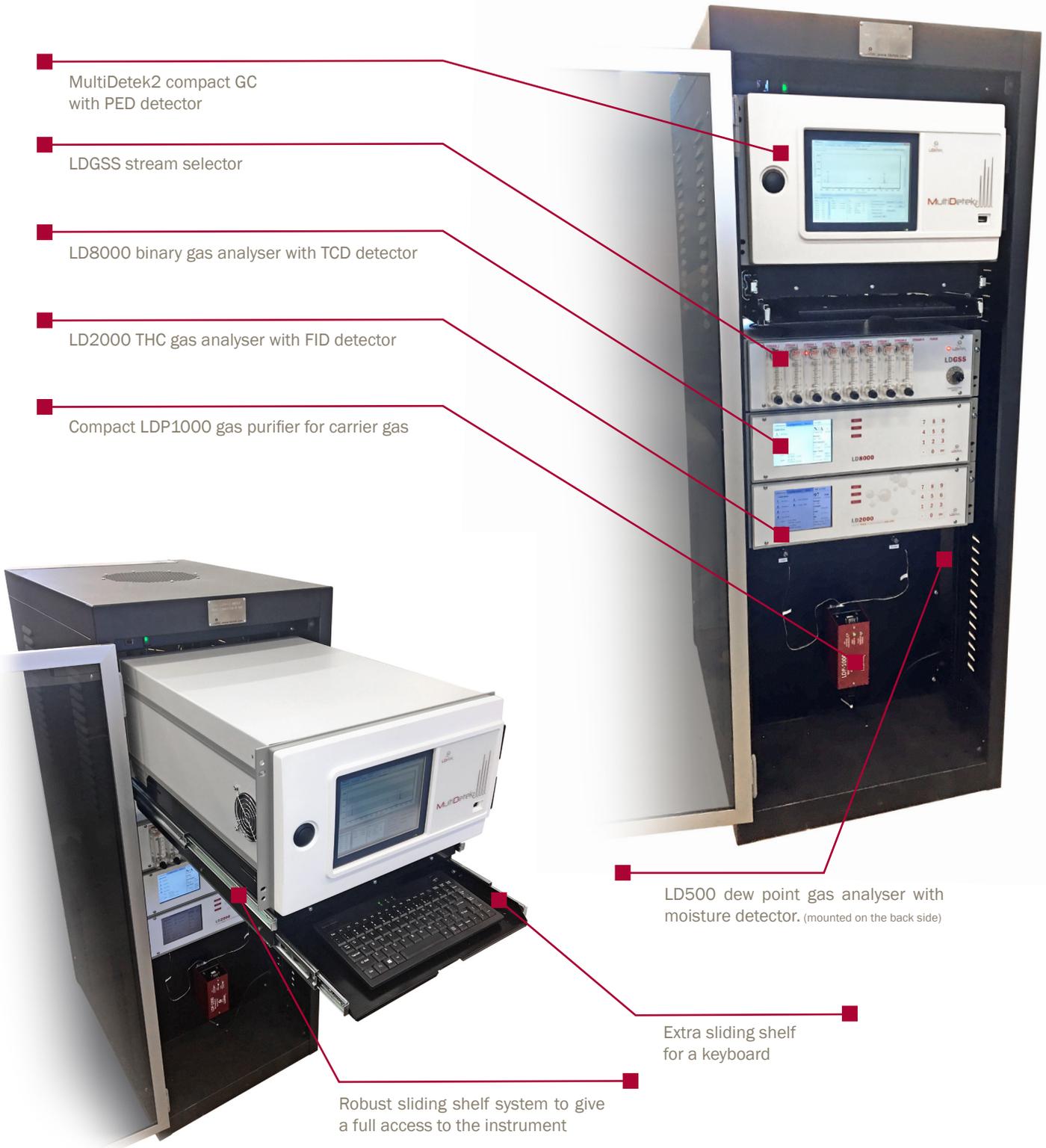
This configuration has 3 channels to cover the analysis of benzene, hydrogen sulfide, nitrogen and oxygen. Additional channels can be added if analysis of more components is required. All the components are measured with one type detector PED using Helium as carrier gas.

- ▶ **Channel#1:** 0-1000ppb benzene
- ▶ **Channel#2:** 0-1000ppb hydrogen sulfide
- ▶ **Channel#3:** 0-10ppm oxygen and nitrogen

A FID analyser LD2000 is added to this solution for measuring THC on a scale of 0-10ppm
A TCD binary gas analyser LD8000 is added for measuring 98-100% CO₂ purity
A dewpoint meter LD500 is added for the analysis of moisture on a 0-10ppm scale

LDRACK CABINET:

All the instruments are integrated in the LDrack cabinet. A multiple streams selector system LDGSS selects the right gas lines for analysis. The stream selector can be controlled locally or remotely with the MultiDetek2 interface. The complete solution is configured with coated stainless steel tubing to ensure stability of the system. It reduces the risk of surface absorption, especially for the sulfur components.



MultiDetek2 compact GC with PED detector

LDGSS stream selector

LD8000 binary gas analyser with TCD detector

LD2000 THC gas analyser with FID detector

Compact LDP1000 gas purifier for carrier gas

LD500 dew point gas analyser with moisture detector. (mounted on the back side)

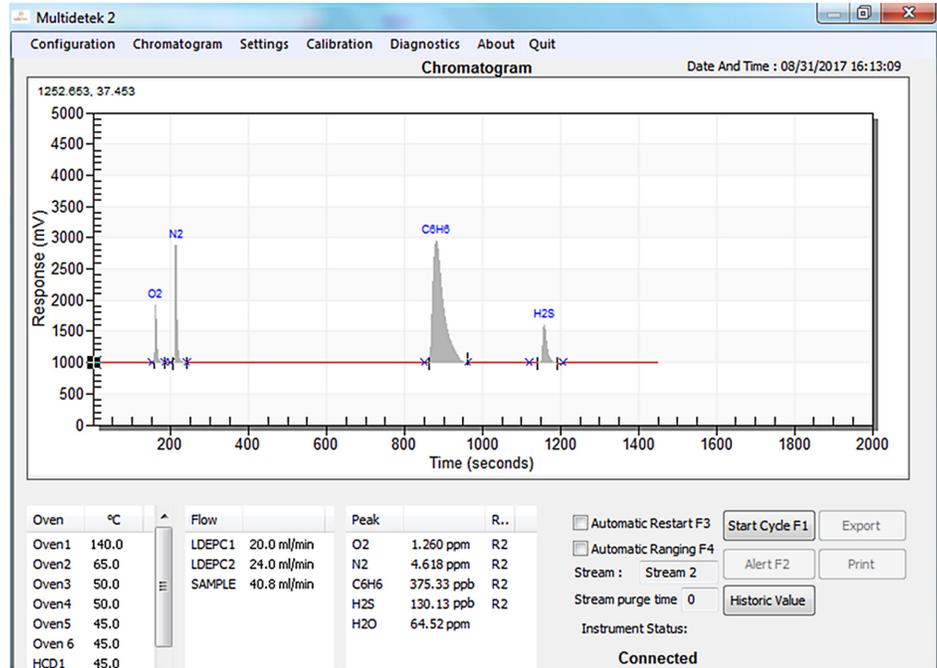
Extra sliding shelf for a keyboard

Robust sliding shelf system to give a full access to the instrument

RESULTS:

The results show the performances of the MultiDetek2 system for a standard configuration used to measure oxygen, nitrogen, benzene and hydrogen sulfide in Carbon Dioxide. The Idl and repeatability results are demonstrated.

Analysis of a gas mixture containing a certified concentration of trace O2-N2-C6H6-H2S-H2O in balance gas CO2



LDL:

COMPONENT	CONCENTRATION	PEAK HEIGHT	NOISE	LDL (3X NOISE)
Oxygen	1.260 ppm	987 mV	4.2 mV	16.0 ppb
Nitrogen	4.618 ppm	1961 mV	2.9 mV	20.4 ppb
Benzene	375.33 ppb	1987 mV	12.6 mV	7.14 ppb
Hydrogen sulfide	130.13 ppb	611 mV	12.9 mV	8.24 ppb

Note: other LDL could be obtained with different injection volume and chromatographic condition

REPEATABILITY:

The results below show the repeatability for each component. Three times of the percentage of coefficient of variation (3*CV %) for each component must be smaller than 5% to meet the requirements.

$$s = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$

COMPONENT	CV (%)	CV% x 3 < 5%
Oxygen	0.95	2.85
Nitrogen	0.66	1.98
Benzene	1.02	3.06
Hydrogen sulfide	0.74	2.22

Component : O2

Date/Time	O2	N2	C6H6
Jun/20/2017 07:53:23	4.132	3.380	<LDL
Jun/20/2017 07:35:37	4.126	3.388	<LDL
Jun/20/2017 07:17:51	4.114	3.380	<LDL
Jun/20/2017 07:00:05	4.142	3.400	<LDL
Jun/20/2017 06:42:19	4.179	3.406	<LDL
Jun/20/2017 06:24:33	4.197	3.432	<LDL
Jun/20/2017 06:06:47	4.211	3.435	<LDL
Jun/20/2017 05:49:01	4.244	3.444	0.068
Jun/20/2017 05:31:15	4.246	3.442	<LDL
Jun/20/2017 05:13:29	4.230	3.433	<LDL
Jun/20/2017 04:55:43	4.213	3.414	<LDL
Jun/20/2017 04:37:57	4.218	3.428	0.089
Jun/20/2017 04:20:11	4.229	3.453	<LDL
Jun/20/2017 04:02:25	4.222	3.447	<LDL
Jun/20/2017 03:44:39	4.203	3.444	<LDL

Component : N2

Date/Time	O2	N2	C6H6
Jun/20/2017 07:53:23	4.132	3.380	<LDL
Jun/20/2017 07:35:37	4.126	3.388	<LDL
Jun/20/2017 07:17:51	4.114	3.380	<LDL
Jun/20/2017 07:00:05	4.142	3.400	<LDL
Jun/20/2017 06:42:19	4.179	3.406	<LDL
Jun/20/2017 06:24:33	4.197	3.432	<LDL
Jun/20/2017 06:06:47	4.211	3.435	<LDL
Jun/20/2017 05:49:01	4.244	3.444	0.068
Jun/20/2017 05:31:15	4.246	3.442	<LDL
Jun/20/2017 05:13:29	4.230	3.433	<LDL
Jun/20/2017 04:55:43	4.213	3.414	<LDL
Jun/20/2017 04:37:57	4.218	3.428	0.089
Jun/20/2017 04:20:11	4.229	3.453	<LDL
Jun/20/2017 04:02:25	4.222	3.447	<LDL
Jun/20/2017 03:44:39	4.203	3.444	<LDL

Component : C6H6

Date/Time	O2	N2	C6H6
Jun/22/2017 07:31:16	0.235	0.721	217.452
Jun/22/2017 07:11:09	0.237	0.721	216.403
Jun/22/2017 06:51:02	0.238	0.722	216.805
Jun/22/2017 06:30:55	0.237	0.782	216.725
Jun/22/2017 06:10:48	0.237	0.718	212.256
Jun/22/2017 05:50:41	0.239	0.728	213.026
Jun/22/2017 05:30:34	0.238	0.722	214.129
Jun/22/2017 05:10:27	0.234	0.729	217.782
Jun/22/2017 04:50:20	0.236	0.735	214.711
Jun/22/2017 04:30:13	0.239	0.739	214.861
Jun/22/2017 04:10:06	0.240	0.746	214.218
Jun/22/2017 03:49:59	0.241	0.753	213.506
Jun/22/2017 03:29:52	0.239	0.739	208.152
Jun/22/2017 03:09:45	0.239	0.777	207.693
Jun/22/2017 02:49:38	0.236	0.736	208.471

Component : H2S

Date/Time	O2	N2	H2S	C6H6
Jul/03/2017 06:48:40	<LDL	0.021	200.383	<LDL
Jul/03/2017 06:28:33	0.011	0.030	199.310	0.057
Jul/03/2017 06:08:26	<LDL	<LDL	199.189	0.089
Jul/03/2017 05:48:19	<LDL	<LDL	201.363	0.065
Jul/03/2017 05:28:12	<LDL	<LDL	202.909	<LDL
Jul/03/2017 05:08:05	<LDL	<LDL	201.060	<LDL
Jul/03/2017 04:47:58	<LDL	<LDL	200.999	<LDL
Jul/03/2017 04:27:51	0.007	0.020	202.269	0.403
Jul/03/2017 04:07:44	<LDL	0.030	200.069	<LDL
Jul/03/2017 03:47:37	0.009	0.030	199.016	<LDL
Jul/03/2017 03:27:30	0.007	0.030	199.152	<LDL
Jul/03/2017 03:07:23	<LDL	<LDL	199.657	<LDL
Jul/03/2017 02:47:16	<LDL	<LDL	197.671	<LDL
Jul/03/2017 02:27:09	0.001	0.019	196.237	<LDL
Jul/03/2017 02:07:02	<LDL	<LDL	193.154	<LDL

CONCLUSION:

Our solution combining multiple LDetek instruments to achieve the complete carbon dioxide analysis all in one cabinet well demonstrated the capabilities to meet the food and beverage industry requirements. Have a look at our complementary application note LD16-012 that demonstrates other capabilities and results related to this market.

