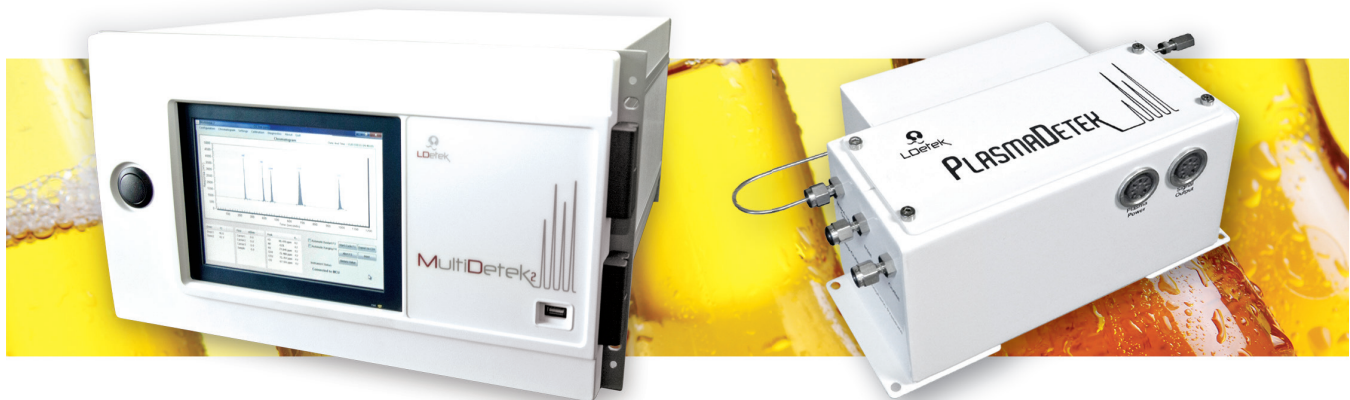


APPLICATION NOTE

LD16-12



Trace impurities in Carbon Dioxide for beverage and food packaging industry



▲ MultiDetek2

▲ PlasmaDetek2

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:

Using the PlasmaDetek2(PED) plasma detector and the MultiDetek2 compact gas chromatograph, the analysis of the most critical trace impurities in carbon dioxide can be achieved in one unit with a single detection technology (PED).

By default, the configuration has 3 channels to cover the analysis of Benzene, Acetaldehyde, Nitrogen and Carbon Monoxide. If additional options for the analysis of Methanol, Sulfurs and Hydrocarbons are required, then channels 4, 5 and 6 are added in the same instrument.

Channel#1: 0-100ppb Benzene

Channel#2: 0-1000ppb Acetaldehyde

Channel#2: 0-120ppm Nitrogen & 0-10ppm Carbon Monoxide

Also integrated inside the MultiDetek2, a dilution system allows generating for a span calibration gas at ppb level for the low concentration impurities. This option gives you the capacity to use a standard certified calibration gas at higher concentrations, which is usually lower in cost and easier to get, also that generates a low ppb calibration gas. The dilution system is designed for low gas consumption, high accuracy/stability and is automatically handled by the interface during span calibration process.

For multiple streams requirement, the LDGSS high purity stream selector system can be combined with the MultiDetek2 to offer all the flexibility to switch streams and even run stream sequences analysis as required.

RESULTS:

The results show the performances of the system for a standard configuration used to measure Benzene, Acetaldehyde, Nitrogen and Carbon Monoxide in Carbon Dioxide.

It displays details about the calibration chromatogram, some examples of low ppb chromatograms for each impurity, the IdI chart for noise/response calculation, the stability and the linearity curves.

SPAN CALIBRATION CHROMATOGRAM:

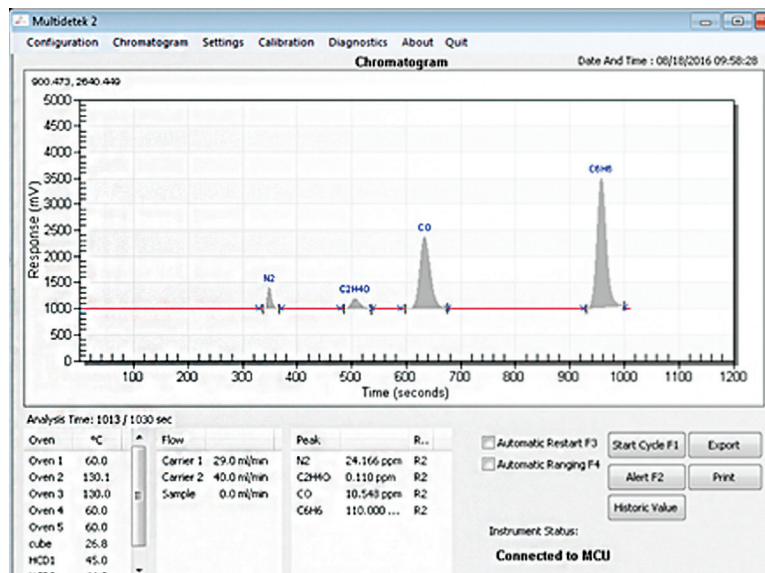


Figure 1: Chromatogram of a gas mixture containing 24ppm nitrogen, 110ppb acetaldehyde, 10.5ppm carbon monoxide and 110ppb benzene in a balance gas carbon dioxide.

LOW PPB CHROMATOGRAM:

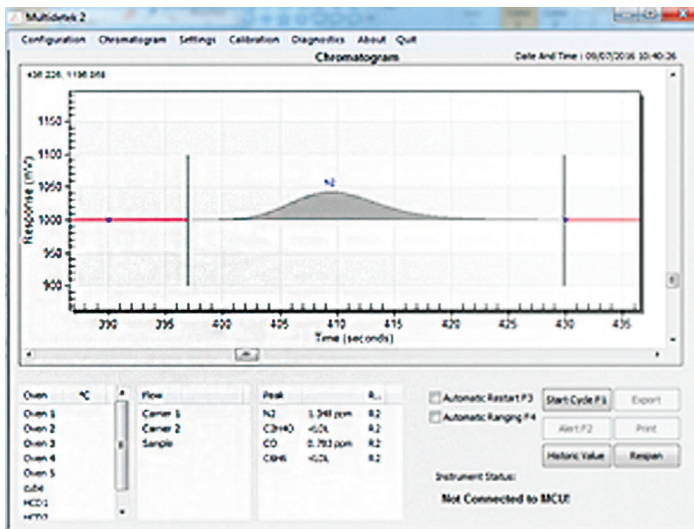


Figure 2:
Chromatogram of 1348 ppb Nitrogen in Carbon dioxide

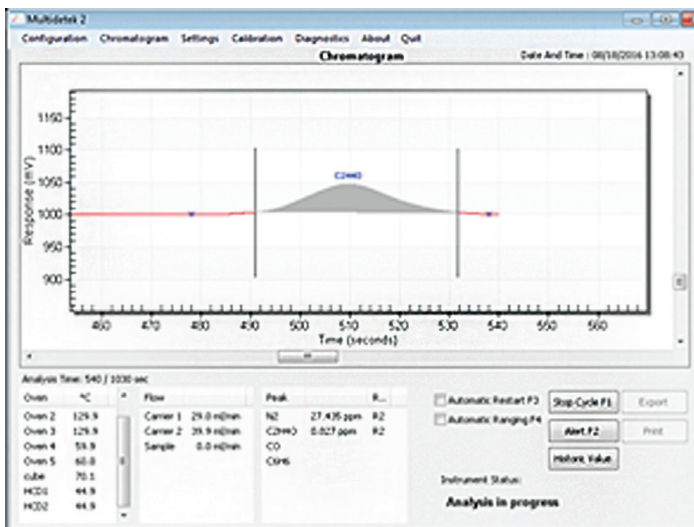


Figure 3:
Chromatogram of 27ppb Acetaldehyde in Carbon dioxide

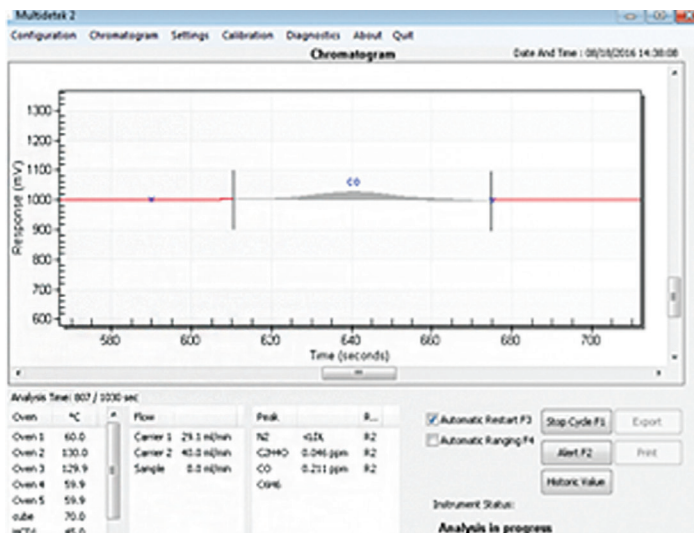


Figure 4:
Chromatogram of 211ppb Carbon monoxide in Carbon dioxide

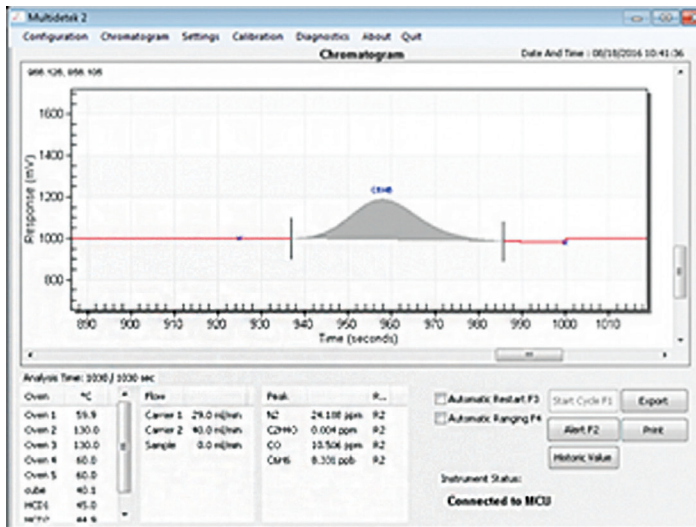


Figure 5: Chromatogram of 8.331ppb Benzene in Carbon dioxide

LDL calculation

COMPONENT	CONCENTRATION	PEAK HEIGHT	NOISE	LDL (3X NOISE)
Nitrogen	1348 ppb	49.3 mV	0.2 mV	16.4 ppb
Acetaldehyde	27 ppb	49.1 mV	1.1 mV	1.8 ppb
Carbon monoxide	211 ppb	35.4 mV	1.6 mV	28.6 ppb
Benzene	8.331 ppb	215.7 mV	2.1 mV	0.243 ppb

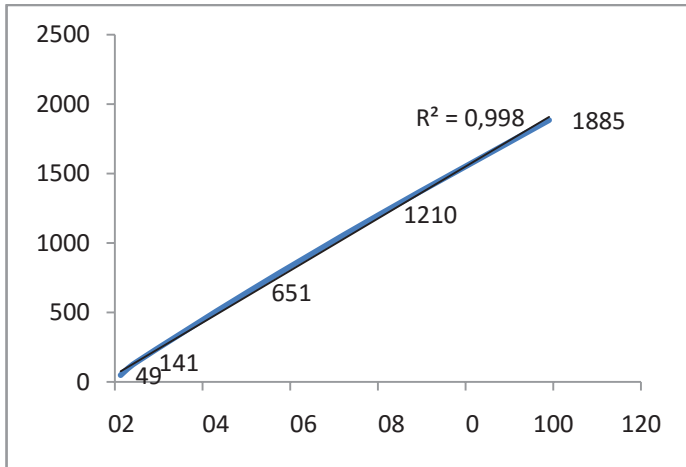
Note: other LDL could be obtained with different injection volume and chromatographic conditions

STABILITY:

Date/Time	N2	C2H4O	CO	C6H6
Aug/18/2016 08:07:47	24.596	0.783	10.601	57.229
Aug/18/2016 07:50:32	24.678	0.783	10.601	57.165
Aug/18/2016 07:33:17	24.606	0.784	10.597	57.110
Aug/18/2016 07:16:00	24.588	0.784	10.615	57.026
Aug/18/2016 06:58:45	24.579	0.784	10.613	57.102
Aug/18/2016 06:41:29	24.617	0.783	10.613	56.838
Aug/18/2016 06:24:13	24.768	0.782	10.617	56.933
Aug/18/2016 06:06:57	24.742	0.781	10.617	56.960
Aug/18/2016 05:49:41	24.627	0.780	10.601	56.890
Aug/18/2016 05:32:25	24.720	0.780	10.599	56.752
Aug/18/2016 05:15:10	24.687	0.780	10.599	56.860
Aug/18/2016 04:57:54	24.762	0.780	10.596	56.920
Aug/18/2016 04:40:38	24.797	0.780	10.599	56.879
Aug/18/2016 04:23:22	24.827	0.780	10.599	57.006
Aug/18/2016 04:06:06	24.728	0.780	10.604	56.974

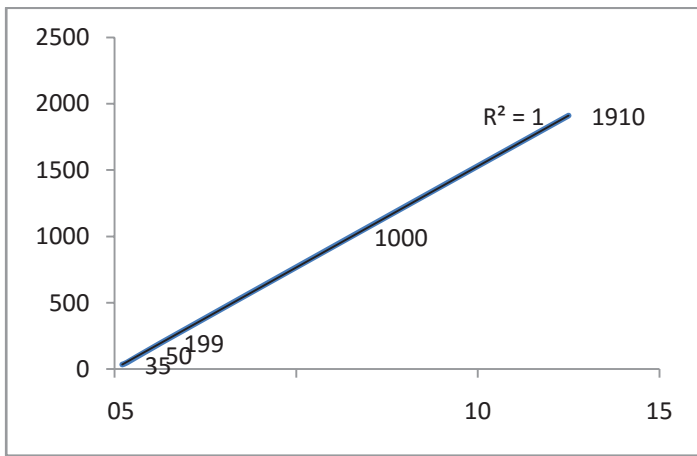
Figure 6: The results show the stability over a period of 15 consecutive cycles. The units for nitrogen, acetaldehyde and carbon monoxide are ppm and the unit for benzene is ppb

LINEARITY:



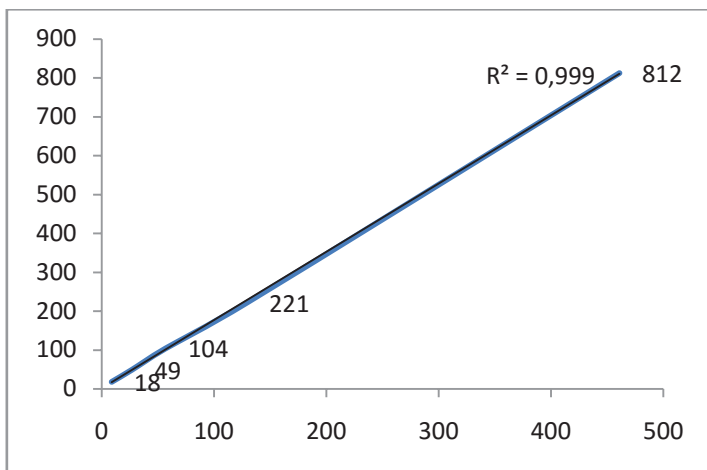
N2 CONCENTRATION	N2 RESPONSE
1.348 ppm	49 mV
4.856 ppm	141 mV
30.518 ppm	651 mV
60.6 ppm	1210 mV
99 ppm	1885 mV

Figure 7:
Impurity : nitrogen



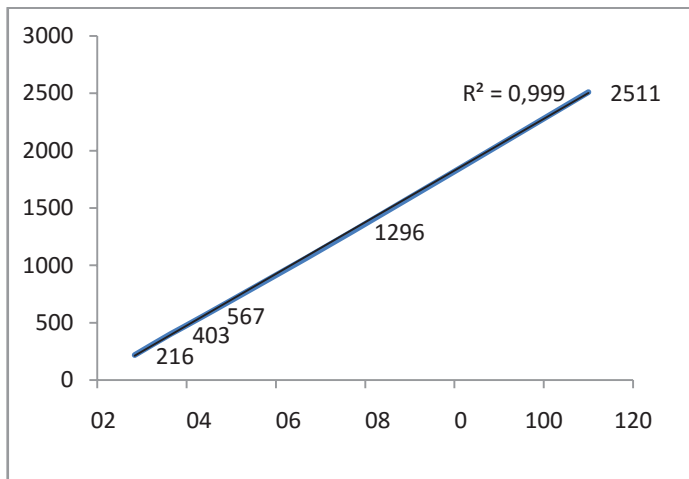
CO CONCENTRATION	CO RESPONSE
0.211 ppm	35 mV
0.343 ppm	50 mV
1.285 ppm	199 mV
6.521 ppm	1000 mV
12.5 ppm	1910 mV

Figure 8:
Impurity : carbon monoxide



ACETALDEHYDE CONCENTRATION	ACETALDEHYDE RESPONSE
9 ppb	18 mV
27 ppb	49 mV
57 ppb	104 mV
129 ppb	221 mV
461 ppb	812 mV

Figure 9:
Impurity : acetaldehyde



BENZENE CONCENTRATION	BENZENE RESPONSE
8.331 ppb	216 mV
16.532 ppb	403 mV
24.212 ppb	567 mV
57.158 ppb	1296 mV
110 ppb	2511 mV

Figure 10:
Impurity : benzene

CONCLUSION:

Our solution detects traces of gas impurities required by the food and beverage industry for Carbon Dioxide. The complete spectrum analysis can be covered with one single MultiDetek2 unit using the PlasmaDetek2 detection technology. It can detect sub ppb concentrations that are required for this type of application. It combines the analysis of different gas types that are usually very difficult to do with the same instrument. The MultiDetek2 offers a solution with an integrated PC interface that offers standard communication protocols compatible with all market standards.



Where **innovation** leads to **success**

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