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

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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.

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

LDGSS stream selector

LD8000 binary gas analyser with TCD detector

LD2000 THC gas analyser with FID detector

Compact LDP1000 gas purifier for carrier gas

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

Extra sliding shelf for a keyboard

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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 ldl 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:

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CONCENTRATION</th>
<th>PEAK HEIGHT</th>
<th>NOISE</th>
<th>LDL (3X NOISE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>1.260 ppm</td>
<td>987 mV</td>
<td>4.2 mV</td>
<td>16.0 ppb</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>4.618 ppm</td>
<td>1961 mV</td>
<td>2.9 mV</td>
<td>20.4 ppb</td>
</tr>
<tr>
<td>Benzene</td>
<td>375.33 ppb</td>
<td>1987 mV</td>
<td>12.6 mV</td>
<td>7.14 ppb</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>130.13 ppb</td>
<td>611 mV</td>
<td>12.9 mV</td>
<td>8.24 ppb</td>
</tr>
</tbody>
</table>

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.

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

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CV (%)</th>
<th>CV% x 3 &lt; 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>0.95</td>
<td>2.85</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.66</td>
<td>1.98</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.02</td>
<td>3.06</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>0.74</td>
<td>2.22</td>
</tr>
</tbody>
</table>

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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.