CO₂ polishing for the sparkling beverage industry
Contents

Introduction .................................................................................. 1
Carbon dioxide contamination ................................................. 3
ISBT quality guidelines ............................................................... 5
Sources and types of contamination ........................................... 7
A dedicated solution for multiple applications ...................... 9
Quality system design ................................................................. 11
The Parker design philosophy .................................................... 13
Performance validation ............................................................... 14
purecare™ schedule of services ................................................ 15
Filtration, purification and separation is our business

Parker is a world leader in the filtration, purification and separation of compressed air and gases.

Parker specialises in purification and separation technologies where compressed air and gas purity, product quality, technological excellence and global support are paramount.

Parker designs and manufactures carbon dioxide polishing systems for the sparkling beverage industry to help preserve and guarantee the quality of gaseous carbon dioxide which is used in the industry.

Using the latest technology, the polishing systems remove a wide range of potential carbon dioxide impurities to guarantee the gas quality so that it remains within industry and company guidelines.

The carbon dioxide polishing systems from Parker are the beverage industries preferred choice and are installed in more than 150 countries worldwide.
Carbon dioxide contamination can be a real problem for the sparkling beverage industry

Recent improvements with on-site analytical equipment have revealed that traditional methods of protecting carbon dioxide quality are insufficient.

Potential carbon dioxide contamination may include residues which can be carried over from the feed source, from contaminants introduced into the bulk liquid carbon dioxide or from gas cylinders within the distribution system.

Some compounds are of particular concern to sparkling beverage manufacturers as they are known to have a negative impact on the flavour and appearance of the beverage.

Other compounds that are known to be detrimental to consumer safety are governed by regulatory control. Voluntary quality standards are listed in the ISBT quality guidelines which are shown on page 5.

Recent improvements with on-site analytical equipment have revealed that traditional methods of protecting the quality of carbon dioxide, such as passing the gas through an activated carbon bed, cannot protect or maintain the required gas quality.

The industry is also becoming increasingly aware of the serious impact of carbon dioxide impurities on the beverage’s characteristics and the associated consequences of not ensuring its quality. This applies to all sparkling beverages, fountain / post mix as well as beer dispense.
ISBT quality guidelines for carbon dioxide

The International Society of Beverage Technologists (ISBT) is the only organisation whose sole interest is the technical and scientific aspects of soft drinks and beverages.

The ISBT is a highly respected body which is dedicated to the promotion, development and dissemination of knowledge relating to the art and science of beverage technology.

The quality guidelines and analytical procedure bibliography has been developed by the ISBT to provide guidance for manufacturers of carbonated beverages and suppliers of carbon dioxide to the carbonated beverage industries about key characteristics for the quality and purity of carbon dioxide when used as a direct food additive in beverages.

The following table lists the voluntary quality standards taken from the document with relation to CO₂ quality.

Voluntary quality standards as listed in the ISBT Quality Guidelines

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guideline</th>
<th>Rationale†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity</td>
<td>99.9 % v/v min.</td>
<td>Process</td>
</tr>
<tr>
<td>Moisture</td>
<td>20 ppm v/v max.</td>
<td>Process</td>
</tr>
<tr>
<td>Oxygen</td>
<td>30 ppm v/v max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>10 ppm v/v max.</td>
<td>Process</td>
</tr>
<tr>
<td>Ammonia</td>
<td>2.5 ppm v/v max.</td>
<td>Process</td>
</tr>
<tr>
<td>Nitric Oxide / Nitrogen Dioxide</td>
<td>2.5 ppm v/v max. (each)</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Non-volatile Residue</td>
<td>10 ppm w/w max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Non-volatile Organic Residue</td>
<td>5 ppm w/w max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Phosphine</td>
<td>To pass test (0.3 ppm v/v max.)</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Total Volatile Hydrocarbons: (as Methane)</td>
<td>50 ppm v/v max. including 20 ppm v/v max. as total non-methane hydrocarbons</td>
<td>Sensory</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>0.2 ppm v/v max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Aromatic Hydrocarbon Content</td>
<td>20 ppb v/v max.</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Total Sulphur Content* (as S): (&quot;Total sulphur-containing impurities excluding sulphur dioxide)</td>
<td>0.1 ppm v/v max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>1 ppm v/v max.</td>
<td>Sensory</td>
</tr>
<tr>
<td>Odour of Solid CO₂ (snow):</td>
<td>No foreign odour</td>
<td>Sensory</td>
</tr>
<tr>
<td>Appearance in water:</td>
<td>No colour or turbidity</td>
<td>Sensory</td>
</tr>
<tr>
<td>Odour and taste in water:</td>
<td>No foreign odour or taste</td>
<td>Sensory</td>
</tr>
</tbody>
</table>

†Rationale definitions:
- Sensory: Any attribute that negatively impacts the taste, appearance or odour of beverage.
- Process: Any attribute that defines a key parameter in a controlled process and an important consideration in the beverage industry.
- Regulatory: Any attribute whose limit is set by governing regulatory agencies.
Sources and types of contamination

Understanding the sources of CO2 contamination and the types of contaminants which must be reduced or eliminated is a key factor in achieving acceptable product quality.

Prior to delivery, pure CO2 is at risk of contamination from atmospheric air, transportation, storage and handling, which can take place up to several times before reaching the production plant.

Types of contaminants include non-volatile organic (NVOR) and non-volatile residues (NVR).

**Oil vapour and grease**
Atmospheric air contains oil in a gaseous form (oil vapour) and derives from inefficient industrial processes and vehicle exhausts. Other sources of oil and grease can emanate from transfer pumps and compressors. As with other contaminants, oil vapour is drawn into the compressor intake and passes through the intake filter. Typical concentrations can vary between 0.05 and 0.5 mg per cubic metre, but these can increase significantly should the compressor be sited near highways. Additionally, lubricants used in the compression stage of a compressor can also be vapourised and carried over. Once inside the CO2 distribution system, oil vapour will cool and condense into liquid oil.

**Plasticiser compounds**
Flexible hoses and rubber gaskets are typical sources for contaminating CO2 with plasticiser compounds.

**Rust and pipescale**
Rust and pipescale can be directly attributed to the presence of water in liquid CO2 storage tanks and distribution piping. Over time, the rust and pipescale breaks away to contaminate the CO2. Rust and pipescale problems often increase for a period of time after the installation of PC02 polishers into older piping systems which were previously operated with inadequate or no purification equipment.

The PC02 system provides effective protection from such contamination risks.
A dedicated solution for multiple applications

From production plant to fountain / post mix and beer dispense, guaranteed CO₂ purity is assured.

The PCO₂ carbon dioxide polishing system from Parker domnick hunter offers a comprehensive solution to preserve and guarantee the quality of gaseous carbon dioxide used in the sparkling beverage industry.

Using multi-layer gas polishing technology, the PCO₂ range includes Maxi and Mplus PCO₂ for plant scale protection, in addition to Midi and Mini PCO₂ designed for fountain / post mix and beer dispense applications respectively.

Operating as a vapour ‘polisher’ to remove a wide range of potentially harmful carbon dioxide impurities, the system guarantees the gas quality to remain within industry and company guidelines, therefore preventing detrimental consequences to the finished beverage and to the producers reputation.

Maxi PCO₂ and MPlus PCO₂ systems for production plant

The system for the production plant environment offers in-line quality incident protection against peak levels of trace impurities which may be present in beverage-grade carbon dioxide.

Nitrogen Polishing

Whilst originally developed for the protection of carbon dioxide quality used in the beverage industry, the Parker domnick hunter PCO₂ system is also effective at removing trace levels of hydrocarbon contamination from nitrogen gas.

As part of the gas polishing system, the PCO₂ system can be used in a wide range of industries where the quality of the gas is critical i.e. life science research, bio-pharmaceutical, laboratory gases and electronics.
Midi PCO2 – fountain / post mix and Mini PCO2 - beer dispense

The same proven technology has been used in the design of the smaller point of use polishers to offer protection against potential carbon dioxide contamination in retail dispense applications and provide the same level of protection.

Approved for food applications, the disposable filters guarantee carbon dioxide quality for fountain / post mix and beer dispense by removing potential carbon dioxide impurities and protecting product taste and appearance.

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Typical retail dispense application
Quality system design

The latest multi-layer technology ensures the highest level of protection.

Six stage polishing technology

Maxi PCO2 and MPlus PCO2 offers six stages of carbon dioxide polishing from a compact, modular system to offer the highest level of production plant and point of use protection.

Stage 1
0.01 micron particle filtration
Removal of non-volatile organic residue (NVOR) and other contaminants down to 0.01 ppm

Stage 2
Removal of water vapour and partial removal of hydrocarbons

Stage 3
Primary removal of aromatic hydrocarbons (Benzene, Toluene etc and Acetaldehyde)

Stage 4
Removal of sulphur compounds (COS, H₂S, DMS etc)

Stage 5
0.01 micron particle filtration

Stage 6
Point of use VBACE sterile gas membrane. Hi Flow Tetpor II

In addition to inlet and outlet particulate filtration, the plant scale systems incorporate a unique multi-layer adsorption bed, pre-loaded into cartridges for ease of maintenance.

The multi-layer materials used in the system have been carefully selected to preferentially adsorb potential impurities, thus ensuring optimum removal efficiency during the systems' operational life.
The removal efficiencies of the system at each stage

### Preferential adsorption

<table>
<thead>
<tr>
<th>Potential Contaminant</th>
<th>Type</th>
<th>Name</th>
<th>Purification Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1st Stage</td>
<td>2nd Stage</td>
</tr>
<tr>
<td>NVR / NVOR Particulate / Oil / Rust etc.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Moisture Vapour</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Benzene Aromatic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ethyl Benzene Aromatic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Toluene Aromatic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Xylene Aromatic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cyclohexane Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Acetaldehyde Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Propyl Alcohol Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dimethyl Ether Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>MIBK Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ethanol Volatile Organic Hydrocarbon</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Nitric Oxide Toxic Gas</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Nitrogen Dioxide Toxic Gas</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sulphur Dioxide Toxic Gas</td>
<td>X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Carbonyl Sulphide Sulphur Compound</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Hydrogen Sulphide Sulphur Compound</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dimethyl Sulphide Sulphur Compound</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Propyl Sulphide Sulphur Compound</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Typical impurities found in CO₂ sourced from fermentation processes and the off flavours associated with them.

**Acetaldehyde**
Present in all beers. Typical ‘apple’ off-flavour at high concentrations.

**DMS**
- Desirable characteristic of some pale lager beer styles. Typical ‘corn’ off-flavour in some beers.

**Benzene**
- Carcinogenic compound - Regulatory control not detected at low levels by taste or smell.

**Iso-Amyl**
- Present in most beers. Typical ‘banana’ off-flavours occur at ppm levels.
The Parker design philosophy

In addition to CO₂ polishing systems, Parker offers a wide range of high quality compressed air purification solutions which are essential to all modern production facilities. It has an unrivalled reputation for delivering high quality products which are developed using The Parker design philosophy.

Parker has been supplying industry with high efficiency filtration and purification products since 1963. Our philosophy 'Designed for Air Quality & Energy Efficiency' ensures products that not only provide the user with clean, high quality gas, but also with low lifetime costs and reduced carbon dioxide (CO₂) emissions.

Air Quality
Parker has been instrumental in the development of both ISO8573 and ISO12500, the international standards for compressed air quality and compressed air filter testing respectively. All Parker products are designed to provide air quality in accordance with ISO8573-1:2001, the latest revision of this air quality standard.

Energy Efficiency
In these times of increasing energy costs, an efficient and cost effective manufacturing process is a major factor in maintaining the profitability and growth of your business. All Parker products are designed to not only minimise the use of compressed air and electrical energy in their operation, but also to significantly reduce the operational costs of the compressor by minimising pressure loss.

Low Lifetime Costs
Equipment with a low purchase cost may turn out to be a poor investment in the long term. By guaranteeing air quality and ensuring energy consumption is kept to a minimum, Parker purification products can reduce the total cost of ownership and help improve profitability through improved manufacturing efficiencies.

Reduced CO₂ Emissions
Many countries worldwide are looking closely at their manufacturing industries in an effort to reduce the amount of harmful greenhouse gases released into the atmosphere. The use of electricity has a direct impact on the generation and release of CO₂. By significantly reducing the energy consumption of its products, Parker can help you to reduce your carbon footprint and protect the environment.
Performance validation

Comprehensive testing has been carried out to verify the performance of the PCO2 system.

Conducted under controlled conditions, a set dilution ratio of specially prepared contaminated carbon dioxide mixed with a clean supply was flowed through a PCO2 unit at a set pressure and flow rate.

Gas samples were taken directly from the unit both upstream and downstream and were analysed by an independent analytical laboratory to evaluate the systems’ efficiency at removing trace contaminants. Removal of up to 10 times ISBT guidelines for stated impurities.

The results confirm the systems’ ability to remove trace contaminants. The system also has the independent verification from Lloyd’s Register.
purecare™ schedule of service

The flexible product support programme which can be customised by adding as many or as few services which may be required.

Parker’s commitment to industry does not stop with the supply of high quality products. It is also committed to ensuring that its equipment provides high performance by offering a bespoke service programme.

Starting with the basic preventative maintenance package through to sophisticated and comprehensive leak detection surveys, purecare™ is the flexible approach to optimising plant wide, compressed gas system performance.

Businesses are under immense pressure to reduce operational costs whilst increasing their profitability and reducing carbon emissions to the atmosphere, and although products can be effectively validated at the point of installation, it does not necessarily guarantee performance at the end of the process.

To help achieve these common goals, the purecare™ schedule of services has been developed by Parker specifically for the Food and Beverage industry.

By incorporating a performance and validation analysis to timely routine maintenance, trouble-free equipment operation can be achieved, and with annual agreement renewal, the warranty period can be extended for another year.

The unique and flexible purecare™ approach to preventative maintenance not only saves money and reduces downtime, it can also be customised to suit specific needs.

Below is a list of services covered by the purecare™ schedule of services.

PCO2 Standard Preventative Maintenance Agreement Incorporates:

- Bi-Annual visits
- PCO2 Leak Detection
- Diagnostics check

Additional services available to complement your Agreement include:

Compressed Air Leak Detection Survey:

- Level 1 - Comprehensive compressed air survey including machine level inspection
- Level 2 - Compressor Room / Mains branches
- Level 3 - Compressor Room only

Compressed Air Purity / Dewpoint Measurement

- Comprehensive analysis & report

Laser Particle Count Test

- All Compressed air, nitrogen and carbon dioxide
Parker’s Motion & Control Technologies

Parker is guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further information call 00800 27 27 5374.