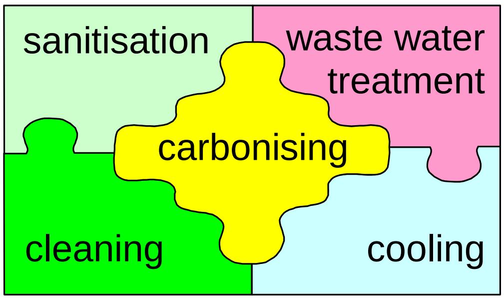
Application Note

Dräger safety

Brewing and Beverage Industry

Introduction

In the beverage producing industry gases are being used for many different reasons. The major raw material at the beginning and the end of the process is water which has to be treated regarding odour and sterility. All vessels and pipes are to be cleaned regularly



with sterilising fluids which generate toxic gases causing a threat to workers. For carbonation and during fermentation CO_2 has to be handled in high concentrations. The refrigerating and cooling system can contain pressurised ammonia to be monitored for leaks to avoid hazards and protect the goods.

Market Segment

Food Processing Industry, Brewery, Soft Drink-, Juice-, Bottled Mineral Water Manufacture, Milk Industry

Description of the challenge

Under certain circumstances the gases from the chemicals in use can become a threat to human health because they are either toxic or flammable. That is why workplace monitoring is necessary. The figure in the last chapter shows the material and energy flow of a brewery in more detail.

- Containers which get in contact with food as well as processed raw materials, like water, have to get sterilised or disinfected. The sterilisation of water required for the production of beverages is a significant subject due to the increased demand for water of good quality (taste, odour) by production plants. This can be done by applying gases like **Ozone, Chlorine, Chlorine Dioxide** or **Hydrogen Peroxide**. Generators produce the Ozone from air or oxygen with the aid of electrical discharges. It is then brought into contact with the medium being treated in reaction chambers.

Chlorine is stored in cylinders. Chlorine Dioxide can be chemically generated on-site whilst H_2O_2 is delivered dissolved in water. Workers have to get protected against leaks from the process where these gases are been used and in areas where these gases are stored.

- The production process and the storage of goods require controlled temperature and environmental conditions. Thus refrigerating and cooling systems are widely been used. Cooling fluids used like **Ammonia,** Hydrocarbons or Halogenated Hydrocarbons are circulating in the cooling systems under pressure and can leak hence pose a danger to workers. Monitored areas are heat exchanger, joints, the compressor and valves.
- **Carbon Dioxide** will be naturally generated by the fermentation of wine and beer or added later to carbonise the beverages. This gas can accumulate on low levels from leaks and lead to asphyxia if undetected. To prevent leaks and system brake-downs a gas detection can be used. Monitoring the workplace area to insure concentrations below TLV is a task.

Solution from Dräger

1.

Chlorine Cl_2 is a very toxic, corrosive gas used for disinfecting. It's stored in cylinders at high concentrations and blended down to the concentration used in the process or dissolved in water.

TLV/TWA	TLV/STEL	TLV/IDLH	NIOSH/ceiling	MAK
1 ppm	3 ppm	25 ppm	0,5 ppm 15 min	0,5 ppm

For TLV monitoring Polytron Transmitters with the DrägerSensor Cl_2 can be used.

No filters like dust filter are allowed due to absorption effects which would delay alarm response time and reduce maximum reading. The DrägerSensor can be used for at least 50.000 ppm x hours Cl_2. In humid environments the measured Cl_2 concentration can be less than anticipated due to absorption.

In more and more applications **Chlorine Dioxide ClO_2** is been used instead of Cl_2. Traditional oxidising agents (Chlorine and Bromine) suffer from pH constraints and corrosion problems. ClO_2 in water is more stable than other oxidising biocides and compatible with most water treatment chemistry. Chlorine Dioxide gas is a highly unstable substance. Long stagnation of the vapours will result in an explosive decomposition $2ClO_2$ --> Cl_2 + 2 O_2 + heat. Vapours are reactive with most organic compounds.

TWA	STEL	MAK
0.1 ppm	0.3 ppm	0,1 ppm

In almost all commercial processes for ClO_2 generation, the chlorate salt used is Sodium Chlorate ($NaClO_3$) and, to date, he only acids used have been sulfuric (H_2SO_4) and hydrochloric (HCl).

On the Polytron transmitter the gas can be selected from the gas list of the DrägerSensor Cl_2. The sensor does not discriminate between Chlorine and Chlorine Dioxide. The sensitivity to ClO_2 is less than to Cl_2. Because of the TWA-ratio and the sensitivity-ratio between ClO_2 and Cl_2, the ClO_2 sensor will behave oversensitive to Cl_2.

Hydrogen Peroxide H_2O_2 is well-established as an environmentally-friendly deodorising and bleaching agent. Hydrogen Peroxide is clear, colourless, waterlike in appearance, and has a characteristic pungent odour. Nonflammable, it is miscible with water in all proportions and is sold as a water solution. H_2O_2 will decompose though temperature and metal catalysts.

High concentrations are generated by vaporising a water/H_2O_2 solution. Wherever water-vapour can condense H_2O_2 will do the same. Thus the measured concentrations can be reduced.

TWA	MAK
1 ppm	1 ppm

For low concentration workplace monitoring we offer the DrägerSensor H_2O_2 LC .

For monitoring the concentration in the sterilisation process the DrägerSensor H_2O_2 HC can be used. The measuring range goes up to 7000 ppm. This sensor is cross-calibrated with SO_2.

Ozone (O_3) is one of the strongest oxidising agents that is readily available. It is used to reduce colour, eliminate organic waste, reduce odour and reduce total organic carbon in water. Ozone is created in a number of different ways, including ultra violet (UV) light, corona discharge of electricity through an oxygen stream (including air), and several others. In treating small quantities of waste, the UV ozonators are the most common, while large-scale systems use either corona discharge or other bulk ozone-producing methods.

Ozone is formed as oxygen (O_2) is struck by a source of energy. The bonds that hold the O_2 together are broken and three O_2 molecules are combined to form two O_3 molecules. The ozone begins to break down fairly quickly, and as it does so, it reverts back into O_2. The bonds that hold the O atoms together are very weak, which is why ozone acts as a strong oxidant as readily as it does.

In environmental air the O_3 concentration can stay in the ppm range for a long time. Therefore workplace monitoring is essential.

TWA	STEL	MAK
0.1 ppm	0.3 ppm	0.1

Environmental back ground concentrations of O_3 also have to be taken into account during summertime when monitored.

All sterilising gases have strong affinity to humidity and surfaces. Sampling or pumping through long, tight tubing my means of the Polytron Sampling pump should be avaided. Tubing material has to be TEFLON.

Example:

DrägerSensor Chlorine	Cl_2	LDL: 0,05 ppm	max range: 50 ppm
DrägerSensor Chlorine	ClO_2	LDL: 0,1 ppm	max range: 50 ppm
DrägerSensor H_2O_2 LC	H_2O_2	LDL: 0,1 ppm	max range: 50 ppm
DrägerSensor H_2O_2 HC	H_2O_2	LDL: 10 ppm	max range: 7000 ppm
DrägerSensor O_3	O_3	LDL: 0,01 ppm	max range: 5 ppm

in Transmitter: Polytron 1, Polytron 2, Polytron 2 XP Tox, Polytron TX (non Ex approved).

LDL: Lower Detection Limit

2.

If pressurised cooling fluids are being used in refrigerating and air conditioning systems a leak monitoring is essential. A small leak at a pipe joint can have a great impact and cause a lot of damage if not detected early. Cases are known where personnel has been intoxicated by exposure and stored goods have been destroyed by leaking Ammonia.

Ammonia is the preferred fluid. As a gas it is no threat to the Ozone layer of the atmosphere. It is a toxic, severe irritant and has a very pungent odour. In high concentrations it is considered explosive. European regulation (EN 378) requires detection in compressor rooms to activate alarms and switch ventilation on and electrical equipment off.

Ammonia can be detected in low concentrations with respective Polytron or VarioGard NH_3 transmitters. For TLV monitoring the electrochemical DrägerSensor NH_3 LC can be used and for concentrations up to 1000 ppm the DrägerSensor NH_3 HC.

For LEL detection Polytron SE Ex , Polytron Ex, Polytron TX, Polytron 2 XP Ex or VarioGard Transmitter Ex are suitable.

The thresholds to be monitored are depending on the country and the regulation. Common **TLV levels are in the range of 25 to 50 ppm**, leakage alarm around 500 ppm and explosion protection from 10000 ppm (1 Vol%) to 30000 ppm (3 Vol% or 20% LEL).

TLV/TWA	TLV/STEL	IDLH	MAK	LEL
25 ppm	35 ppm	300 ppm	50 ppm	15 Vol%

In cooling areas, locate sensors near control / piping end of evaporators and valve stations. Do not mount in front, back or on top of evaporators. When installing sensors near evaporators, keep sensor out of direct airflow from and to the evaporator and away from any moisture created during defrost. Make drip loops for cables on Polytron. Do not mount over door in refrigerated area, because the sensor will become a chunk of ice. Seal all conduit connections for XP- Tox, and Polytron TX.

In compressor rooms the transmitter should be installed at the ceiling. Ammonia is lighter than air and will rise first. So even if you don't smell Ammonia at ground levels the concentration at the ceiling can be high. Because of presence of background concentrations the alarm levels here should not be put at TLV level to avoid false alarms.

Example:

DrägerSensor NH_3 LC	NH_3	LDL: 5 ppm	max range: 100 ppm
DrägerSensor NH_3 HC	NH_3	LDL: 30 ppm	max range: 1000 ppm

in Transmitter: Polytron 1, Polytron 2, Polytron 2 XP Tox, Polytron TX,

VarioGard NH_3;

Polytron SE Ex, Polytron 2 XP Ex, Polytron FX, VarioGard Ex, using Ammonia or Methane for calibration. Cross calibration factor between methane and Ammonia almost one.

3.

In breweries and wineries odourless **carbon Dioxide CO_2** is naturally been generated in the malting, fermentation and storage process. Because it is heavier than air it may collect in poorly ventilated areas or confined spaces in low level clouds replacing the oxygen. The same can happen in the beverage industry where CO_2 is been used for carbonation of soft drinks and mineral water.

Polytron IR CO_2 is the suitable product to monitor the CO_2 concentrations and alert personnel or switching on fans. Selected thresholds for prealarms are 1000 ppm to 3000 ppm and main alarm 5000 ppm CO_2. Transmitters should be mounted at low levels. They should be protected from mechanical damage and against water ingress if washed down occasionally.

TLV	STEL	MAK
5000 ppm	15000 ppm	5000 ppm

Example:

Polytron IR CO_2

USP's

- superior electrochemical sensors with good measurement performance
- fast response and stabile signals.
- low drift, long expected life-time
- extended temperature range – 40 to + 65°C
- unique electrochemical Ammonia sensor with range up to 1000 ppm
- long-living poison resistant combustible sensor for NH_3

- very robust Polytron Infra-red CO_2 detector with wide measuring range

Reference (internal, external)

Pepsi Cola USA	– Ammonia detection in 53 locations all over the US
Frigoscandia GmbH Hamburg Germany	- VarioGard Ammonia
Danbrew "Panonska", Koprivnica Croatia	- CO_2 and Ammonia
Molson Breweries, Edmonton Canada	- CO_2
GUINNESS BREWING Great Britain	- CO_2, Ammonia
MILLER BREWING CO, OH USA	- Ammonia
Holsten Brauerei, Hamburg Germany	- Ammonia, CO_2, Cl_2
Castlemaine Perkins, Brisbane, QLD. Australia	- CO_2
KRAFT GENERAL FOODS, IA USA	- Cl_2, H_2O_2
Heineken Nederland-Zoeterwoude	- CO_2, NH_3

Appendix

Cl_2:	http://www.cl2.com/clinfo.htm
ClO_2:	http://www.haloxtech.com/uses.html
	http://clo2.com/factsheet/raw/raw.html
O_3:	http://www.osmonics.com/products/Page928.htm
H_2O_2:	http://www.h2o2.com/index.html
NH_3:	http://www.eurammon.com/

Drawings & Pictures

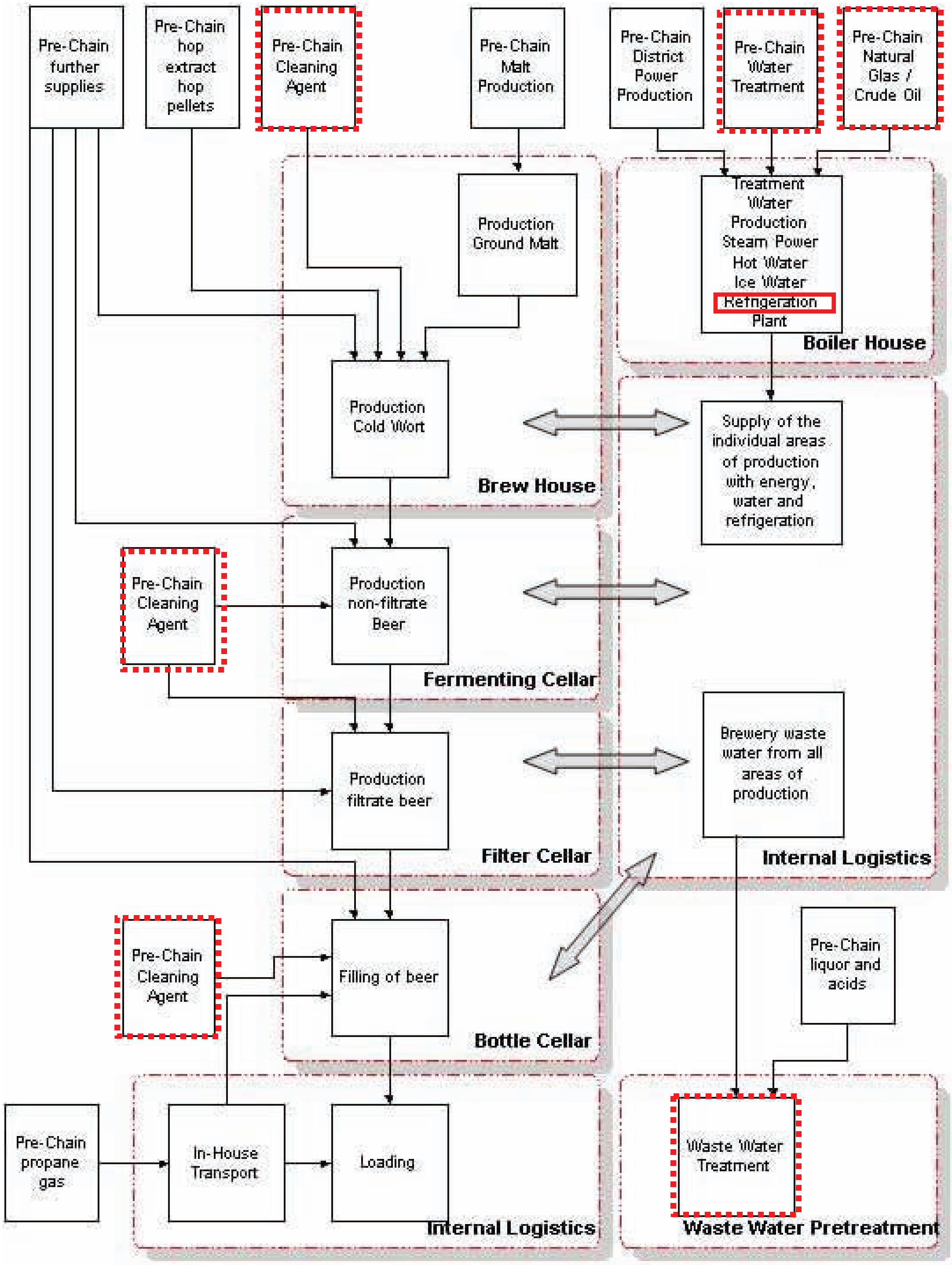


Figure: Brewery flow chart.

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