

## INTRODUCTION

This application note focuses on the use of CO<sub>2</sub> as extinguishing agent, as media for dry-ice blasting as well as fumigant for chickens.

The application fields of Carbon Dioxide (CO<sub>2</sub>) are very widely spread and extend over all possible aggregate states. Since CO<sub>2</sub> has favourable characteristics and is common as gas itself, as well as in liquid and solid form as dry ice, there are multiple applications for it. Most widely spread applications for CO<sub>2</sub> are the use of it in carbonated beverages, as an extinguish agent, as refrigerant for car airconditioning and so-called Carbon Dioxide 'snow' for the cleaning of surfaces.

Carbon Dioxide itself is a colourless and odourless gas with a slightly acidic taste. The Workexposurelimit (WEL) for CO<sub>2</sub> is at 0,5 Vol%. At a concentration of 3 – 5 % the breathing rate doubles, while a concentration of 6 vol% leads to unconsciousness and higher concentrations lead to death.

At 20°C and a pressure of 55.4 bar, CO<sub>2</sub> can be liquified to a colourless, easily mobile liquid. If the pressure is reduced rapidly, so much evaporative cold is created, that the temperature cools to less than -80°C. The resulting product is called Dry ice. Dry ice is also formed in fire-extinguishers, which use CO<sub>2</sub> as extinguishing agent.

## CARBON DIOXIDE AS EXTINGUISHING AGENT

One of the most common extinguishing agents is Carbon Dioxide. This is because it is on one hand environment friendly during its manufacturing process and on the other hand the only extinguishing agent, which can extinguish completely free of residues. It is most effective in closed rooms, since it evaporates fast in fresh air. Besides that, it is one of the only options to extinguish burning liquids.

A CO<sub>2</sub>-extinguisher is used wherever the extinguishing itself must leave no residues. Typical applications for this are: electrical and electronic equipment, pure and clean rooms, sensitive rooms and facilities, chemical industry and areas with special hygienic requirements.

The use of CO<sub>2</sub> extinguishers requires special safety steps. If those extinguishers are used in closed rooms, all persons must be warned and evacuated in time because of the risk for Oxygen depletion. The danger of suffocation can only be prevented by using SCBA (Self containing breathing apparatus). Unprotected persons must leave the rooms immediately. After use, it must be sufficiently ventilated before people can enter the room again.



Figure 1: Fixed CO<sub>2</sub> extinguishing system

But how to be sure by installing those fixed CO<sub>2</sub> extinguishers that you have enough CO<sub>2</sub> at all levels for extinguishing the fires? If there is not enough CO<sub>2</sub>, the fires may survive and if there is too much CO<sub>2</sub> people must wait longer to get back to the room and continue their work. For testing this the AirWatch CO<sub>2</sub> shows adequate CO<sub>2</sub> levels and logs the concentrations. The built-in pump even allows extraction at wild places.

## THE AIRWATCH FOR TESTING FIXED CO<sub>2</sub> EXTINGUISHING SYSTEMS

The special designed High-range CO<sub>2</sub> AirWatch offers the solution. The AirWatch provides an infrared sensor for high-level CO<sub>2</sub> monitoring. This ensures you a fast and reliable CO<sub>2</sub> detection. Together with the optional Datalog, the AirWatch shows adequate CO<sub>2</sub> levels and logs the concentrations. The built-in pump allows extraction even at difficult spots, which are hard to reach. Just ask your sales representative for the extension hose.

## EXTERMINATION / STUNNING OF POULTRY WITH CO<sub>2</sub>

Nowadays farm animals get “stunned” before they get slaughtered by exsanguination. It does not matter if the animal is ready for slaughtering or if it gets culled out for disease control. There are several methods for stunning established.

One of them is stunning with gas, so-called Controlled Atmosphere Stunning (CAS). There is only one stunning method, which is claimed more humane: the low atmospheric pressure stunning (LAPS), which works simply via reducing the Oxygen level incremental. Both methods reduce the stress associated to the birds compared to electrical stunning. Stunning methods in general are used to induce unconsciousness during cutting and bleeding, which is in the EU needed due to animal welfare and in the USA to immobilise the birds for automatic neck cutting.

In 2013 the European Union introduced a new regulation. It determines, that each operator must know, what they are doing in terms of animal welfare. Therefore, operators must evaluate the efficiency of their preferred stunning method with indicators based on the animal. This means, that the stunning itself and the further process must be monitored accordingly to ensure, that the animal does not regain consciousness before exsanguination. Also, this regulation determines stunning equipment manufacturers to provide instructions on the use and how to monitor the efficiency.

Currently there are 2 approaches for the CAS established. The first one is to unload the birds out of their crate, put them on a conveyor belt and expose them to gas mixture, containing 40% CO<sub>2</sub>, 30% O<sub>2</sub> and 30% N<sub>2</sub>, for one minute to stun them and afterwards expose them to 80% CO<sub>2</sub> and 5% O<sub>2</sub> for two minutes to kill them. The other approach is to leave the birds in their crates and place them into a gas chamber, which contains a mixture of inert gases. The gas mixture itself is depending on the country. In the UK, for example, the CO<sub>2</sub> content is limited to 30% and the O<sub>2</sub> to 2%.

Advantages of the CAS are obviously that there is no need any more to handle the birds manually, which results in less risk of inducing them injuries, which results in better meat quality. But how to make sure, that the CO<sub>2</sub>-concentration in the gas chamber is high enough to ensure those animals a fast ending without painful suffocating, but to stay within the legal frame? And how to make sure, that the birds do not regain consciousness before exsanguination?

## THE AIRWATCH FOR MONITORING EFFICIENCY OF POULTRY STUNNING

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WatchGas is dedicated to continuously improving its products. Therefore, the specifications and features mentioned in this datasheet are subject to change without prior notice.

Since stunning of animals means to kill all brain activities of them, the High-range CO<sub>2</sub> AirWatch can provide you with all the essential data needed for your proof of stunning efficiency. With the Data from the optional Datalog the stunning process can be retraced. Just lead the extension hose, with a length up to 50m, to the stunning chamber and use an AirWatch Receiver to lead the data to your personal office. Together with a monitoring camera you are not only able to ensure that the birds encountered the correct gas mixture, you can even show that they were unconscious. To offer you the most versatile solution, the Datalog from the AirWatch uses a normal SD-Card. You can choose in which interval between 1 – 60 minutes you want to log.



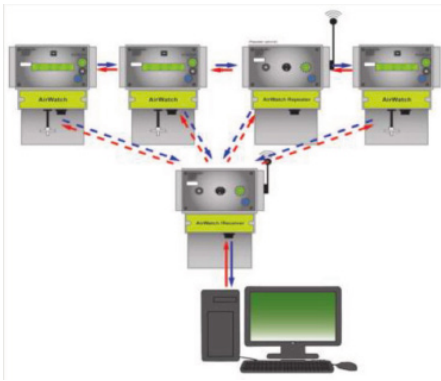
Figure 1: Multistage CO<sub>2</sub> stunning system for poultry

## DRY ICE BLASTING

There are several names for dry ice blasting established. Besides, it is called dry ice cleaning, CO<sub>2</sub> blasting or dry ice dusting. The technique itself is like sand blasting and plastic bead blasting, where a media gets accelerated by a pressurized air stream. The media, in this case, is pelletized dry ice. As soon as the dry ice hits the surface, it causes a mini-explosion, which lifts the undesired items from the underlying structure. The most important advantage of this is, that it does not leave any residues as dry ice sublimates at room temperature. But there are multiple other advantages like making it able to clean surfaces during production, without disassembly and being approved for the food industry. Also, CO<sub>2</sub> as a cleaning media is inexpensive and can easily be stored at work sites.

But how safe is it to blast around with CO<sub>2</sub>? It depends on the provided protection and if you use it for an indoor or outdoor application. The man in charge of the blaster should always wear a portable detector for self-protection. But to create the pressurized air stream, a diesel compressor is used. What happens, if a lorry driver parks in a way, that the compressor is sucking the exhaust of the lorry? Or to formulate it in general, if the compressor has no fresh air supply? The man in charge is not noticing, that he is spreading toxic gases and encounters other persons in the area to life-

threatening dangers. But how to avoid this?



## THE AIRWATCH FOR DRY-ICE BLASTING

The AirWatch offers a potential free relays, which you can connect to a Dry-ice blaster. This has not only the advantage, that you don't need an additional power supply, but also the AirWatch can communicate via Modbus to the dry-ice blaster itself and shut it down as soon as the fresh air supply is not provided anymore. This protects persons in the same area. The internal pump of the AirWatch protects the filters compared to diffusion gasdetectors. To ensure the most comfortable usage of the AirWatch, the pump provides 2-year-warranty.

With multiple AirWatches equipped with the wire-less function, you can even monitor whole areas. This might come handy, if the device or plant, that you are using the dry-ice blaster for, is in a critical location. Just place them in their GasPod version around the area, which you need to monitor and they communicate over a 300m distance to each other and share alarm information. This way they ensure with a simple colour-coding that no one gets into the riskarea. With the optional Wireless function, the AirWatch can communicate with another AirWatch or AirWatch Receiver within 300m, so that you are able together with an AirWatch Receiver to monitor the efficiency of your CO<sub>2</sub> concentration up to 100 vol%. This might come handy for poultry stunning for example. For outdoor applications like the Dry-ice blasting, you can just connect it to the blaster for power supply. Also, the AirWatch can shut down the diesel compressor in an emergency.

## KEYADVANTAGES OF THE HIGH-RANGE CO<sub>2</sub> AIRWATCH

- Long-time monitoring of high CO<sub>2</sub> concentrations
- No additional power supply needed
- Datalog available & programmable
- 2 internal pumps
- Internal programming for sensor purging allows long sensor lifetime
- Wireless texts messaging option
- Can shutdown compressor