A woman with blonde hair, wearing glasses and a blue surgical face mask, is standing in a grocery store aisle. She is wearing a red trench coat over a red and white striped shirt and blue jeans. She is holding a red package in her right hand and a yellow package in her left hand, looking at them intently. A shopping cart filled with various items is visible in the foreground to her right. The background shows shelves stocked with products, and another person is partially visible in the distance.

# THE DAIRY & CHEESE MAP GUIDE

- PRODUCT SAFETY
- SUSTAINABILITY
- QUALITY DEMANDS

# Why a cheese & dairy guide?

It is a defining (and vulnerable) moment when your packaged product meets the consumer. That's when your brand is literally in their hands.

The purpose of this guide is to try and pinpoint the most common challenges of MAP quality control for dried milk powder, yoghurt and other dairy products.

At Ametek Mocon, we have been developing, selling and servicing precision gas measurement instruments for Modified Atmosphere Packaging applications for more than 35 years and we hope this guide will inspire and motivate you to reach out to us for support and collaboration.

## **Yoghurt**

*The most popular packaging material currently in use for fresh yogurt is pigmented, thermoformed, TiO<sub>2</sub> high impact polystyrene (PS-HI). Lids of heat-sealed aluminum/plastic or paper/plastic laminate are the most common closures. For pasteurised, spoonable yogurt products, laminated barrier materials are desirable if a long shelf-life is needed, particularly for products with shelf lives of 4–6 months at ambient temperatures. Packaging with good O<sub>2</sub> barrier properties help to protect the product from oxidation, and a good light barrier helps to delay fading of light-sensitive colors and avoid light-induced oxidation.*



## **Cheese**

*The dairy segment, and in particular the cheese segment, is a universe of diverse sensorial experiences and cultures. Soft, hard, grated, blue, creamy and more – each unique microbial profile is key, and directly responsible for the characteristic properties.*



## **Powdered Milk**

*Milk powder, especially for use in baby formula, is very sensitive to oxygen. In order to extend shelf life, it is crucial that oxygen is displaced from the package and replaced by the desired MAP gas mixture - pure nitrogen with as low residual oxygen content as possible. This will ensure your product maintains premium appearance and quality throughout the supply chain.*



# Why product safety is in sharp focus during the COVID-19 crisis

Product safety remains the highest priority. Packaging type and technology are the main factors affecting microbial population in dairy and cheese products. Right now, the world is trying to reduce human interaction. In Quality Control, going from manual headspace analysis to on-line monitoring is one way to reduce human interaction with the food (and thereby, risk of contamination). But in critical situations, it also makes you less dependent on key personnel. The benefits of on-line monitoring go beyond the current crisis. It puts you in control and improves your overall Quality Control.

The basic concept of Modified Atmosphere Packaging, or MAP, is pretty straightforward. You package your product – cheese or yoghurt for example – in a sealed packet containing a mixture of gases. This extends shelf life and makes your product look tasty and appetizing to the shopper. Usually this means flushing most of the oxygen out of the package with a blend of gases such as nitrogen and carbon dioxide.

The concept is easy - getting it right can be tricky.



# Food freshness and appearance It's all in the eye of the consumer

Preservatives-free products, freshness, clear information about ingredients and traceability are keys to product selection and purchase in retail settings.

Consumers are interested in many aspects related to the quality of food, such as appearance, freshness, taste, nutritional value and food safety.

Almost all dairy products need to be stored in the refrigerator. The exceptions include powdered milk products and products such as UHT (Ultra-high temperature) products which can be stored in the pantry, or ice cream which needs to be stored in the freezer.

The period of time each dairy product stays fresh varies significantly. For example, pasteurized milk will keep for 12-14 days if kept below 4°C, while yoghurt and other fermented products should retain their high quality for 30-40 days under the same storage conditions.

## Dairy product shelf life:

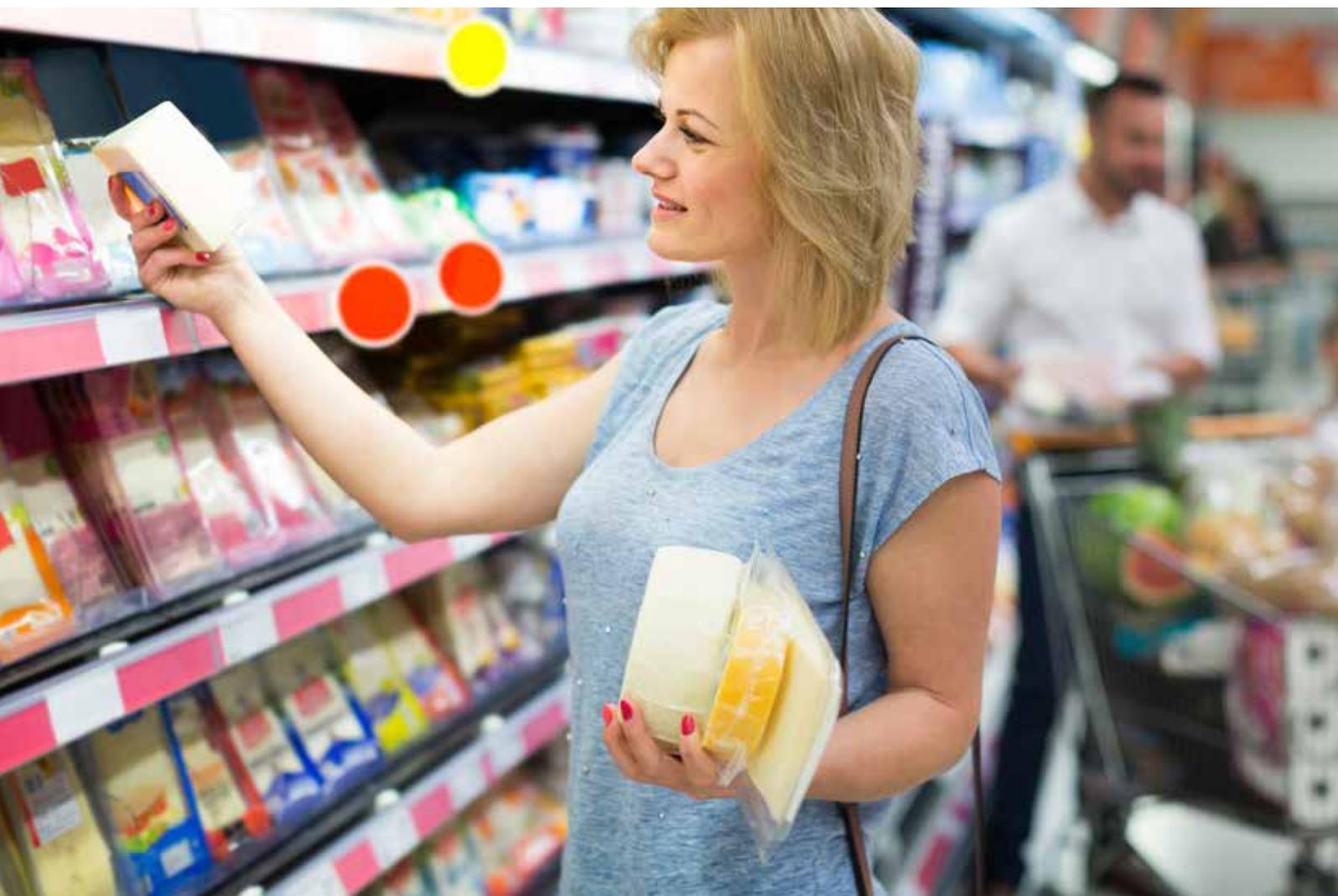
Pasteurized whole milk: **12–14 days**  
*(Skim and flavored milks usually have shorter shelf life)*

Yoghurt: **4–6 weeks**

Hard and semi-hard cheeses: *Depending on type, it may be kept for several weeks or months*

Cottage cheese, ricotta and cream cheese: **1–2 weeks**

Be aware that some consumers keep their refrigerators too warm. Whether it's fair or not, this will affect their perception of your dairy product. Freshness is in the eye of your customer.



# The trend is clear: Reduce. Reuse. Recycle.

To meet goals of increased use of sustainable packaging, suppliers have been adopting different and integrated strategies, facilitated by the introduction of new materials and solutions. Reduce, reuse, recycle – those are the 3 concepts summing up the main drivers and challenges for packaging professionals.

## The common solutions

- Reduce thickness
- Use of mono-material and functional coatings
- Introduction of new bio-based, bio-sourced compostable materials
- Use of recycled materials
- Paper-based materials, possibly combined with other materials and coatings (different sources, including plastic)

The introduction of these “new” packaging materials has been proven to be effective in protecting foodstuff from mechanical strains, but it increases

the challenges in ensuring barrier properties and seal integrity.

During the packaging process, materials are submitted to mechanical and thermal stresses. It becomes extremely important to know how the packaging material will react, not only immediately after the packaging step, but during the entire supply chain.

Even if a package is initially hermetic, after a few days, weeks or months it can lose its seal integrity due to thermal abuse or exposure, humidity, or other physical factors like UV, visible light, or radiation. Compromised packaging can lead to undesired changes in the sensory, nutritional and hygienic characteristics of food; thereby leading to an unsustainable and uneconomic waste of food, materials and resources. In addition, it greatly increases the risk of negative brand reputation and dangerous food-borne diseases.

*The general trend has already affected the dairy industry.*



- **100% RECYCLABLE**
- **REUSABLE**

**PLEASE REUSE & RECYCLE THIS BAG**

# Cheese and the importance of CO<sub>2</sub>

The introduction of a high percentage of CO<sub>2</sub> into the package can produce the appearance of vacuum packaging after a certain period of time, especially at low temperature. This is the result of absorption of CO<sub>2</sub> by the cheese, as well as some diffusion of gas through the packaging material. Because the permeability constant of CO<sub>2</sub> is approximately four times that of O<sub>2</sub> or N<sub>2</sub>, the rate

of loss of CO<sub>2</sub> is greater than the rate at which these other gases can permeate the package from the surrounding environment. As a consequence, there is a decrease in volume of the package and the packaging material collapses around the cheese.



## **Fresh and creamy cheeses**

*Fresh cheeses must be protected against light, O<sub>2</sub> and the loss of moisture. CO<sub>2</sub> content should be limited when packaging creamy cheeses to avoid a packaging implosion and to limit the effect of CO<sub>2</sub> absorption on the cheese's acidity. Keep in mind that CO<sub>2</sub> solubility increases at low temperatures.*

## **Matured cheeses**

*In matured cheeses, the CO<sub>2</sub> % can be higher (due to lower water content) and in some cases could represent 100% of the MAP gas.*



## **Sliced cheese**

*When packaging sliced or grated cheese the recommended MAP gas mixture ratio (CO<sub>2</sub>:N<sub>2</sub>) is 80:20. In order to avoid the slices being pressed against each other by atmospheric pressure, a ratio of 70:30 can be used.*



[CLICK HERE!  
TO SEE OUR GAS MIXERS](#)

*Learn about the benefit of our gas mixers to produce the correct MAP blend and extend the shelf life of all the different types of cheese you produce.*

# The importance of testing the whole package

Testing the whole package in terms of seal integrity, leaks and barrier permeation properties has become more essential than ever. We must ensure the extended shelf life of food achieved by MAP and vacuum packaging processes.

## Seal integrity

Testing packages in terms of seal integrity is achievable by submitting the package to standardized procedures.

This will produce valuable data that will help you select the right packaging solution. It will also produce information to set up the correct packaging line sealing parameters in terms of:

- Time-temperature-pressure
- Core test the effectiveness of the introduction of Ultra sound sealing systems.

## The most common quality norms

There are specific international test norms Quality and R&D Managers can use to establish internal procedures for seal integrity and combined leak tests.

The most common standards are:  
ASTM F-1140, F-2054, F-2095, F-2096, ISO 11607

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**TO SEE OUR BURST-CREEP LEAK TESTERS**

After an internal evaluation of the package performance in terms of seal integrity, it is important to detect and prevent leaking packages from reaching customers.



**Overpackaging is not uncommon. However, it is a waste of money and resources.**



# Leaks!

## What, where, why?

### What generates leaks?

There are 2 basic types of leaks:

1. Random leaks – the most difficult to predict and control.
2. Systematic leaks – if not quickly detected these can create a huge amount of damage, returns and waste. But the good news is that if your Quality Department implements a leak detection test in their HACCP plan, those can be promptly detected and the root cause fixed.

### What is the root cause of leaks?

*Random leaks* can be created by food contamination on the sealing areas, a mechanical shock or mishandling during second packaging stages.

*Systematic leaks* are usually related to incorrect settings on the packaging line, e.g., misalignment between lid and tray, overlapping of layers, a defect in the packaging film or laminates or a defect in the package machine welding bar, just to mention few.

### The basics: Keep it clean!

There are some simple actions you should make a habit of:

- Keep the welding bars perfectly clean
- Properly store and protect the packaging materials
- Check the sealing parameters
- Check the sealing areas
- Avoid foodstuff touching or deposit oil, fat or grease on seal areas

These are just simple actions to prevent the generation of leaky packages.

### Leak detection strategies

There are several approaches to leak detection:

- Bubble test (waterbath)
- Trace gas (CO<sub>2</sub>, He, H<sub>2</sub>)
- Pressure/vacuum decay

[CLICK HERE!](#)  
**TO SEE OUR RANGE OF LEAK DETECTORS**

*9 out of 10 times, leaks  
are located at the seal*



# Does leak size matter?

## Are all leaks equal?

There are many factors to be considered when defining or deciding which leak size is critical. You need detailed knowledge about the main chemical reactions and bacteria profile of your product.

What is the kinetics of those reactions, which factors accelerate bacterial growth and how will they influence the shelf life of your product?

You also need to know and predict the interaction between your product, packaging material and MAP gases in ambient, chilled and extreme temperature conditions.

One of the most common factors affecting shelf life is the presence (or absence) of O<sub>2</sub>. This will trigger oxidation and/or discoloration reactions. O<sub>2</sub> presence or absence will also determine the growth of different type of bacteria.

### **You can't avoid a proper shelf life study**

Conducting a proper shelf life study will help define how much O<sub>2</sub> the product can tolerate or needs. Conducting an O<sub>2</sub>-dependent shelf life study (assuming the package has the required barrier properties) that correlates leaks and O<sub>2</sub> % ingress in the headspace of the package is possible by creating leaks using a standardized needle of known size.

**A leak of 100 microns (twice the diameter of a human hair) can bring the O<sub>2</sub> level in your package to ambient in less than a week.**

**A leak of 50 microns can bring the O<sub>2</sub> in your package to ambient in one or two weeks.**

You can also use the Dansensor simulation kit:

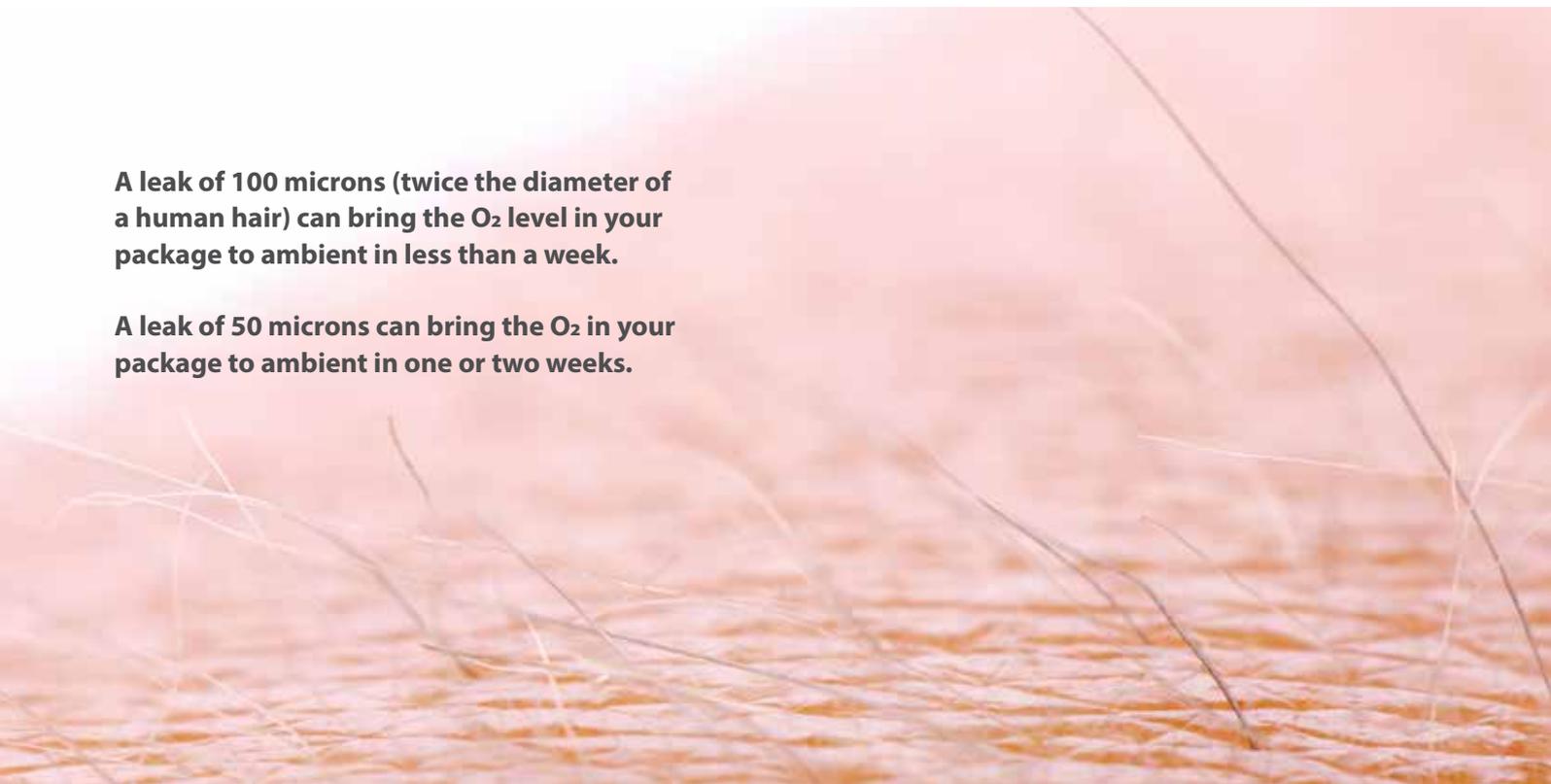
CLICK HERE!  
TO DOWNLOAD LEAK SIMULATION KIT PDF

A non-destructive O<sub>2</sub> headspace analyzer like [OpTech](#) can monitor the O<sub>2</sub> ingress over time. This will simulate shelf life, gradually testing the mechanical strains on packages during transportation and handling.

Other factors that affect shelf life are the size, position and shape of the hole, as well as the overlap of package layers which can create a weak seal. This will affect the speed of O<sub>2</sub> ingress and MAP gas replacement.

### **Leak size matters**

In addition to leak simulation, best practise should include statistics about leak sizes. This is possible using a trace gas leak system like [Dansensor® LeakPointer 3](#). This is a non-destructive CO<sub>2</sub> leak detector capable of detecting leaks down to 50 micron (the size of a human hair) and has integrated data management, enabling it to provide a report with full statistics.



# How to go from Quality Control to Quality Assurance

Implementing MAP technology also requires the introduction of internal quality control procedures to ensure that the desired gas mixture is actually present in the headspace of the package. This requires testing a certain number of packages (to build statistics) based on the packaging line speed and other variables.

This is a typical "quality control approach" using a headspace analyzer chosen based on its sensor accuracy and data handling capability (to ensure data traceability).

The alternative to manual testing is to have an on-line gas analyzer. This is an instrument that keeps tabs on the gas mixture and oxygen levels inside the packages. The analyzer will alert the operator or automatically shut down the line if any parameters fall outside the pre-set limits. It gives you full control of your process and full traceability by delivering production data. It dramatically reduces the need for time consuming and waste generating manual testing. It also eliminates the human error factor.

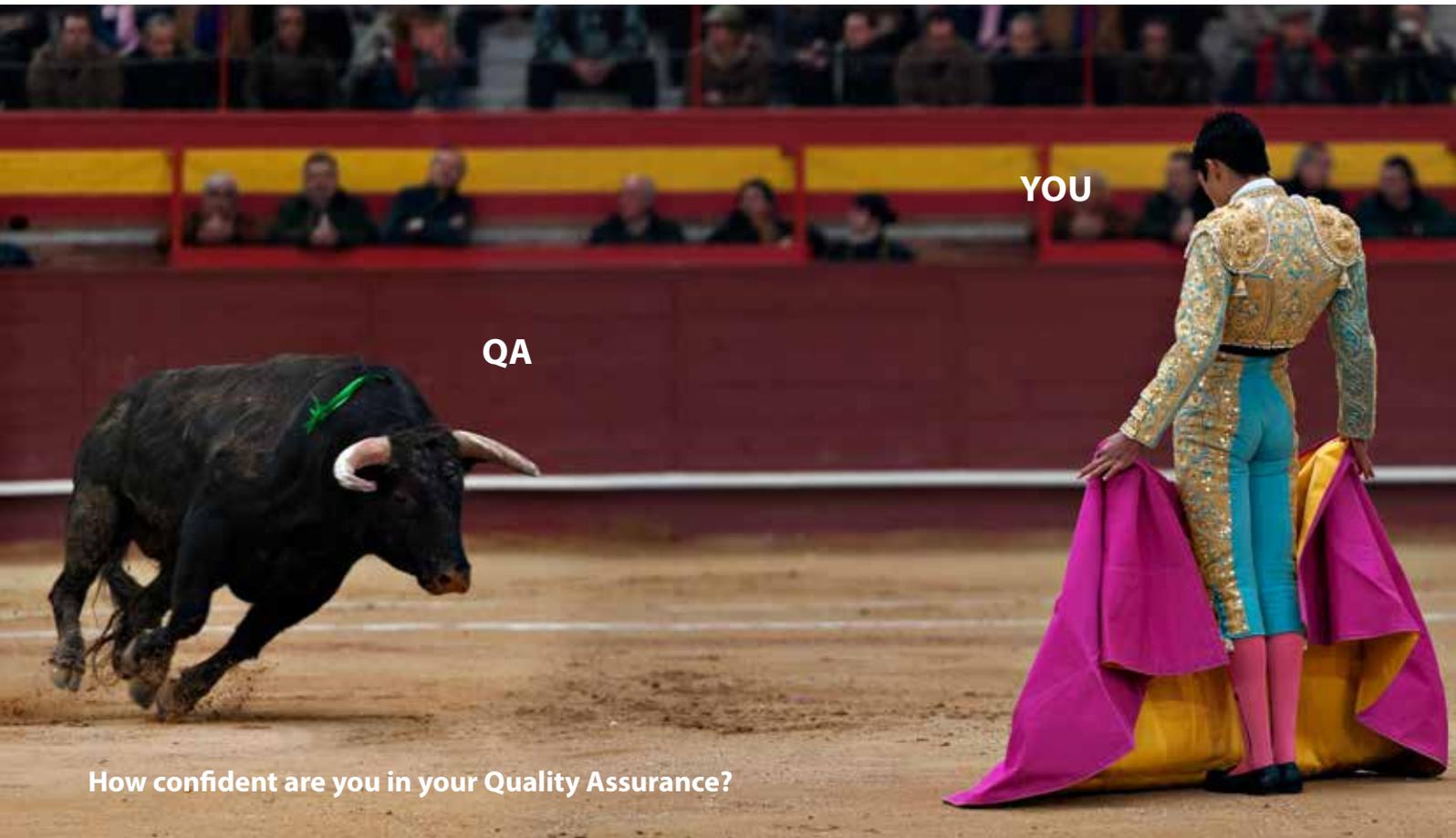
Some on-line gas analyzers have a smart 'gas save' function that controls the flow of the gases and keeps the residual oxygen at the right level. With manual systems, the operator often takes a 'better safe than sorry' approach and sets the flow rate extra high. This is to be certain that all oxygen is

flushed out. Unfortunately, this consumes unnecessary amounts of gas – and money.

And while you need one in-line gas analyzer for each packaging line – as opposed to a headspace analyzer that can work across lines – there are many advantages.



# Our on-line gas analyzers gives you the edge



How confident are you in your Quality Assurance?

- Cost savings from reduced gas consumption
- Zero packaging waste
- Minimal labor costs
- An on-line analyzer soon pays for itself



*Compared to quality control, an on-line gas analyzer is a cost-effective solution which minimizes the use of excess packaging gas and reduces the need for time-consuming repackaging of products.*

*The Dansensor series of on-line gas analyzers are equipped with user-friendly touch-screen interfaces and offer excellent data-logging and traceability options, which make them suitable for:*

- MAP Quality Assurance
- Control of gas flushing processes
- Streamlining Modified Atmosphere Packaging processes

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TO SEE OUR GAS MIXERS

# Team up with the best

## **The only thing that is constant is change**

In several recently published surveys, it emerges that modern consumers appreciate companies which commit to sustainability and the reduction of food waste. Packaging scientists are developing new types of materials – bio-based, compostable, with reduced thickness, monolayers with special coatings, and many more.

These new materials bring additional challenges in terms of barrier properties to O<sub>2</sub> and water vapor, as well as sealing properties.

## **Proven solutions and technology**

Ametek Mocon is the leading supplier of gas and water vapor permeation equipment, with a wide

range of solutions to test flat films and laminates. The tests are performed under 'real life' conditions in terms of humidity and temperature. Visit our website to get in contact with our contact with our laboratory and application specialists for more information about the importance of testing permeation properties of packaging materials.

## **We'd like to hear from your**

At Ametek Mocon, our support, service and application teams are available to help teams are available to help Production and Quality Managers optimize processes, reduce waste, protect your brand reputation and save you time and trouble.



**Let's meet and talk Cheese & Dairy**

**CLICK HERE**