Take an inline look to Bubbles & Foams

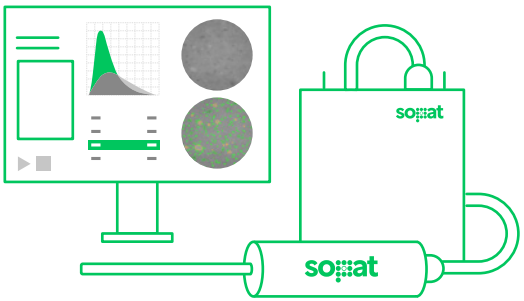
MicroBubbleScope

MADE IN GERMANY

sopat

Make every detail count

Principal challenges



The challenges in industry are numerous and can be divided into various categories. The MicroBubbleScope offers a way to address these issues.

In Food, Pharma and Cosmetics Industry

Bubbles and foams are ever-present in food and fine chemical production processes and oftentimes, the addition of air or nitrogen is desirable, e.g. for production of chocolate mousse or marshmallows (see “Application examples - Food” section on page 4).

Dynamics and Stability

Bubbles and foams are inherently dispersed, and they are subject to local inhomogeneity, coalescence and separation. Hence foam quality is subject to continuous changes. Very rarely, the interplay of bubble growth and segregation follows the expectations of the consumer who expects constant product quality of packed products until best before date.

Avoiding Foams in Production

Unwanted foam formation can lead to disturbances or expensive downtimes. Typical examples are mash or fermentation vessels and mixing tanks. Unwanted foam formation leads to pressure loss, lower capacity, lower heat transfer rates, reduced separation efficiency and backmixing. Depending on plant capacity, losses can be in the range of 100k€/day. Increased safety factors, elaborate trial-and-error experiments in pilot scale or the use of defoaming agents add to the costs.

Process Control

Production processes are not perfect, and fluctuations occur over time. Pressure variations due to changes in cross-section, passages through valves, bends, and orifices, or peaks in pressure due to start-stop-events will change the quality of the final product. Moreover, further product modifications such as addition of more components, fruit or herb additives, hot-filling or cooling will affect the foam stability.

The solution: MicroBubbleScope

The SOPAT MicroBubbleScope is your inline tool to measure the bubble size distribution in bubbly multiphase flows and all sorts of food and non-food foams.

Easy process integration provides instantaneous access to relevant process data – no dilution, no sampling, no human interaction, 24/7 with reliable repeatability.

Our TCP/IP interface allows easy connection to your process control system and enables the setting of demand-driven production parameters of your bubble or foam generators.

Product Model	MicroBubbleScope
Measurement Range [µm]	9 – 1,100
Field of View (image diagonal) [mm]	2.6
Tube Length [mm]	220
Tube Diameter [mm]	12
Pressure Range [bar]	0.01 – 10
Probe Temperature Range [°C]	-10 – 130
Periphery Temperature Range [°C]	0 – 40
Probe Window Material	Sapphire
Probe Tube Material	1.4404 (316L)
Probe Housing Material	
Weight (without Cable) [kg]	3.2
Focus	Electronic
Picture Rate [Hz]	15
Picture Resolution [MP]	5
Power Input [VA]	141 (50-60 Hz)
Certifications	CE, IP65, CIP/SIP, RoHS

Application Examples - Food

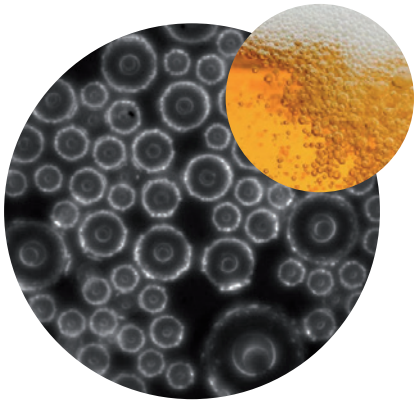
The SOPAT MicroBubbleScope can be applied to a vast range of different applications in food industry.

Consumers of foamed products often associate a high level of enjoyment when consuming the product, may it be the foam on top of a cappuccino, ice cream, whipping cream, bakery products, mousse au chocolat, and many more.

So foams show - due to the impact of entrapped bubbles and their microstructure - unique organoleptic properties. Foams are playing more and more a significant role in product development, delivering innovation to meet market and consumer trends, e.g. controlling portion size or reduction of the meal's energy density.

The SOPAT MicroBubbleScope can be applied to various stages of the foaming production process, may it be in a mixing tank, a foam generator or in a pipe. Also the final product can be analyzed. SOPAT's automated image analysis workflow allows to follow the transient behavior of bubble size distribution parameters and immediate control.

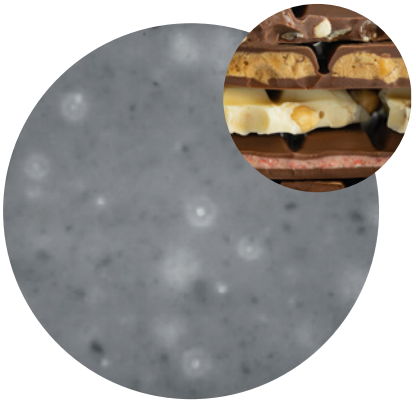
Beverage foaming, bottling processes etc.



200 µm

Beer foam

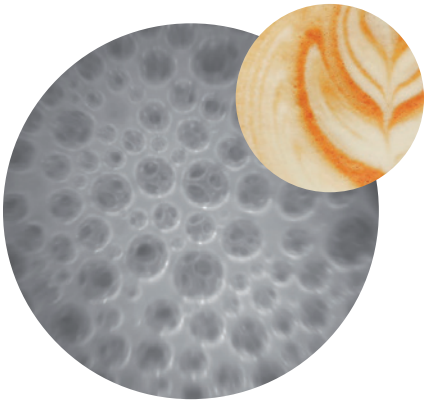
Sweets, dairy products, baked goods etc.



200 µm

Aerated Chocolate

Cappuccino, coffee, dairy foams etc.



400 µm

Milk Foam

Application Examples - Non-food

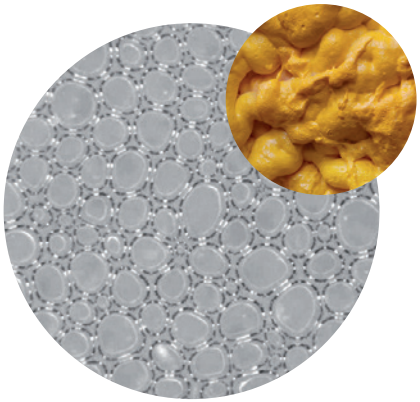
A broad range of applications can be identified for the use of the SOPAT MicroBubbleScope in the production process of non-food products.

Opposed to the end-consumer-oriented product development, the motivation in non-food industry may be quite different, albeit based on the same principles. The main objective is to increase the level of control on the production process to increase quality and lower costs.

For example, bubble size distributions play a significant role in reaction columns, bubbly flows, or within the pulper during paper or non-woven tissue production. Polyurethane foams need to be carefully controlled as the hardening step occurs in a short amount of time, and the impact of process variables such as pressure, temperature, nozzle size etc. can be evaluated with the MicroBubbleScope.

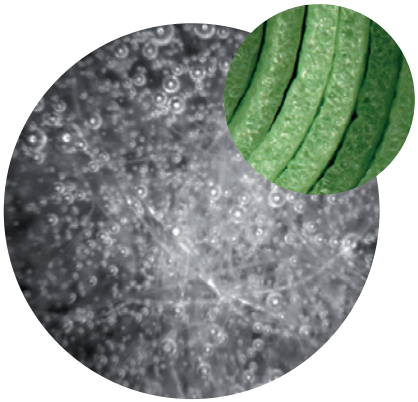
Foam or bubble generators are used in the plasterboard production process. The bubble sizes influence the pore structure and hence quality of the final product. In other processes, diverse types of foams with different life-times with and without activators are used to produce a diverse range of products, such as coatings on textiles, carpets, PVC floor coverings and many more.

Polyurethane foams, polyethylene foams, high quality foams, molded foams



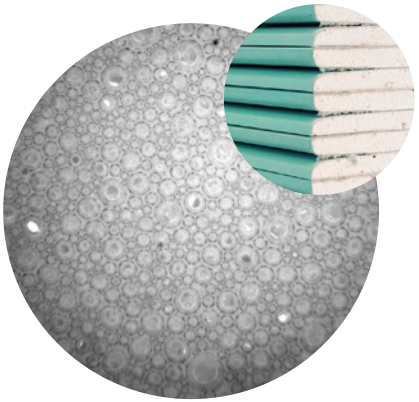
Polyurethane Foam

Pulp mixing, microbubbles, non-woven tissue production



Non-woven Tissue Production

Gypsum Plasterboard Production



Gypsum Plasterboard Production

From individual Bubbles to Foam

Detection of individual Gas Bubbles

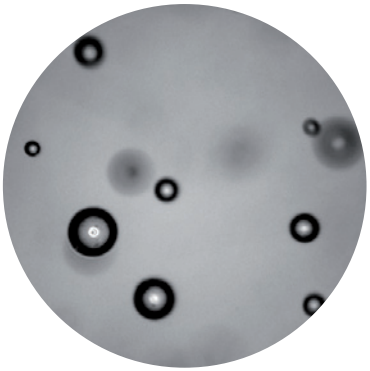
In some processes bubbles and foams occur unintentionally. The detection of air bubbles helps to detect and localize leakages. The observation of foam formation enables the optimization of processes where these foams lead to difficulties, e.g. beverage bottling, or chemical processes using surfactants in reaction vessels.

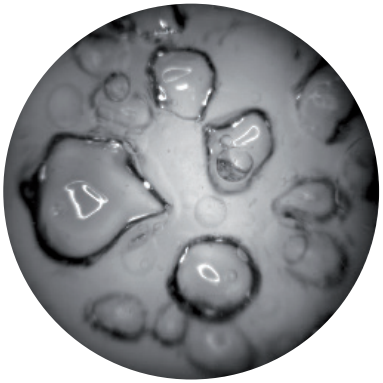
Use of Gas Bubbles in (bio-) chemical and pharmaceutical Processes

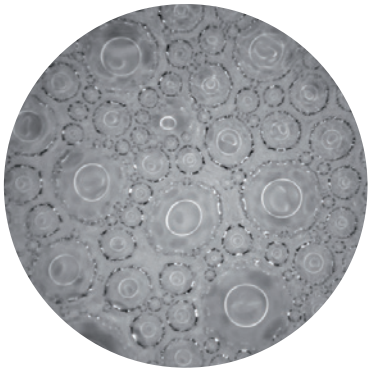
Many gas- and liquid-phase chemical reactions employ the use of bubble columns. Biochemical reactions like syngas fermentation are performed by injecting the gas at the bottom of the reactor reacting over the whole height of the column with the liquid. Separation processes like gas-liquid absorption and liquid-liquid extraction are one of the most important processes in the chemical industry and are heavily influenced by mass transfer properties and thus the particle size and shape of air bubbles.

Structure and Stability of Foams

Foam products occur in a vast range of applications, from whipped cream over cappuccino foam to expansion foam, polyurethane and insulation material. Here, the reliable formation of stable foams is mandatory. The analysis of bubble size distribution, structure formation and altering push foam engineering to a new level.







Process Control with the MicroBubbleScope

SOPAT offers an all-round solution for detecting single bubbles up to complex foam structures. Integrate SOPAT's MicroBubbleScope directly into your production line and benefit from real-time process control:

Phase 1
Measure bubbles inline

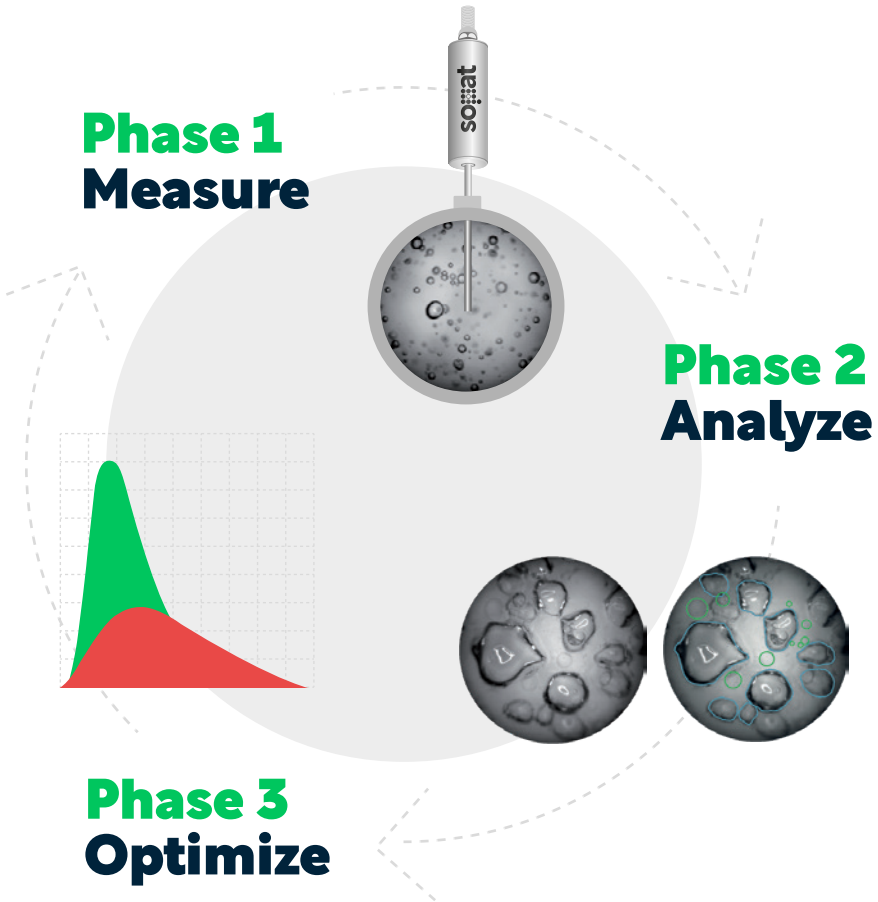
- Bubbles and foams are extremely dynamic particular structures. Neither sample extraction nor diluting is possible.
- The MicroBubbleScope can be installed directly in your pipe, reaction vessel or foam generator.

Phase 2
Analyze in real-time

- Analyze different kinds of particles (bubbles, droplets, solids) individually and get quantitative results.
- Track variations in particle size distribution and shape to obtain characteristic percentiles like $x_{v,10}$, $x_{v,50}$, $x_{v,90}$ and $x_{n,10}$, $x_{n,50}$, $x_{n,90}$.

Phase 3
Optimize your production

- Detect unwanted bubble and foam formation.
- Distinguish bubbles from liquid droplets and solid particles.
- Save energy, natural resources and reduce the production costs.
- Ensure to get persistent product quality despite external influences that can't be avoided.



Characterizing Bubbles & Foam

IMAGING

Imaging:
Photo-optical techniques are able to identify different kinds of particles according to their optical properties. Bubbles can be distinguished from solid or liquid particles.

Visualization:
Detect single bubbles or clusters of bubbles up to dense foams.

Quantification:
The MicroBubbleScope combines the visual information with quantitative results from automated image analysis.

DATA ACQUISITION

Data Treatment:
Starting from the original image, different steps of pre-filtering and background subtraction bring out the individual particles.

Analysis:
The underlying algorithms can be used to differentiate particles according to their grey value, size and shape (see image below).

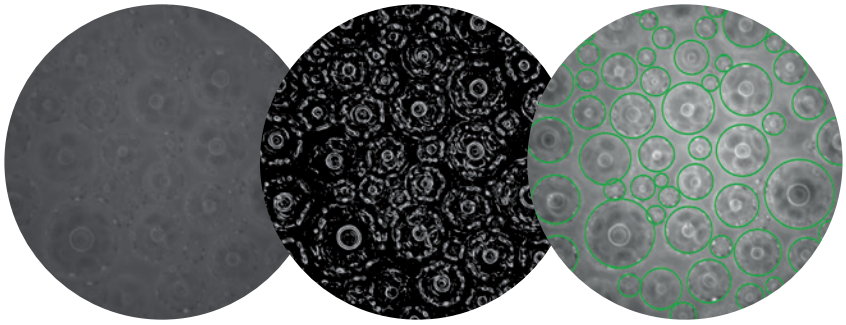
An Example:
In the image below, an image of a typical foam has been acquired, pre-filtered and analyzed. The MicroBubbleScope provides both the images and the quantitative results.

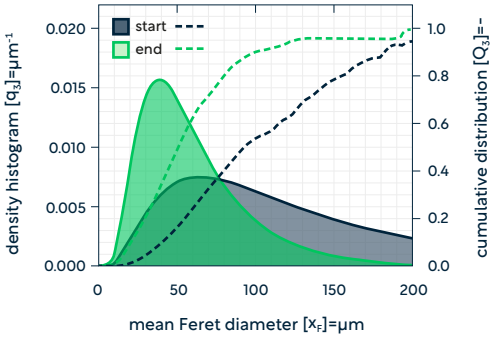
PROCESS CONTROL

Interpretation:
Particle size distributions can be obtained inline by analyzing the images.

Process Control:
SOPAT's combination of stroboscopic image acquisition and simultaneous analysis enables a continous process control using the MicroBubbleScope.

Standardized:
SOPAT's automated image analysis detects particles and quantifies size and shape according to ISO standards: ISO 13322-1-2014, ISO 12322-2-2006





1 Original Picture 2 Prefilter, normalize 3 Object Classification 4 Particle Size Distribution

Use of the MicroBubbleScope

Detection and quantification of single bubbles has a high importance in several applications.

According to the exact process conditions, bubbles don't need to be necessarily spherical. The MicroBubbleScope is able to analyze the exact shape of deformed bubbles in various concentrations.

Stability, mechanical properties and quality of the final product are heavily influenced by the bubble size distribution within the foam.

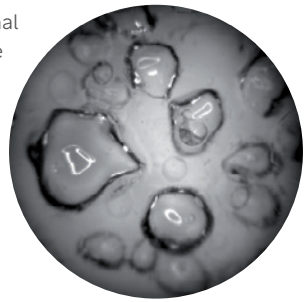
The structure of foams, and the arrangement and shape of the individual bubbles can be analyzed inline to quantify foam stability and quality.

Bubbles might coexist with other kinds of particles in the same process as foreign particles or wanted component.

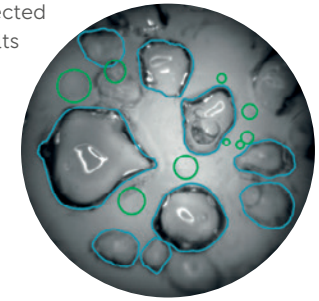
The MicroBubbleScope can distinguish between different kind of particles due to their optical properties. Air bubbles, solid particles or liquid droplets can be differentiated.

Individual Bubbles

Original Image



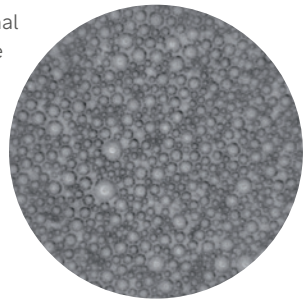
Detected results



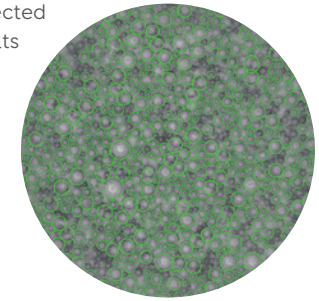
400 µm

Foams

Original Image



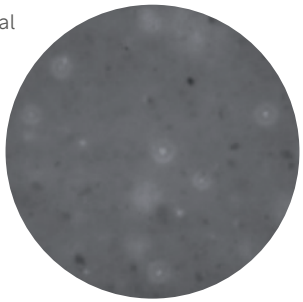
Detected results



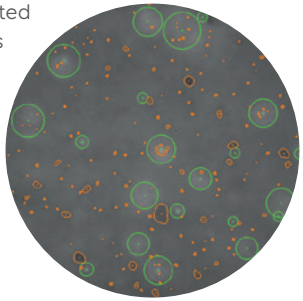
200 µm

Particle Differentiation

Original Image



Detected results



200 µm

Integration into Production Line

The MicroBubbleScope can be inserted at several positions in the production line according to the individual production conditions and the need to avoid contaminations.

The design of the probe with a tip diameter of 12 mm and a tube length of 220 mm enables a comfortable integration into your existing process.

The system is FDA compliant according to EC 1935/2004.

The MicroBubbleScope fulfills CIP/SIP requirements.

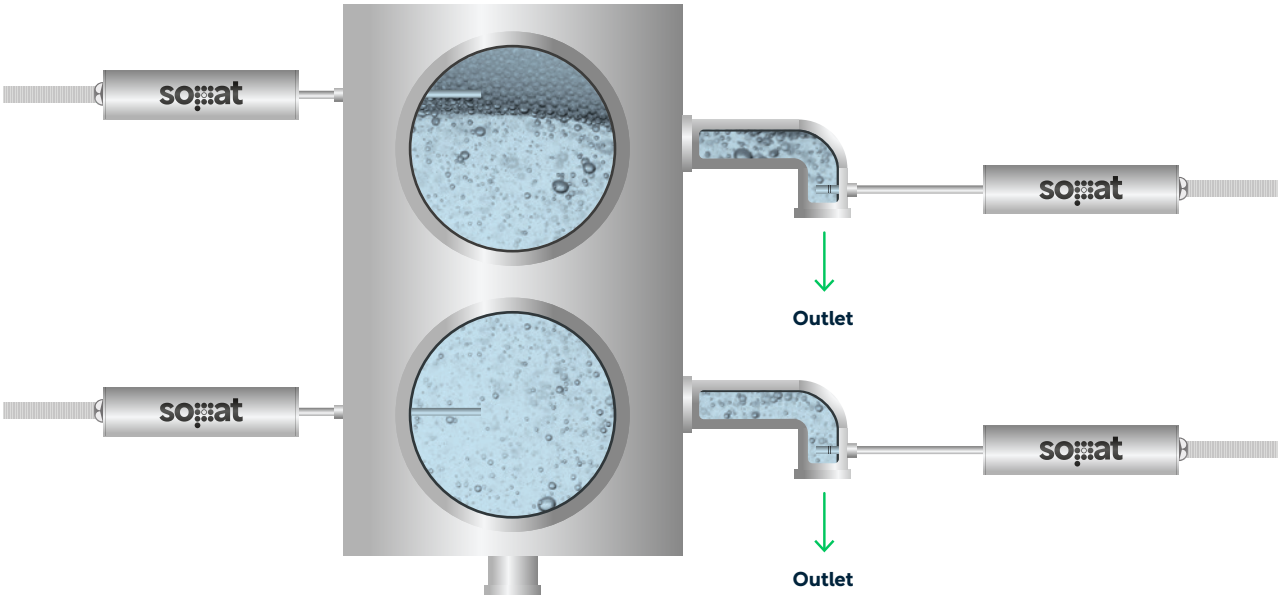
Easy connection to your process control system (PCS) via Modbus TCP/IP, OPC UA or others is given.

The modular design of the individual components (probe, Centralbox, computer) allows an easy handling.

The MicroBubbleScope is easy to clean.

AS AN EXAMPLE

The MicroBubbleScope can be inserted at the outlet of a foam generator. This enables inline monitoring of the bubble size distribution of the foam and real-time process control by means of e.g. pressure and flow rate.



5 Steps to Your Own SOPAT Particle Measurement System

Define your problem and your process/application with the help of our checklist.

Get to know the SOPAT System:

a) With the help of live measurements at your site.

b) Through the shipment of samples that will be tested in depth at our laboratory.

Monitor your process thanks to an optimal SOPAT measurement system tailored to your needs.

Profit from all the different ways to test the SOPAT system:

a) Measurement as a Service

b) Renting

c) Try and Buy

d) Direct Purchase.

Take advantage of our knowledge.

We support you during the installation of our system and also offer comprehensive support during system operation. Multiple training courses are offered each year and are included in the service package.

R & D
An Essential Part of Our Company's Philosophy

New approaches are constantly being tested to improve the SOPAT system. We maintain many cooperations with universities and are active in many research projects. In addition, we support the next generation of young scientists.

SOPAT sees itself as a research partner, system supplier and employer for young people and maintains a close relationship with a number of international research institutes. SOPAT is proud to work with the new generation of emerging scientists.

Globally Active Thanks to a Strong Sales Network

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