Case Study: Lab

Rethinking Air Release Performance with Optical Bubble Measurement

Application:
Air Release Performance

Environment:
Laboratory Testing

Focus:
Controlled Oil-Air Dispersion

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Case Study at a Glance

CASE STUDY 03 · SLIDE 02 OF 08

Challenge

Air release performance is often difficult to understand beyond single-point or standardized test results.

Approach

One oil was tested in the SBS-ST under controlled starting air contents of 3%, 2% and 1.5% using constant boundary conditions.

Result

The measurement made air release behavior, bubble population and trend progression visible over time.

Impact

The data created a more detailed basis to evaluate lubricant behavior, reproducibility and dynamic air release performance.

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Air release behavior is dynamic — but often evaluated too narrowly

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Air release performance is critical in gearboxes, hydraulic systems, pumps and other lubricated systems where entrained air can influence how the lubricant behaves and how the system performs. Trapped air can affect lubrication effectiveness, compressibility, temperature behavior, oxidation risk, cavitation potential and overall system stability.

Limited visibility into bubble behavior

Bubble population and size distribution are rarely captured in full.

Single-point interpretation

Final values can hide how quickly or slowly the oil actually releases air.

Reproducibility questions

Repeatability must be demonstrated under controlled and comparable conditions.

Application relevance

Lab data should support better interpretation for testing and field use.

Case objective

Create a reproducible optical measurement approach to observe how air content decreases over time and how bubble-level behavior changes under controlled starting air contents.

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Controlled oil-air dispersion measured over time

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1 Measurement solution:
SBS-ST stationary test setup

2 Test object:
one oil sample

3 Starting air content:
3.0%, 2.0%, 1.5%

4 Boundary conditions:
constant for comparability

5 Measurement mode:
real-time optical measurement

One oil was tested under defined starting air contents in a reproducible laboratory environment to capture how air-in-oil behavior evolves during the release process.

What was recorded

- Air **content** in %
- Bubble size distribution in µm
- Air-oil contact surface
- Real-time recordings during the full test course

Purpose

Make the dynamic release of air from oil visible, measurable and comparable under controlled lab conditions.

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From air release value to dynamic bubble-level data

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Air content

Shows how much air remains dispersed in the oil over time.

Bubble size distribution

Shows whether air remains as fine bubbles or separates more quickly.

Bubble population

Characterizes the number and structure of detected bubbles.

Air-oil contact surface

Indicates the interaction surface between oil and air.

Trend progression

Reveals how quickly air content decreases over time.

Data value

The measurement generated more than a single air release value. It created a time-resolved view of how air content, bubble behavior and oil-air interaction changed throughout the test.

Why this matters

It enables deeper comparison, reproducibility assessment and stronger interpretation for lubricant development and testing.

Case Study | Field

Controlled air injection revealed reproducible air release behavior

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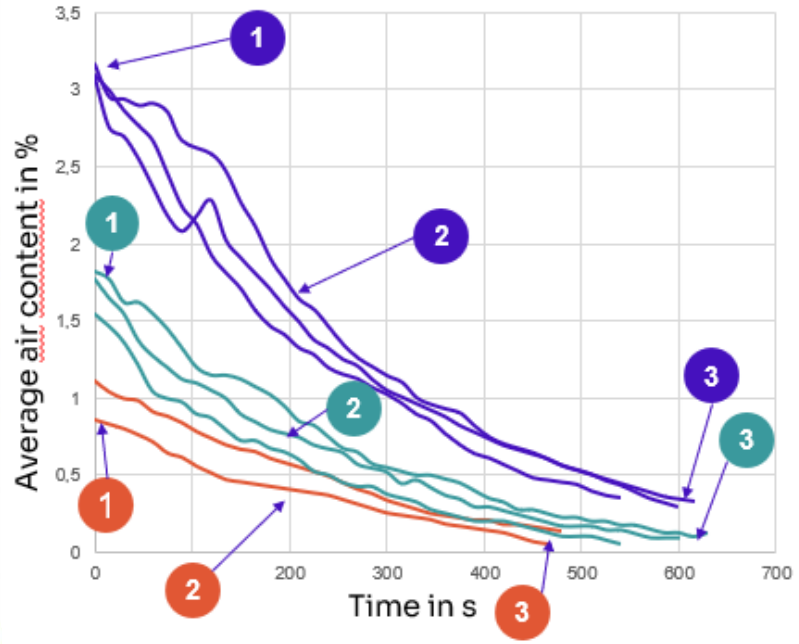
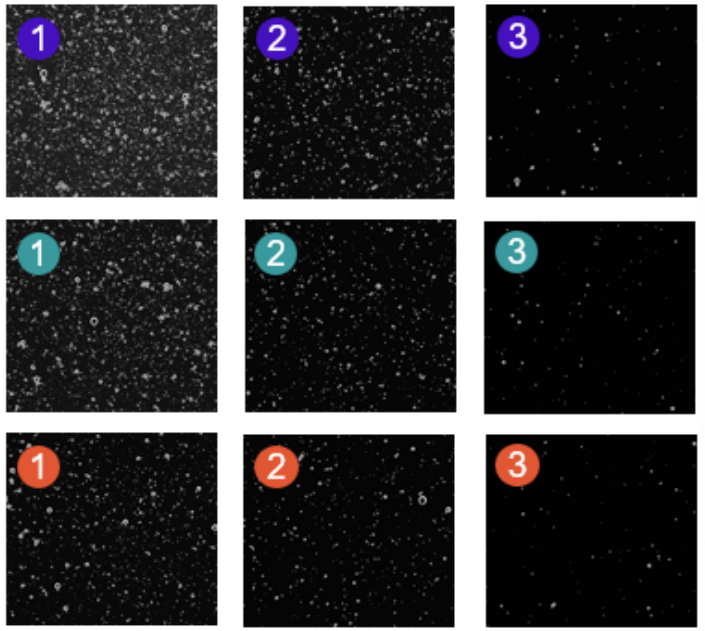




Continuous trend visibility

Air release became visible as a time-based process, not only a final value.

Reproducibility

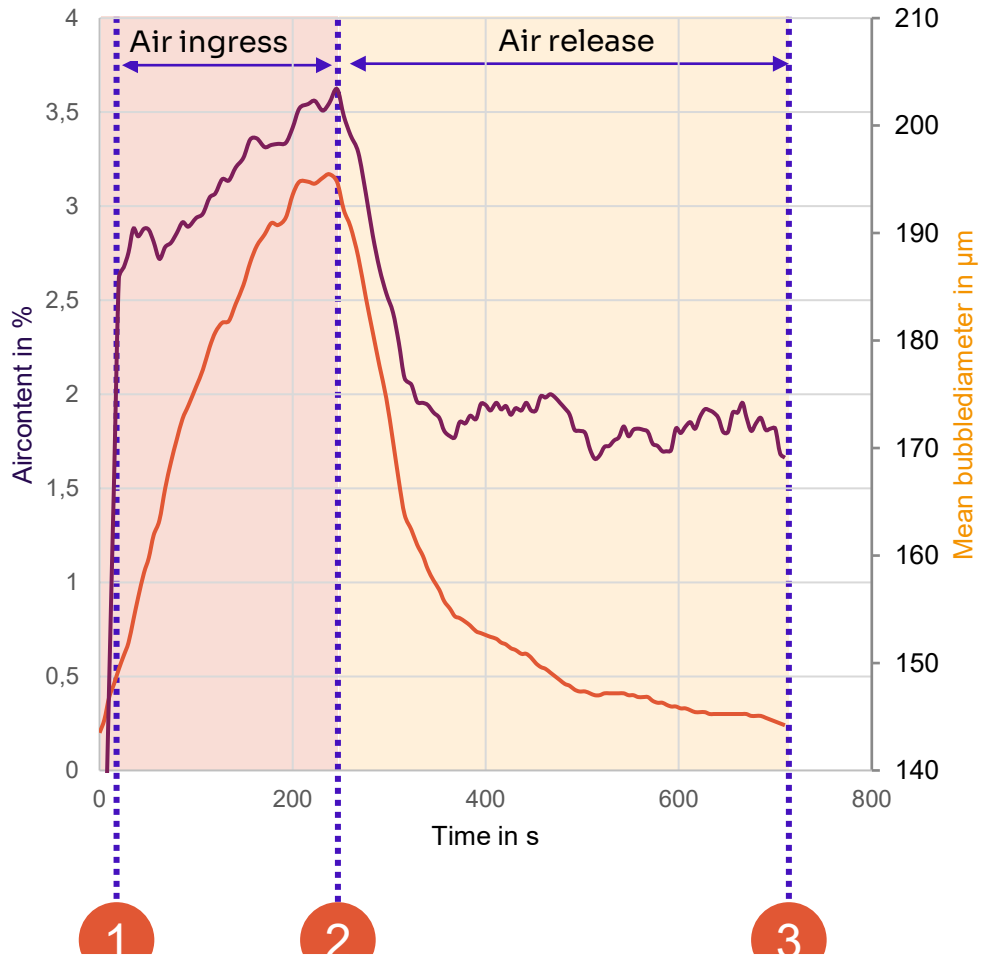
Repeated measurements showed comparable trend behavior under controlled conditions.

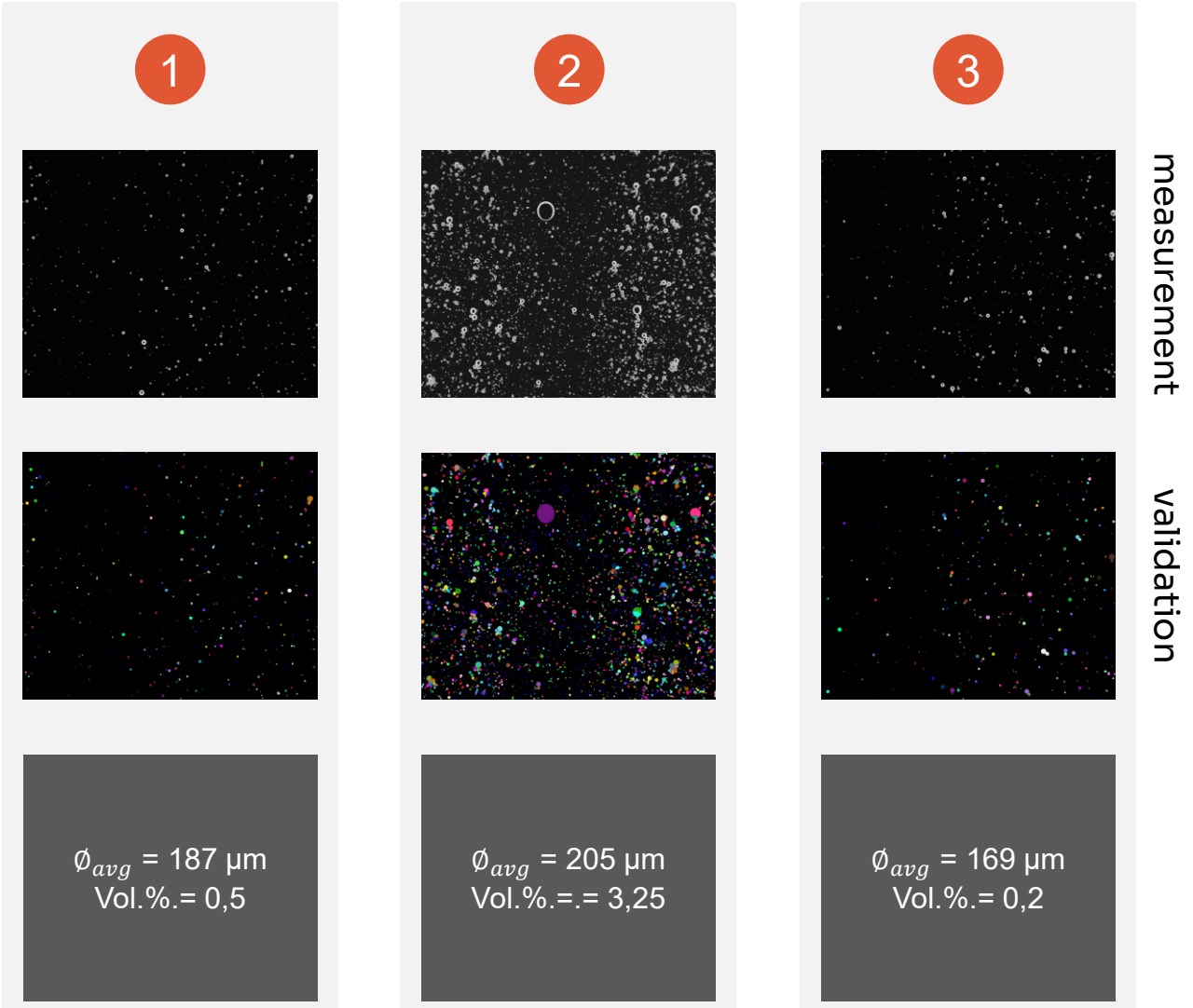
Comparability

Different starting air contents created a clear basis for overlay and release-rate comparison.

Result message: | *Optical measurement makes air release performance visible as a dynamic curve rather than only as a final test value.*

Air Intake & Release (AIR)
Measurement





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Measurement added reproducibility and deeper interpretation

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What the data showed

Air content decreased continuously over time
Air release can be tracked dynamically instead of being judged at one point only.

Repeated measurements showed comparable trends
The method supports reproducible air release testing.

Different start-air levels changed the release profile
Initial aeration level influences the observed degassing behavior.

Bubble population and interaction became visible
The oil-air dispersion can be characterized more deeply.

Value created

Lubricant development	Supports better formulation understanding.
Lab testing	Improves test transparency and repeatability.
Product comparison	Enables more detailed oil comparison.
Diagnostics	Helps interpret dispersed air behavior.
Application transfer	Strengthens the bridge from lab to field.

Key message

By measuring air release dynamically, teams can understand not only whether an oil releases air, but how it releases air — and how stable or reproducible that behavior is.