Case Study: Lab

Effect of Anti-Foam Additives on Air Intake & Release Behavior

Application:
Lubricant Formulation

Environment:
Controlled Lab Testing

Focus:
Antifoam Effect & Bubble Dynamics

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Why Formulation Effects Need Better Air-in-Oil Visibility

Application Context

Two oil variants were compared:
no antifoam vs antifoam

Both variants were tested under
low and medium air ingress

The goal was to understand air uptake,
bubble behavior and release dynamics

Why conventional evaluation is limited

Many methods reduce performance
to a single end value

Dynamic ingress and release behavior
remain difficult to see

Formulation differences are harder
to explain without bubble-level visibility

What we wanted to learn

- How much air each formulation absorbs
- How bubble diameter changes during the test
- How effectively air is released again

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Measurement Approach and Test Logic

1. Controlled air ingress

Introduce air at a constant flow rate under controlled boundary conditions.

2. Peak oil-air dispersion

Continue until peak air content and stable bubble dispersion are reached.

3. Air release phase

Stop air addition and allow the system to release air naturally over time.

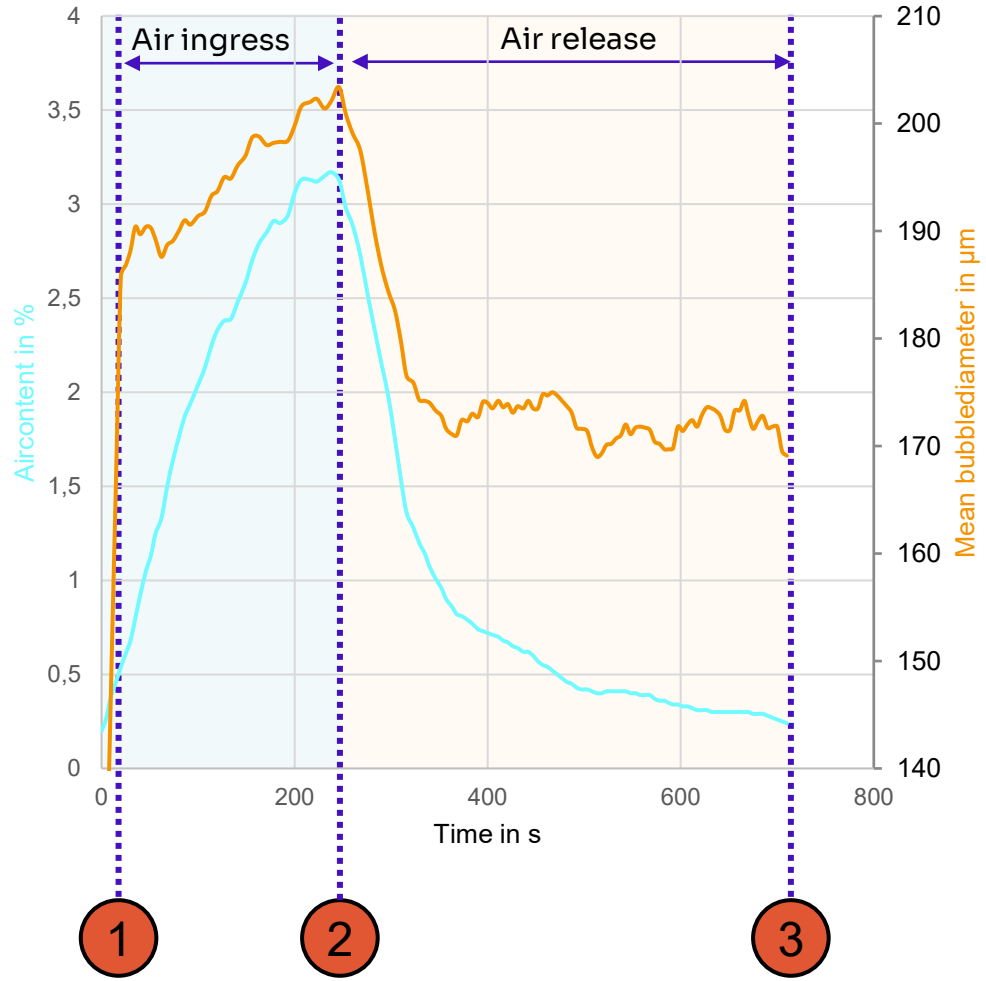
4. Compare both formulations

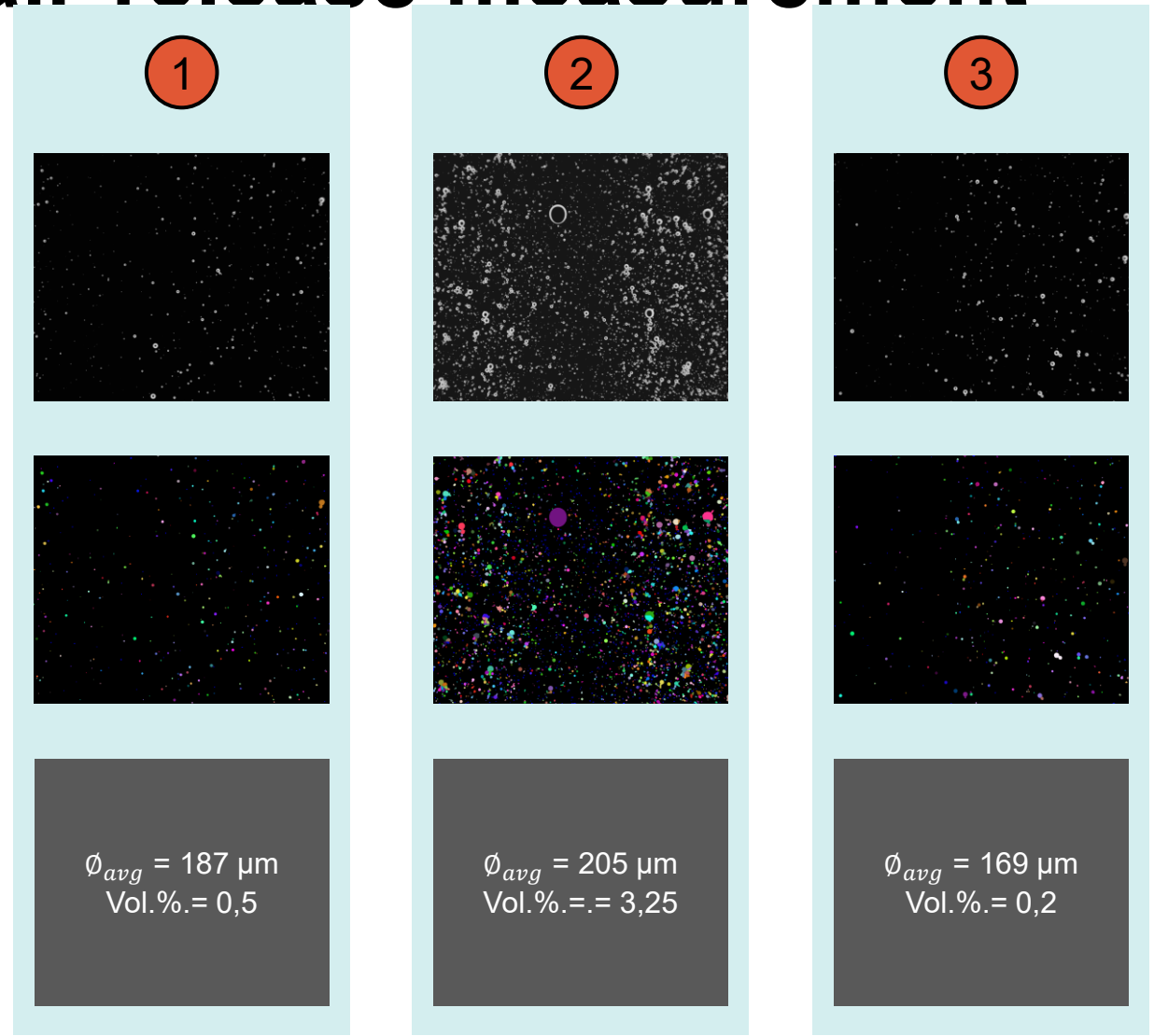
Compare time-resolved metrics between the two lubricant formulations.

Measured over time

- Air content (Vol.%)
- Mean bubble diameter (µm)
- Bubble images and validated detection
- Bubble-size distribution / histogram over time

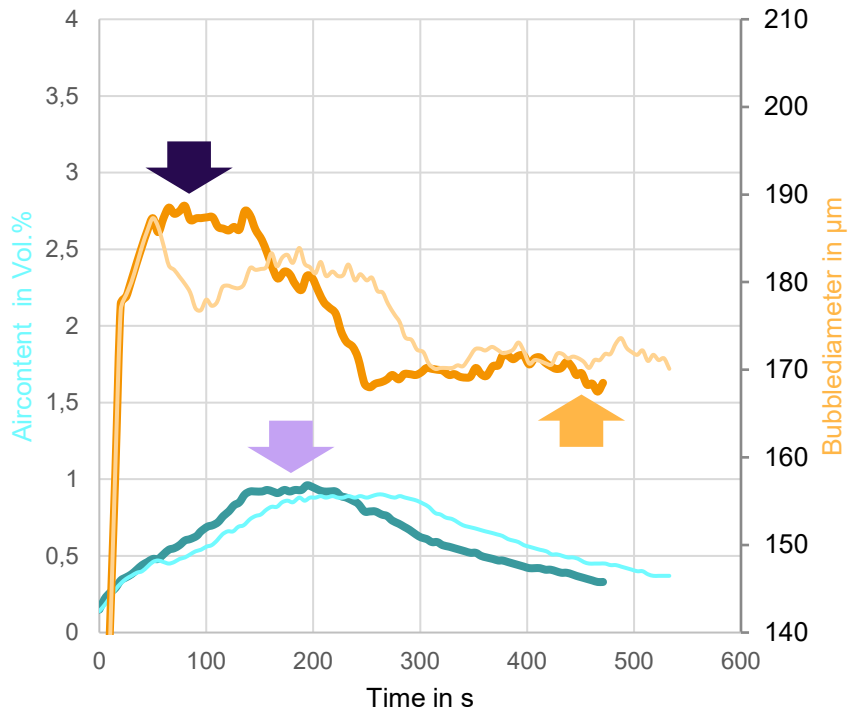
Direct air-ingress and air-release measurement





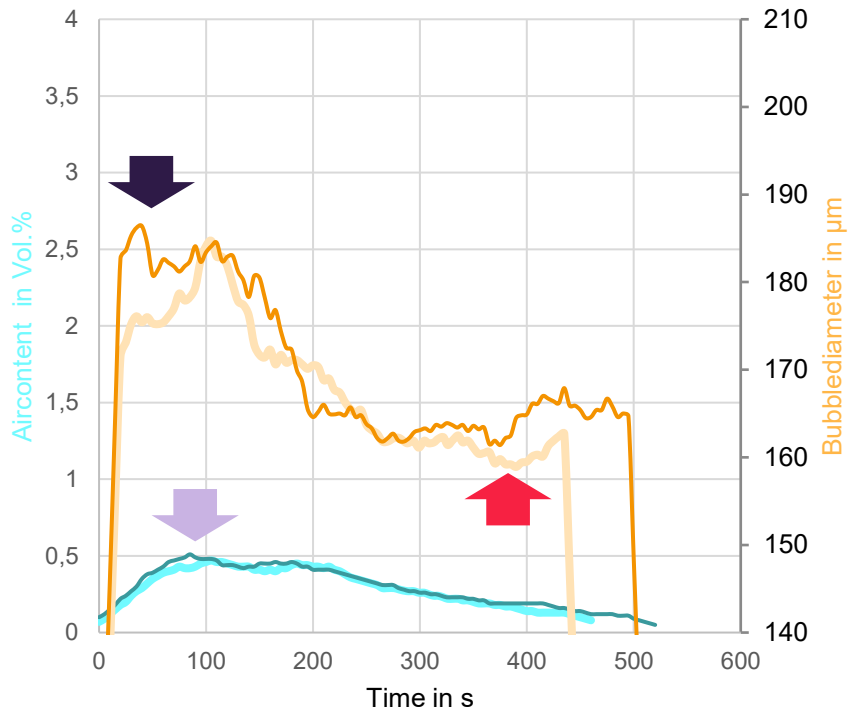
Measurements low air ingress

Without Anti-Foam Additives



$Ø_{max}$ = 189 µm $Ø_{min}$=167,5 µm
Vol.-%$_{max}$= 0,95

With Anti-Foam Additives

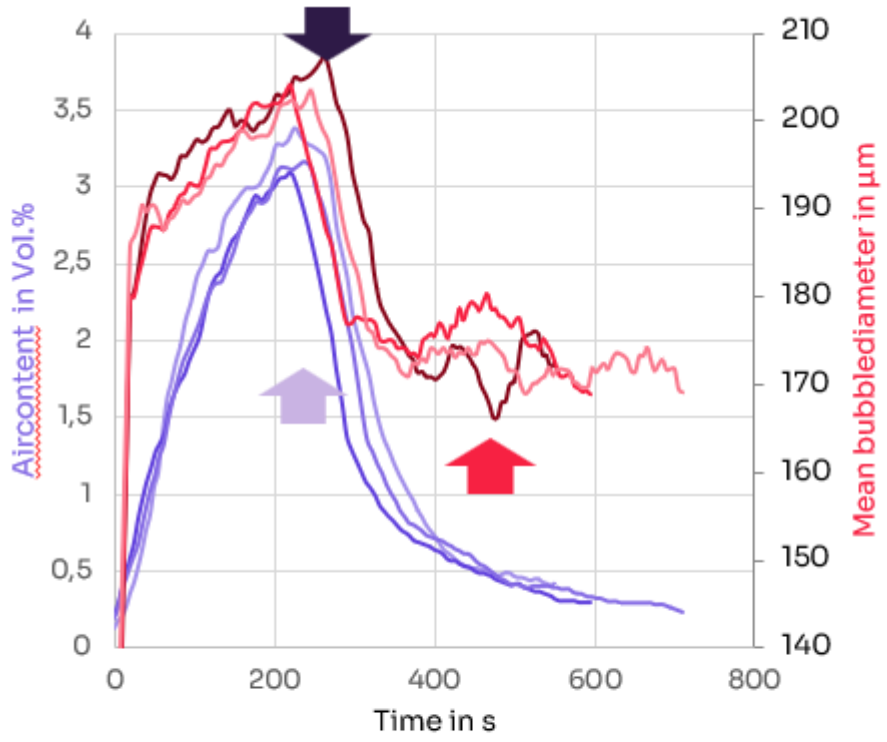


$Ø_{max}$ = 186 µm; $Ø_{min}$=158 µm
Vol.-%$_{max}$= 0,48

Case Study | Field

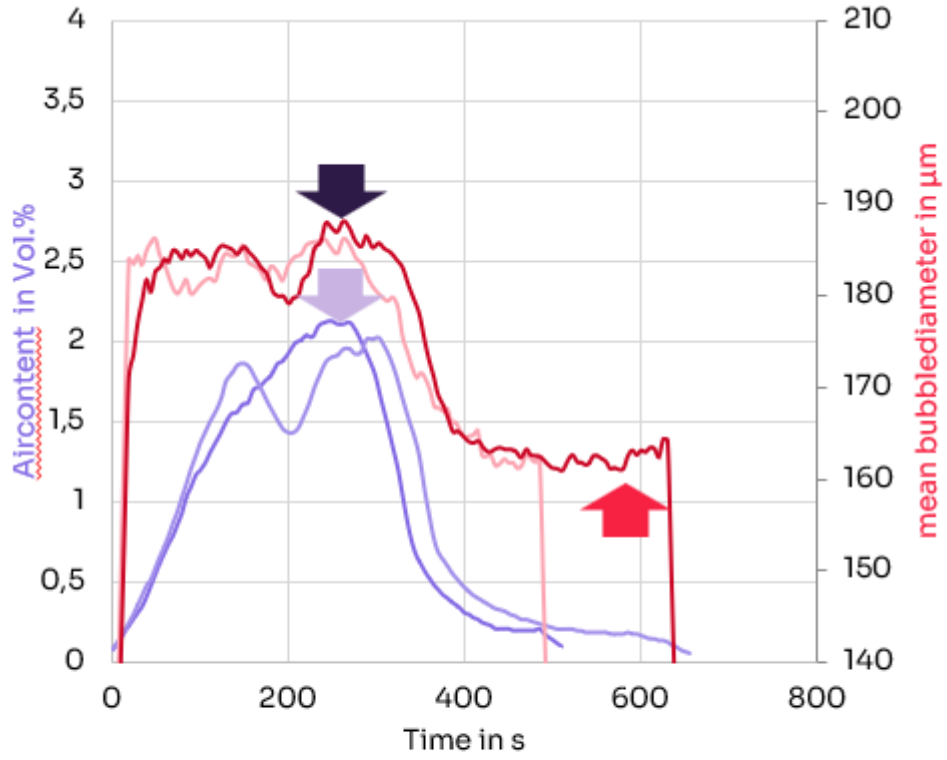
Measurements medium air ingress

Without Anti-Foam Additives



$Ø_{max}$ = 205 µm; $Ø_{min}$=166,5 µm
$Vol.\text{-}\%_{max}$= 3,38

With Anti-Foam Additives



$Ø_{max}$ = 187,9 µm; $Ø_{min}$=161 µm
$Vol.\text{-}\%_{max}$= 2,11

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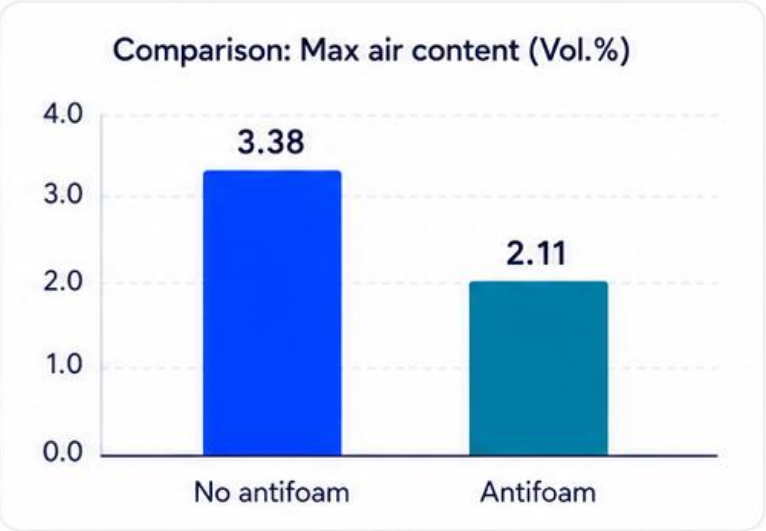
Medium Air Ingress: The Formulation Effect Remained Visible

At the higher air-ingress level, the antifoam formulation still showed lower peak air content and lower bubble-diameter levels.

	No antifoam	Antifoam
Max air content	3.38 Vol.%	2.11 Vol.%
Max bubble diameter	205 µm	187.9 µm
Min bubble diameter	166.5 µm	161 µm



≈38% lower maximum air content with antifoam

Key takeaway

The formulation effect stayed measurable even under stronger air ingress.

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Engineering Interpretation and Practical Value

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What the data indicates

- Antifoam influenced both air uptake and release behavior
- Formulation differences remained visible across different ingress levels
- Bubble-diameter trends added explanatory power beyond a single air-content value
- Optical measurement made the mechanism easier to compare and discuss

What teams can do with it

- Screen additive packages earlier
- Compare candidate formulations under the same test logic
- Support formulation decisions with quantitative bubble data
- Build stronger lab evidence before moving to rig or field tests

The measurement turns formulation comparison into visible, explainable air-in-oil behavior.

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Key Takeaways and Next Steps

Formulation effects became visible

Both air content and bubble behavior changed measurably between the two variants.

Low and medium ingress levels mattered

The comparison remained meaningful across different air-ingress conditions.

The method goes beyond a single end value

It captures ingress, release and bubble-diameter dynamics over time.

The workflow supports formulation development

It is well suited for additive screening and comparative lab evaluation.

Next steps

01 Extend the comparison to additional formulations

02 Add more ingress levels or operating conditions

03 Correlate lab findings with rig or field observations

Want to evaluate air-in-oil behavior in your formulation or additive program? Let's talk.