



Managing lubrication to deliver rotating equipment performance

A detailed close-up photograph of a metalworking process. A large, dark-colored gear is being machined by a brass-colored hob. Bright yellow coolant is being poured over the mesh between the hob and the gear. A significant amount of fine metal shavings is visible on the right side of the gear, indicating active material removal. The scene is set in an industrial environment, with various mechanical components and a hex nut visible on the left.

Managing lubrication to deliver rotating equipment performance

How innovative technologies create value-adding solutions for industrial equipment, give competitive advantages and contribute, at the same time, to a sustainable global society.



WHY IS SKF INTERESTED IN ROTATING EQUIPMENT PERFORMANCE?

The world is changing

- The world around us continues to shift
- Sustainability, digitalization, electrification, and regionalization are megatrends forming the future
- The landscape is more competitive than ever before. Actors offering digitalization, connectivity and analysis are competing with low-cost actors for customer loyalty
- To stay competitive, we must focus on understanding and driving long term customer value

WE ARE EVERYWHERE



We have something unique

- A deep understanding of almost all industrial applications
- Close customer relationships
- Recognized leader in application engineering and design
- 100+ years of hard work, innovation, and dedication, has taken us to a position of strength, a position we now set out to leverage!





Bearings and units

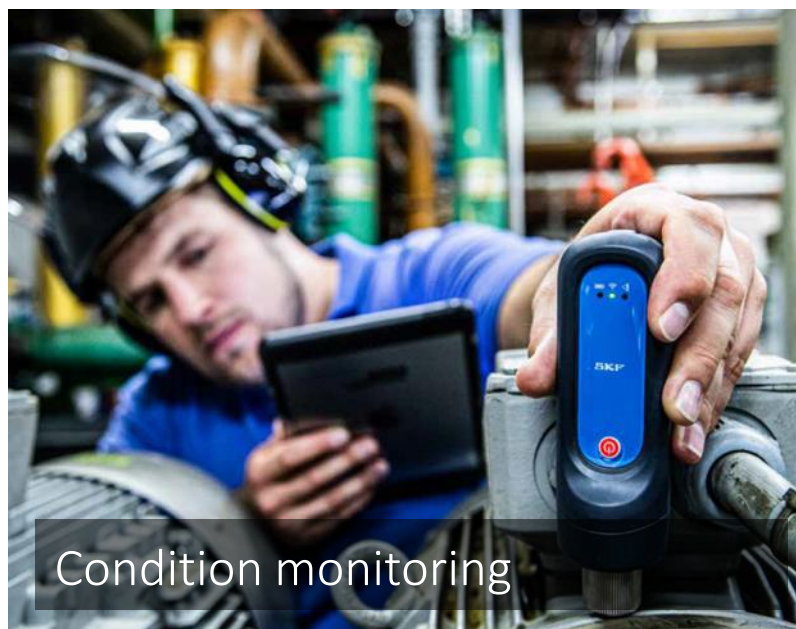


Seals

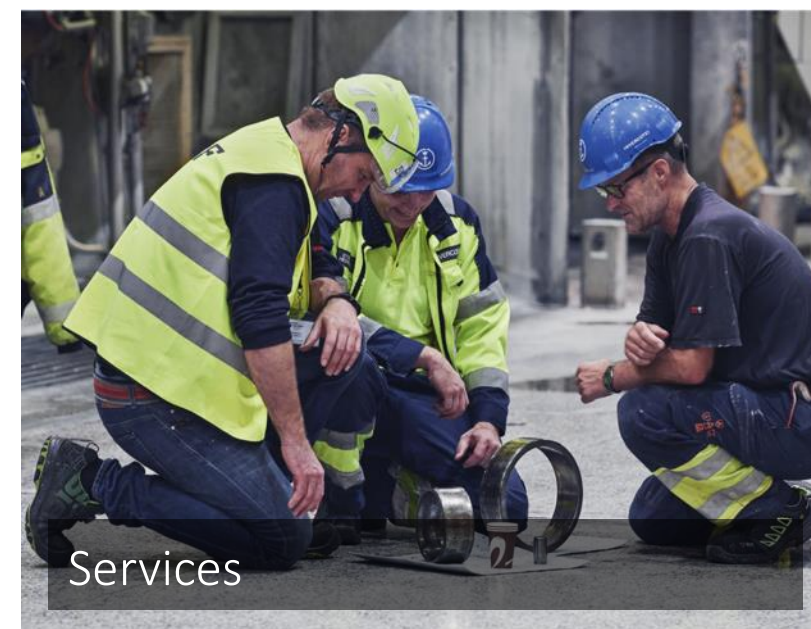


Lubrication systems

SKF's combined offering – Clean and intelligent



Condition monitoring

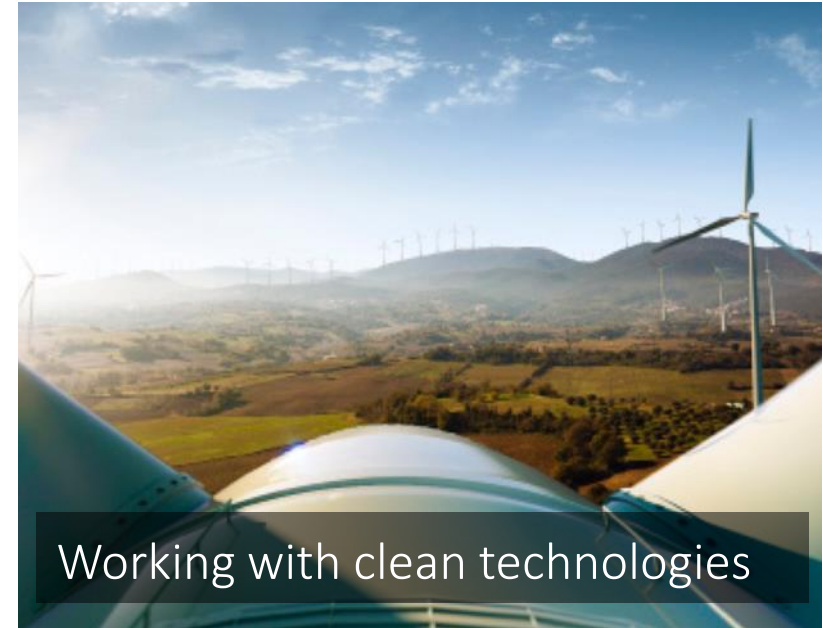


Services

How we contribute to a better environment



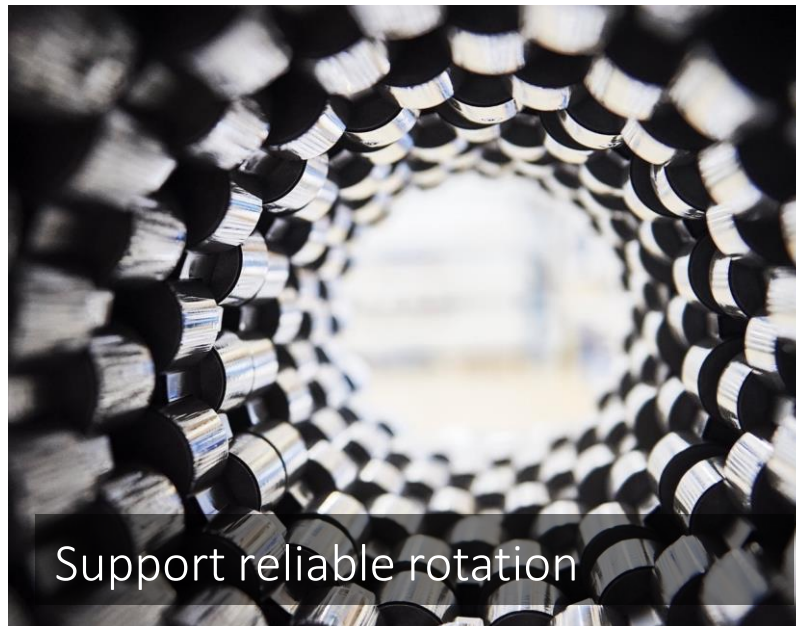
Our products reduce friction



Working with clean technologies



Carbon neutral manufacturing

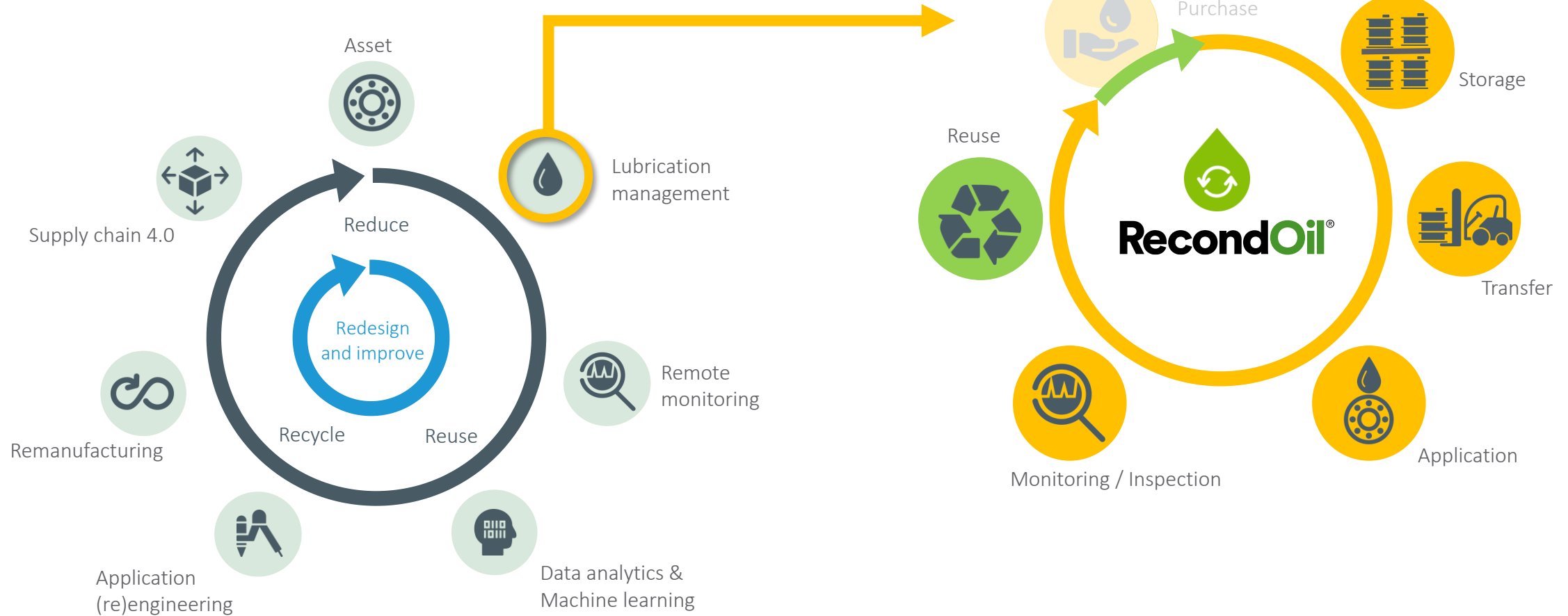


Support reliable rotation



Reduce waste & contamination

How lubrication can contribute



Our talks and speakers today



Lubrication Management – The next step in machine care

Over 50% of premature bearing failures can be attributed to lubrication. How efficient lubrication management effectively organizes resources to reduce machine failures, inefficiencies, injuries and environmental impact related to lubrication.



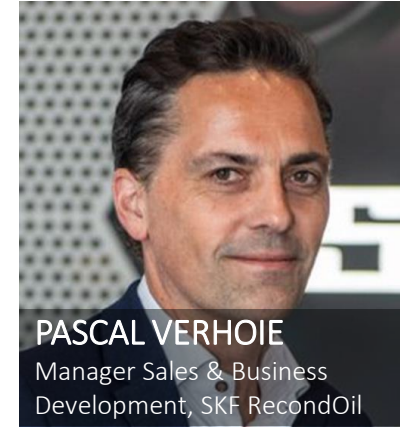
Lubrication going digital

How digitalization helps customers to get the right information about their assets and how smart technologies improve the usage of lubrication equipment and offer new services to customers.



Grease lubrication in rolling bearings

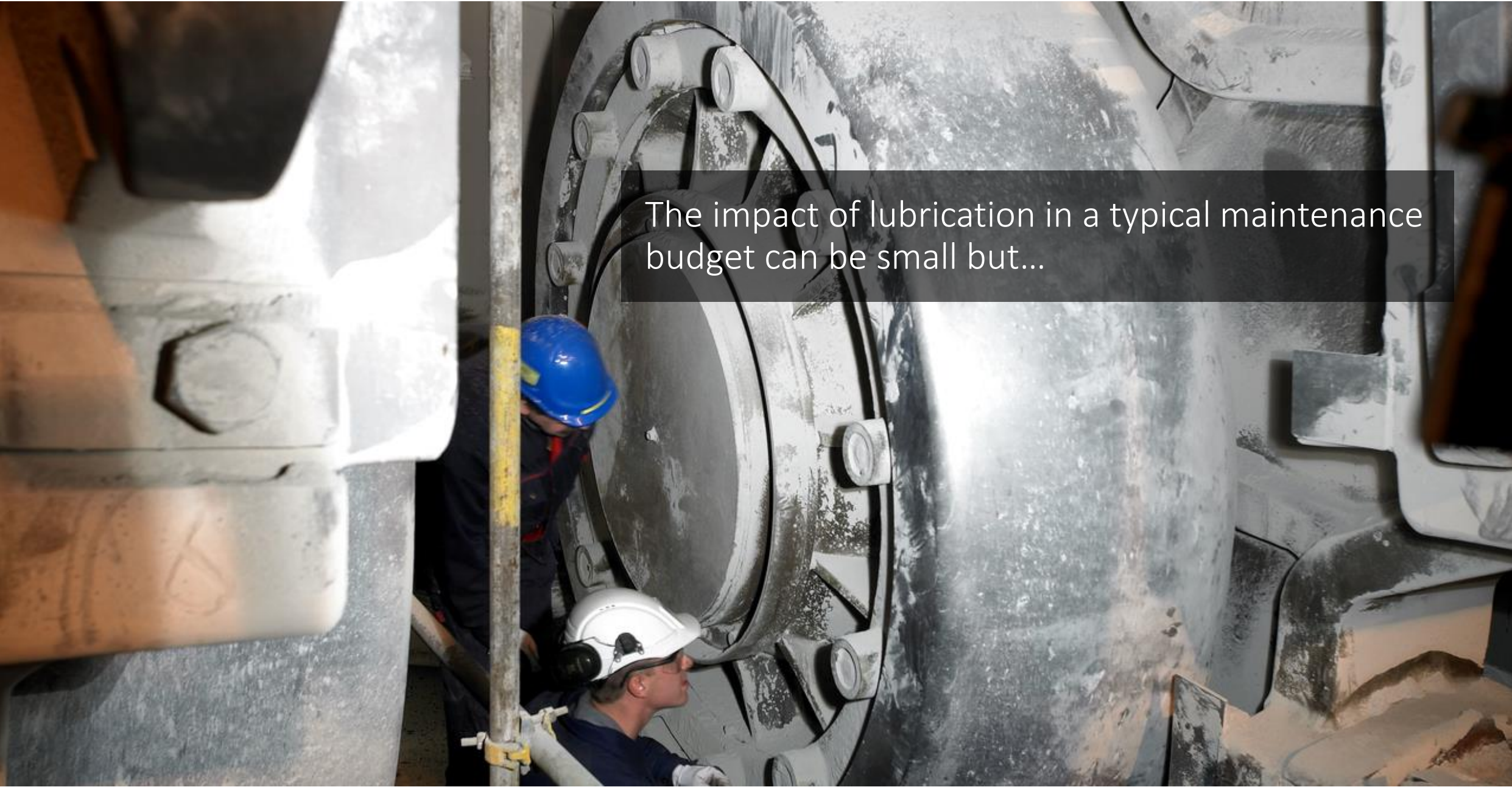
A scientific excursus



Beyond filtering – New approaches for oil cleanliness

Dirty oil is a drain on industrial productivity. For equipment that requires higher levels of oil cleanliness, in-line filtering might not be enough to achieve the necessary performance. How new technology transforms lubrication oil from a contamination problem to an ally in reliability.

LUBRICATION MANAGEMENT – THE NEXT STEP IN MACHINE CARE

A photograph of two industrial workers in a maintenance setting. One worker, wearing a blue hard hat and dark clothing, is partially visible on the left. The other worker, wearing a white hard hat and a dark jacket, is in the foreground, looking up at a large, circular, metallic component of a machine. The machine has several bolts and a flange. The background shows more of the industrial structure, including pipes and other components. A semi-transparent dark box with white text is overlaid on the right side of the image.

The impact of lubrication in a typical maintenance budget can be small but...

The importance of lubrication

2%

Cost of lubricants in
the maintenance
budget

Lubricants
1-3%

40%

Maintenance costs
influenced by
lubrication activities

Intervention
40%

Components
40%

Misc. materials
12-14%

Labour
30%

Overtime labour
15%

Total
maintenance
budget

Category	Percentage
Labour	30%
Components	40%
Overtime labour	15%
Misc. materials	12-14%
Lubricants	1-3%

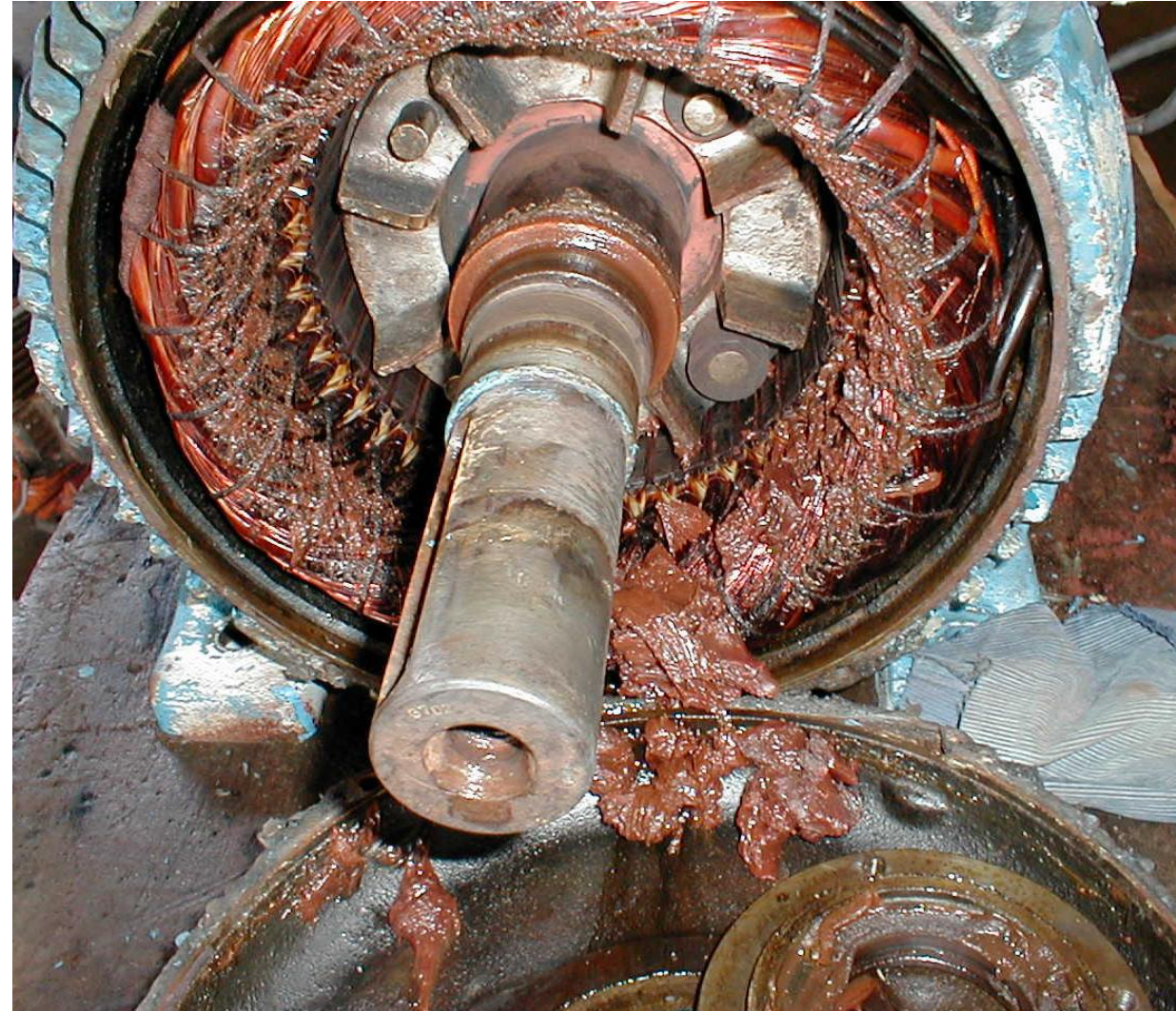
And the importance of lubrication



- Production losses
- Spare part and repair costs
- Intervention time
- Health and safety risks

50%

of premature bearing failure
is caused by poor lubrication
and contamination



The importance of lubrication

2%

Cost of lubricants in
the maintenance
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40%

Maintenance costs
influenced by
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50%

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and contamination

Lubrication has a direct and profound impact on key performance indicators

✓ Production

- Output
- Quality
- Losses

✓ Cost

- Components
- Labor
- Contracts

✓ Compliance

- Health & safety
- Environment
- Product

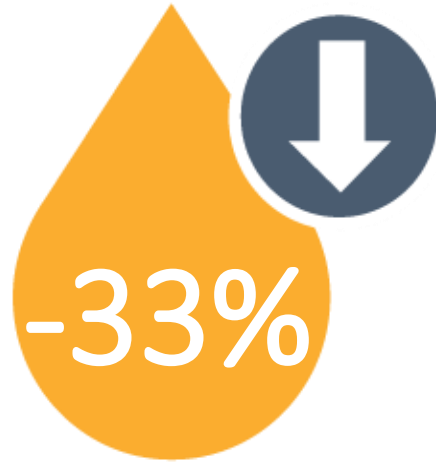
And in some industries...

70%

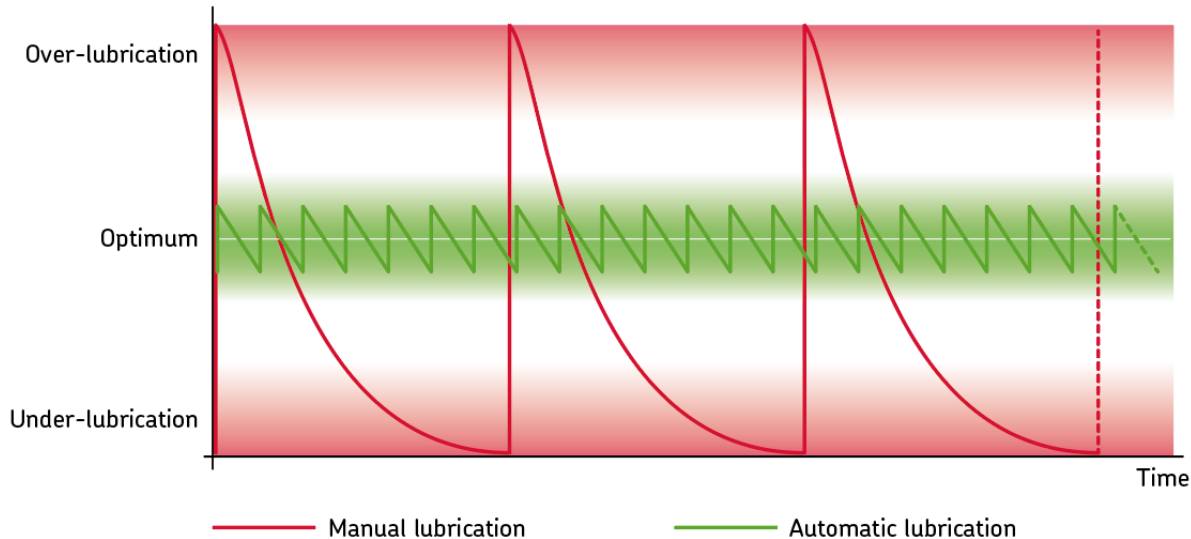
...of lubrication points are still manually lubricated!

Sustainability and business impact

Automated lubrication
uses 33% less grease than
manual lubrication

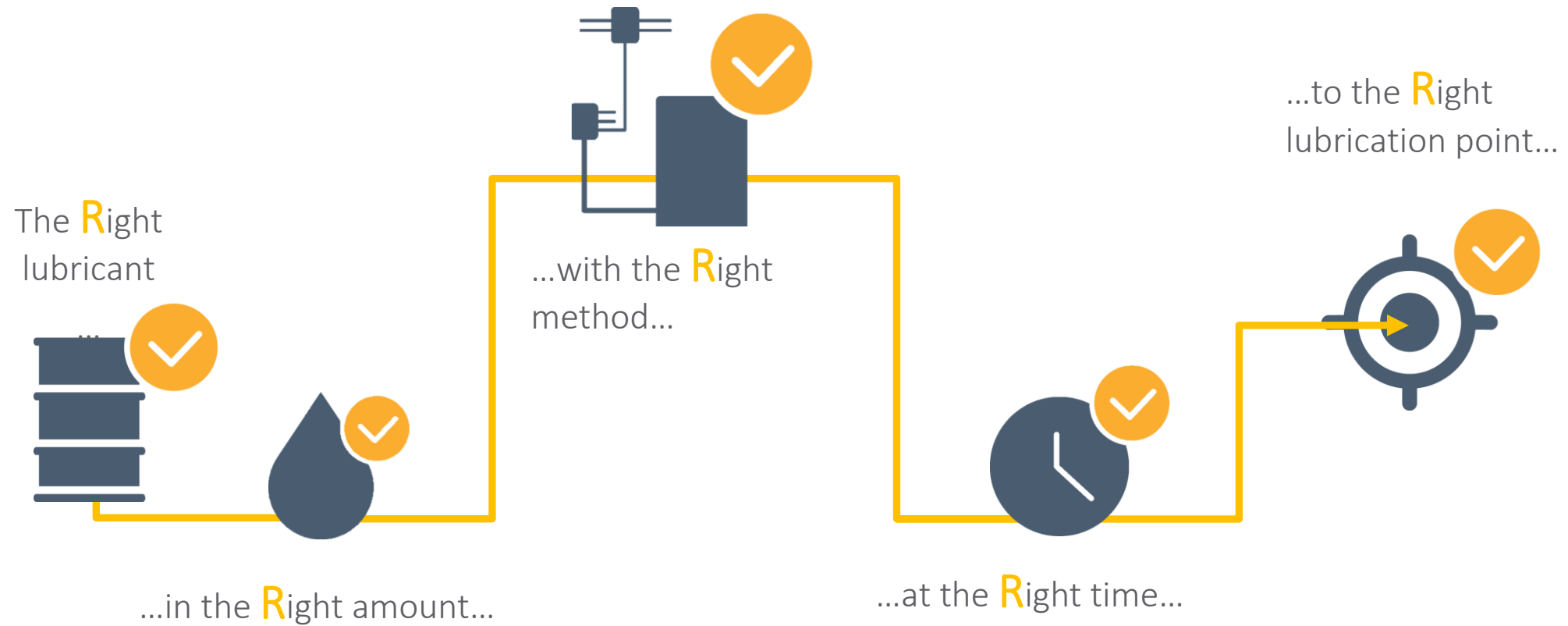


Automated lubrication globally
saves roughly 200 million kg of
grease per annum



→ Potential savings:
over 300,000 tonnes CO₂eq

How to ensure lubrication reliability?





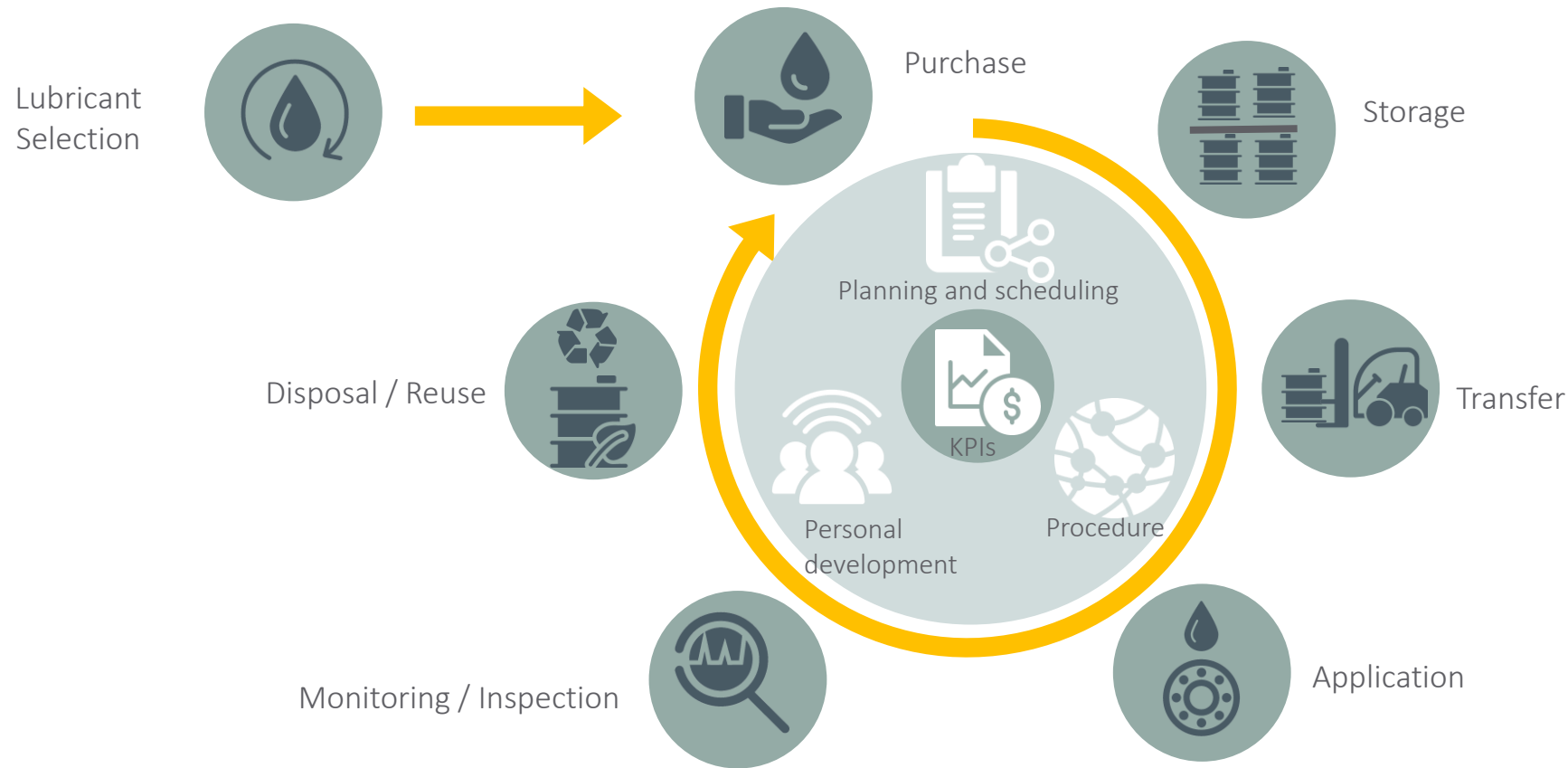
Right time
Right location
Right lubricant
Right amount
Right method

**5x R's for the
right lubrication**



- Correct lubrication can already be difficult for individual points.
- The challenge is to do it right for all points.

The lubricant life cycle to enable rotating equipment performance



- Correct lubrication can already be difficult for individual points.
- The challenge is to do it right for all points.
- To **effectively and efficiently** manage the lubrication of a factory, we will start with the lubricant during its life cycle.
- ... and have an eye on processes, skills and priorities

Salt pellet press needs help to solve lubrication troubles

Lubrication problem

- Grease is not food compatible
- Leakage causes monthly production stops
- High efforts to clean production
- Loss of production due to contamination

Customer value

- ✓ F&B compliance
- ✓ No more contamination of the product
- ✓ No production stops and cleaning efforts
- ✓ High equipment reliability



The right lubricant for the application



The right method, timing and quantity



Grease and condition monitoring for reliability



Sealing to protect against contamination ingress



New bearing and installation service

Automotive Paint Shop

15 years
chain life

-60%
consumption

↑ Reliability
↑ Quality

CUSTOMER



16.000 lubrication points



4 chains



2 pendulum conveyors

BENEFITS



2000 kg/yr to 750 kg/yr



Cost reduced by > 30.000 €/yr



Longer chain inspection interval



Increased chain life



Higher reliability & quality

LUBRICATION GOING DIGITAL

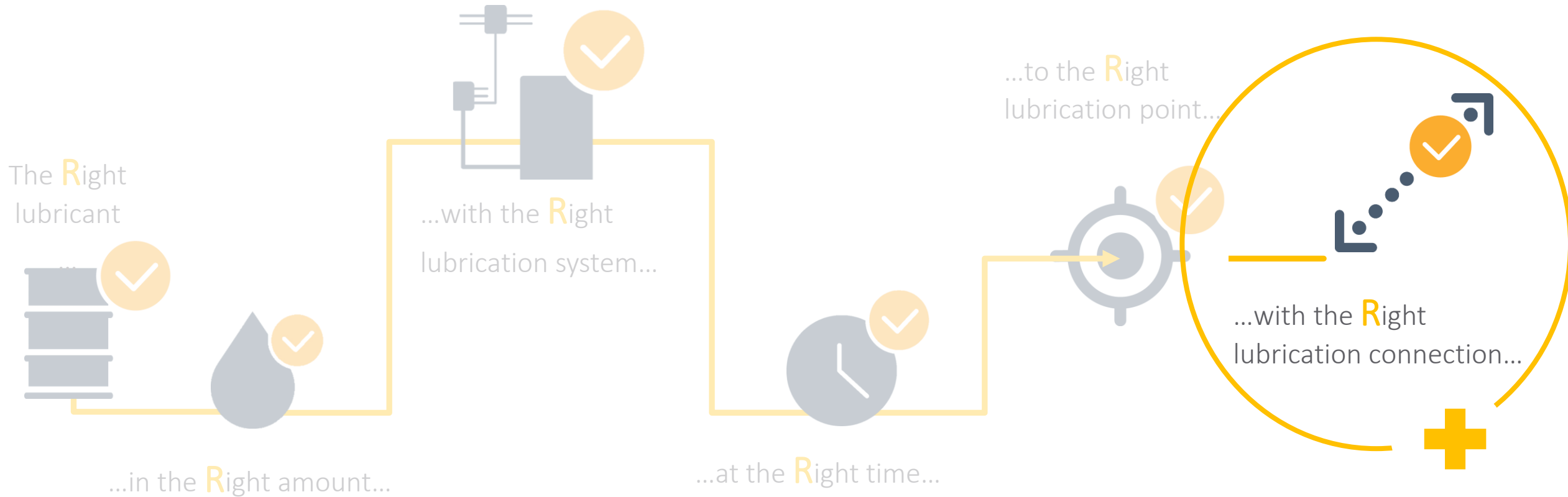


CONNECTIVITY



DIGITALIZATION

Just doing it right is not enough...



What is the right steps to enable digitalization?



...with the **R**ight
lubrication connection...



The right lubrication



Lubrication overview



Remote monitoring & control



Insights and optimization



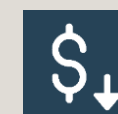
Fact based decision making



Better environmental impact



Easy and efficient lubrication



Cost reduction



Customer case Food & Beverage



Client needs analysis



Design the lubrication charts



Automatic lubrication system



Connected single point lubr.



Integrated lubrication management software



More efficient lubrication



Service life increase



Lubricant consumption reduction

FEE
BASED

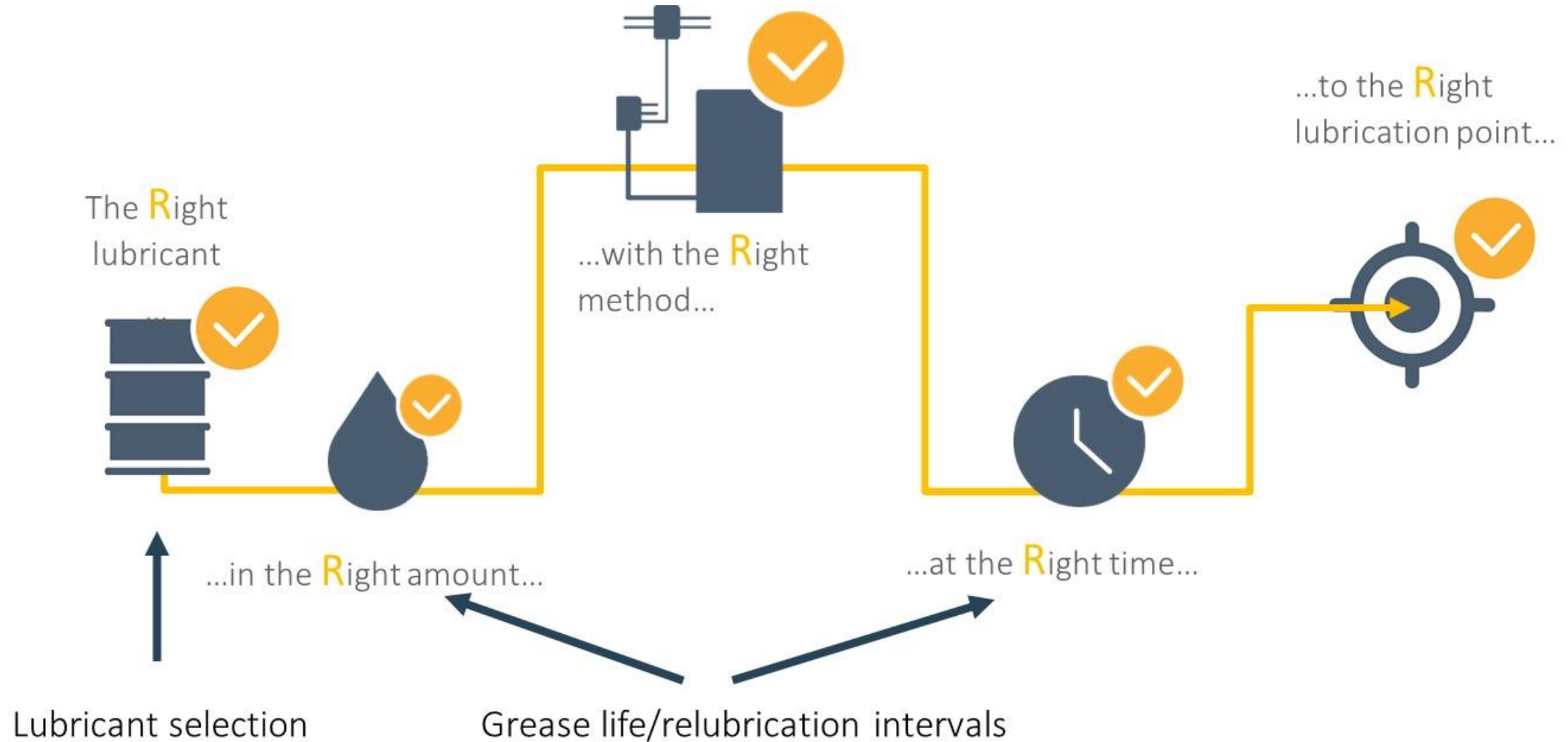


Digitalization helps us to ...

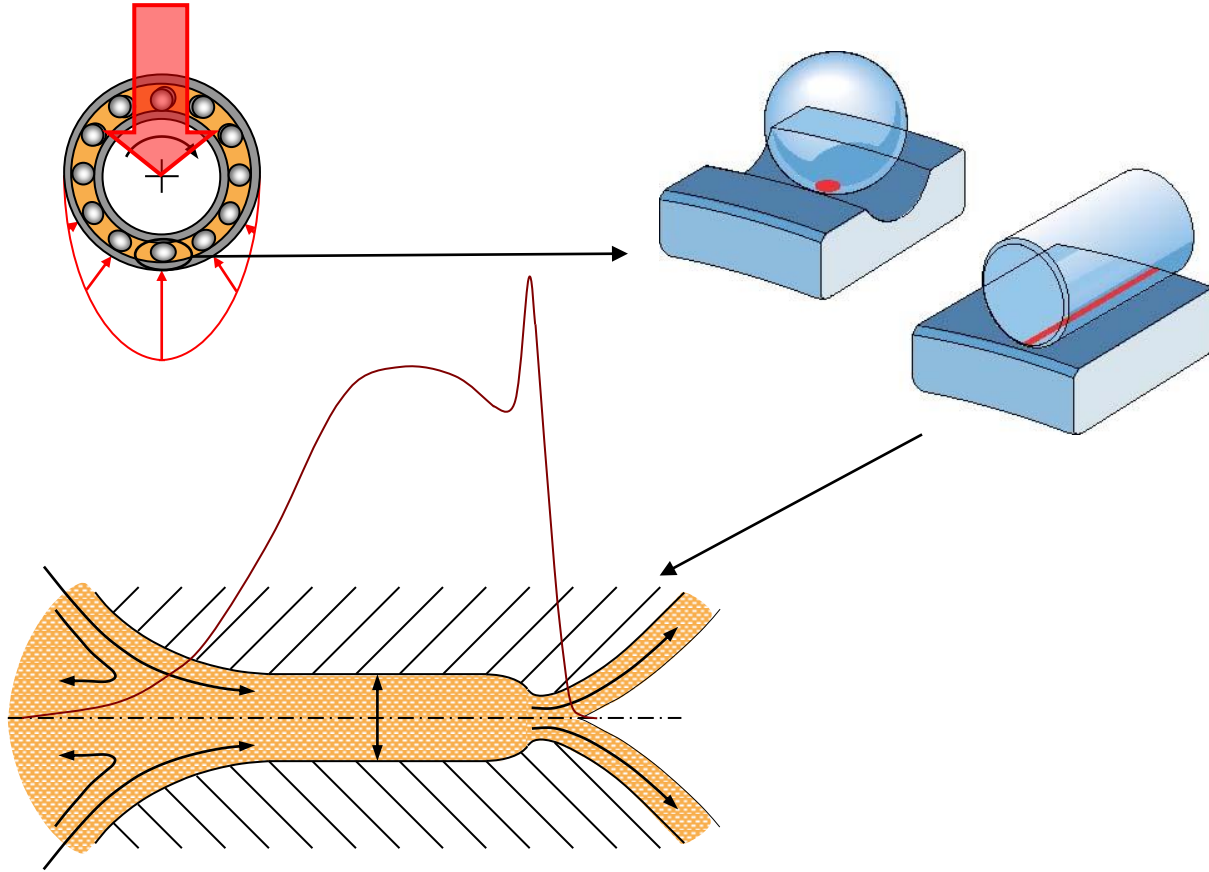
- + achieve the right lubrication
- + make lubrication easy & efficient
- + reduce environmental impact
- + reduce costs
- + enable a new way of doing business

GREASE LUBRICATION IN ROLLING BEARINGS

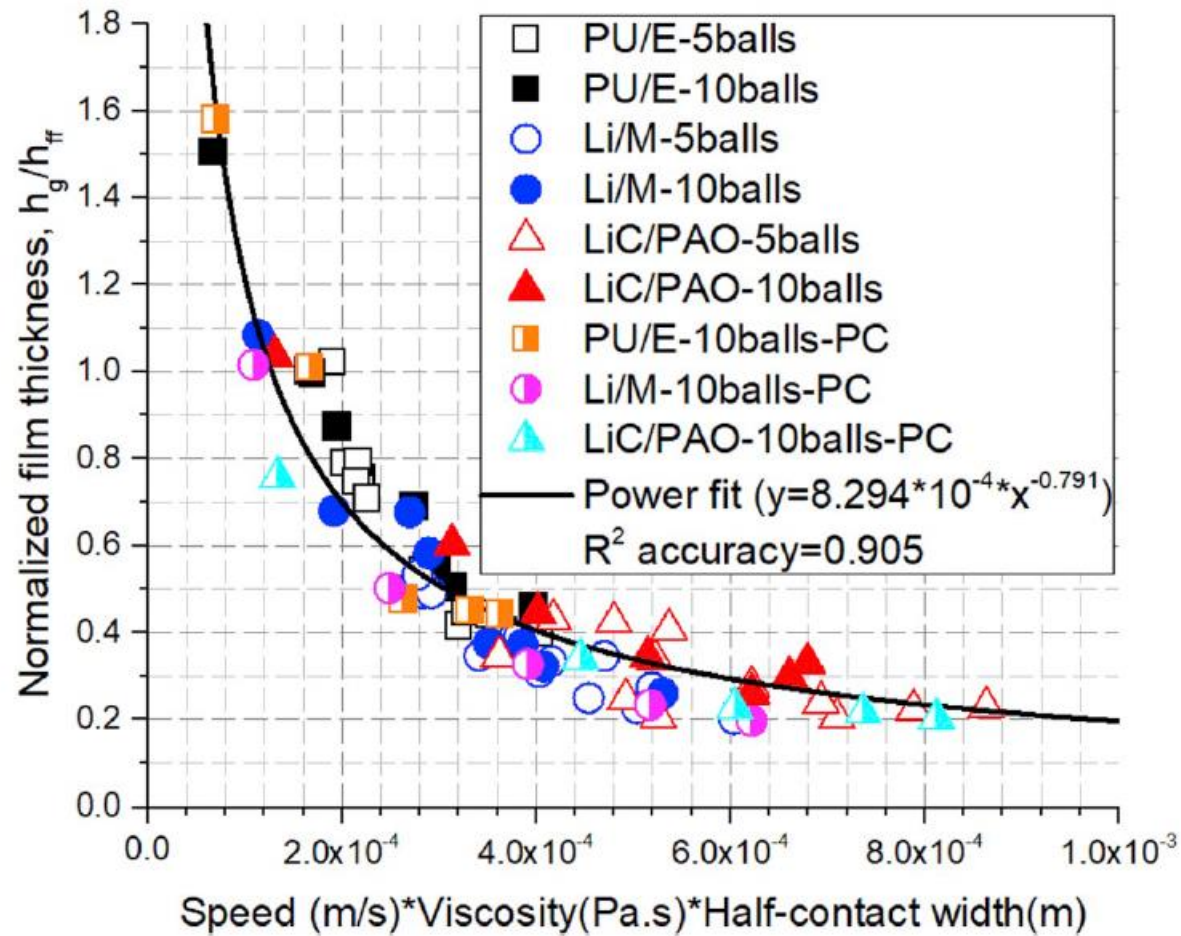
How to ensure lubrication reliability?



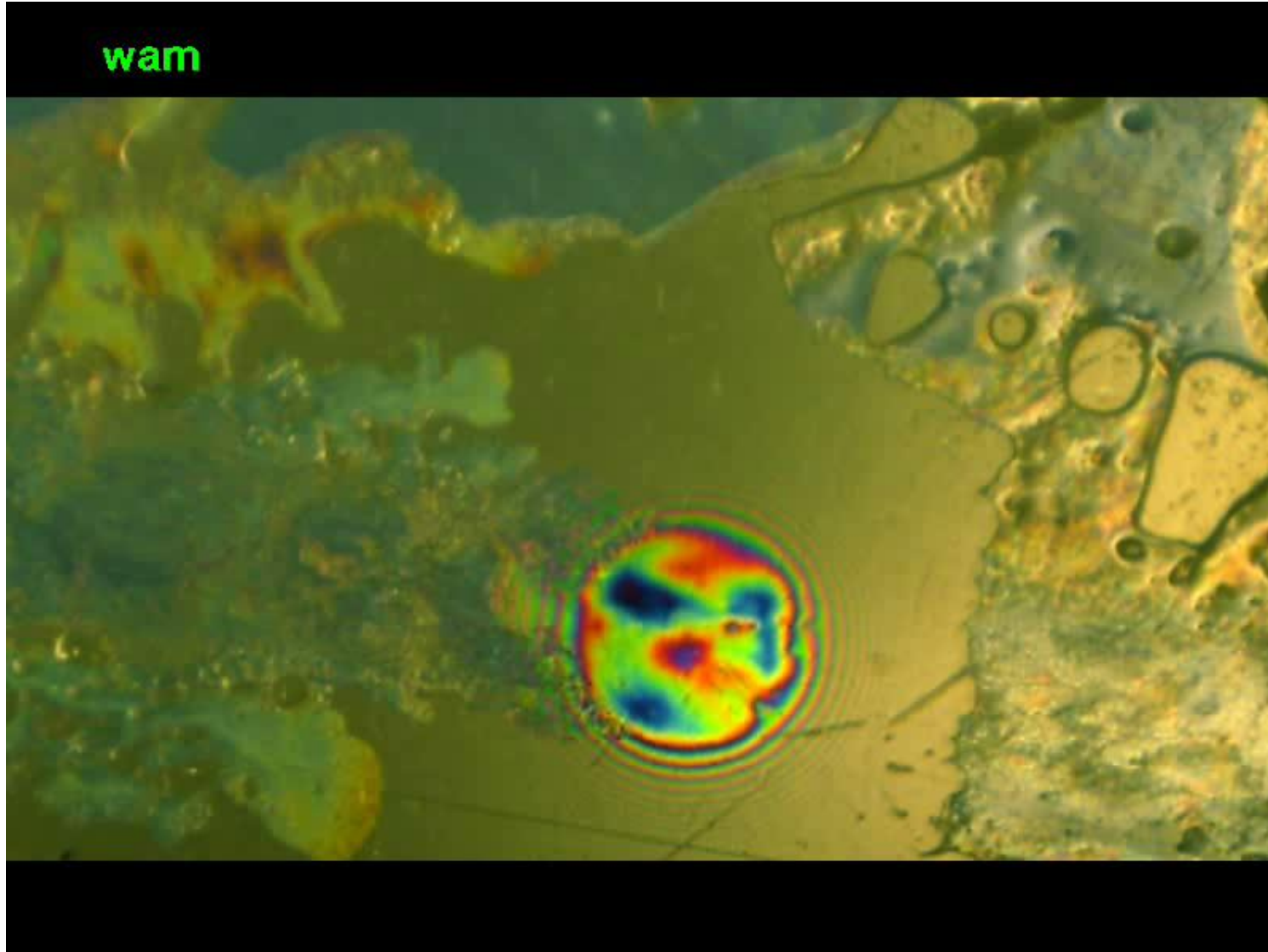
Main task of a grease is to provide a thick enough lubricant film:
Elasto-Hydrodynamic Lubrication



Film thickness is smaller than “oil film thickness”: starvation

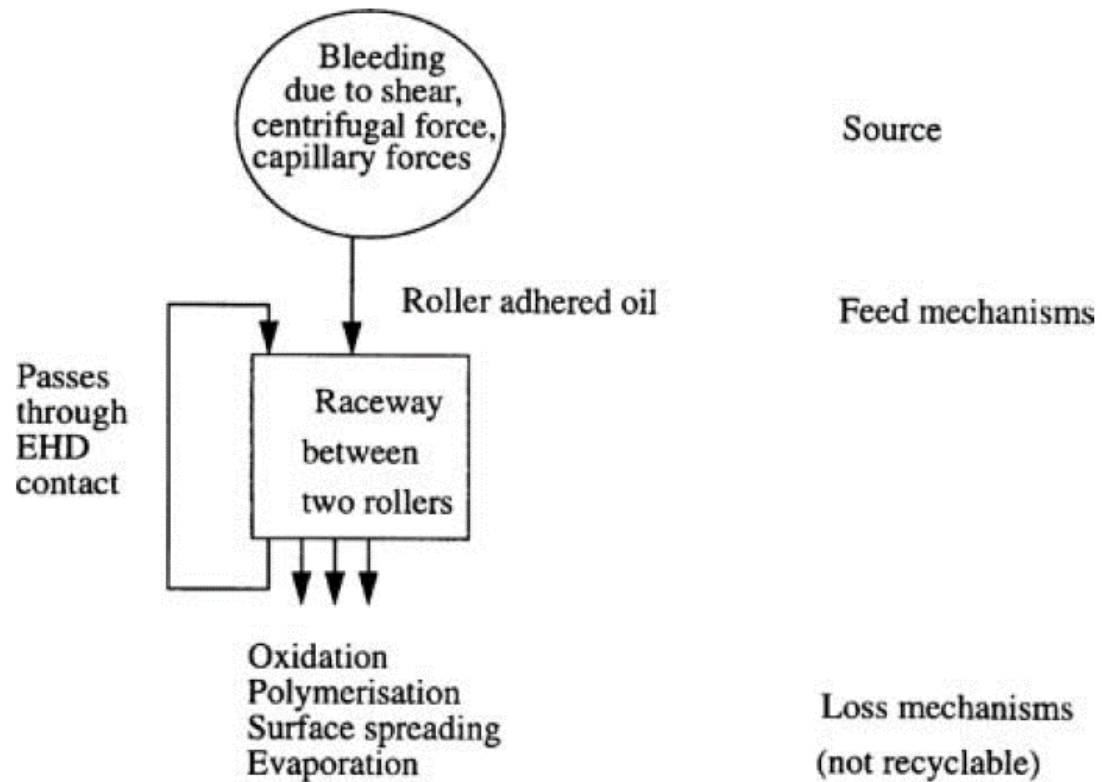


Low Speeds



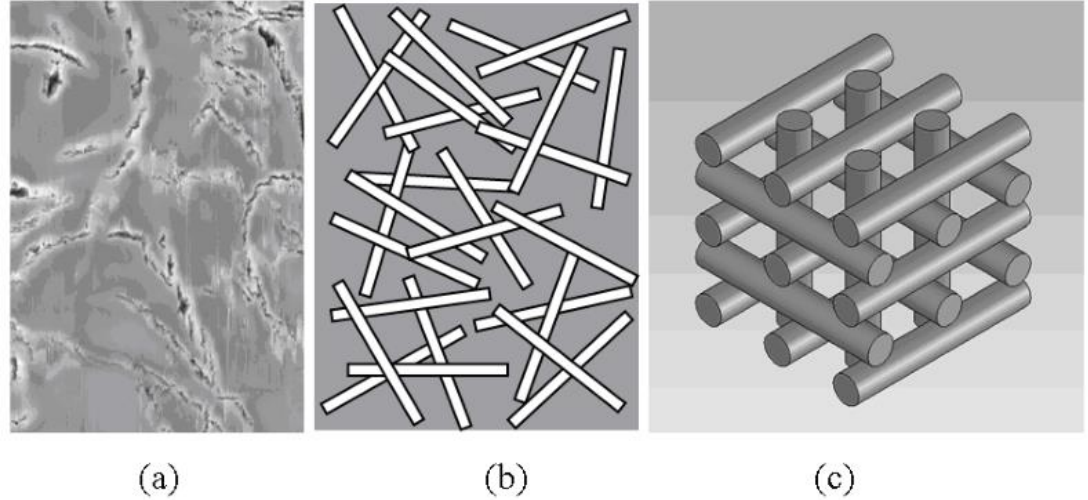
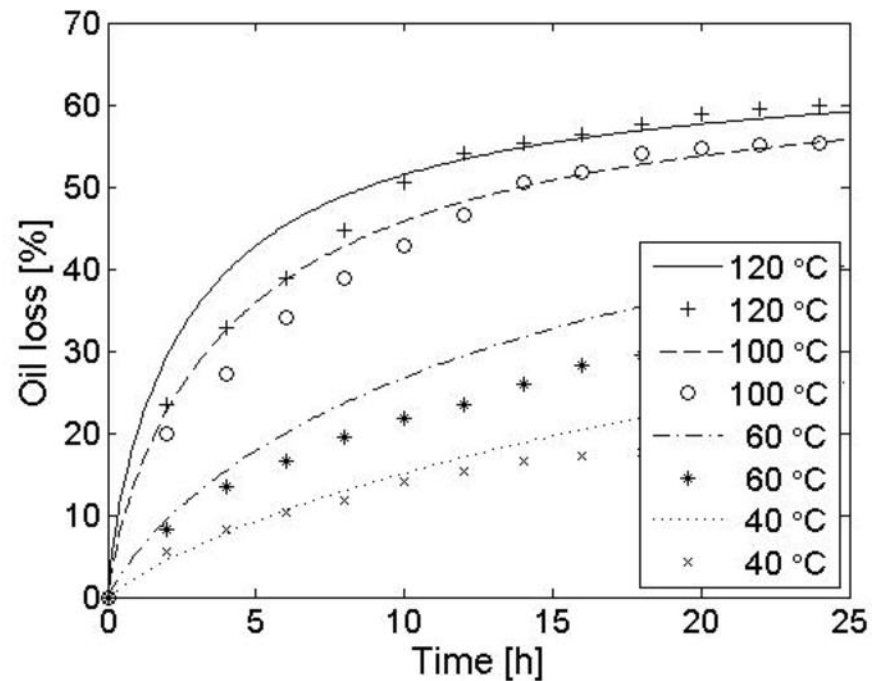
Thickener material travelling through the contact.

The mass-balance determining film thickness



Feed-mechanisms: grease bleed

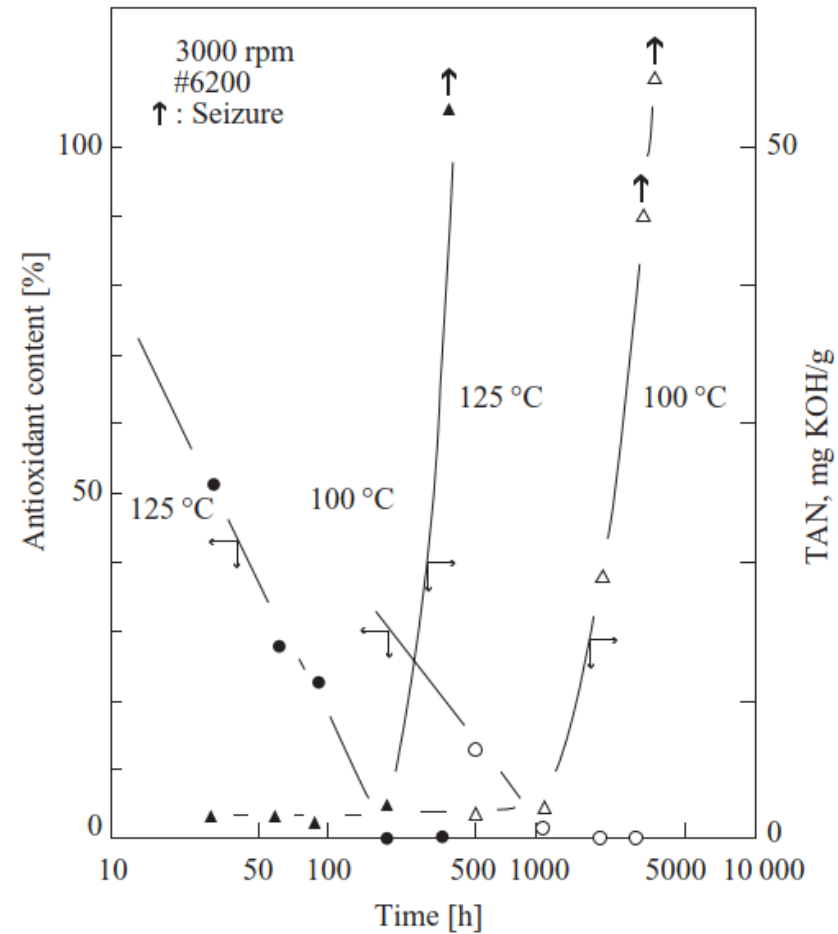
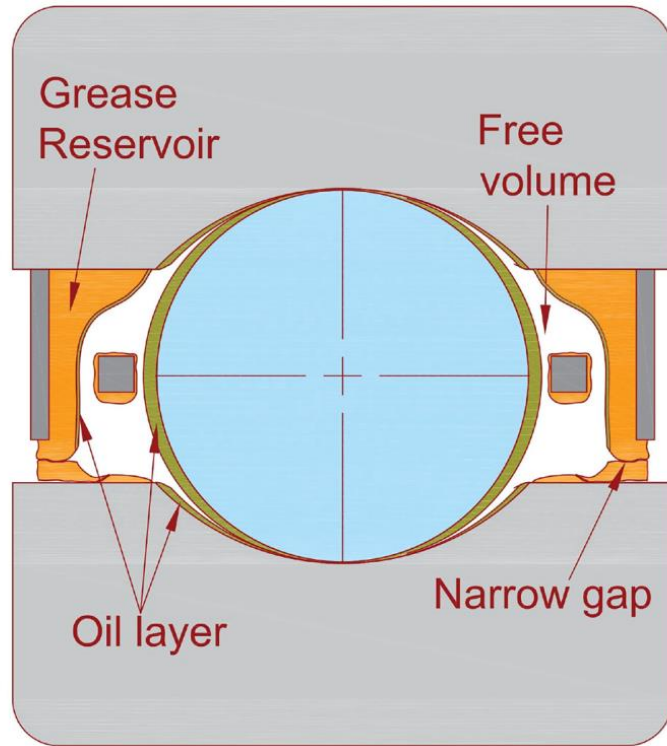
Grease = porous medium
filled with oil



P. Baart, B. Van der Vorst, P.M. Lugt, and R.A.J. Ostayen. Oil bleeding model for lubricating grease based on viscous flow through a porous microstructure. *Tribology Transactions*, 53(3):340–348, 2010.

Q. Zhang, F. Mugele, P. M. Lugt, and D. van den Ende. Characterizing the fluid–matrix affinity in an organogel from the growth dynamics of oil stains on blotting paper. *Soft Matter*, 16(17):4200–4209, 2020.

Loss mechanisms: oxidation and evaporation

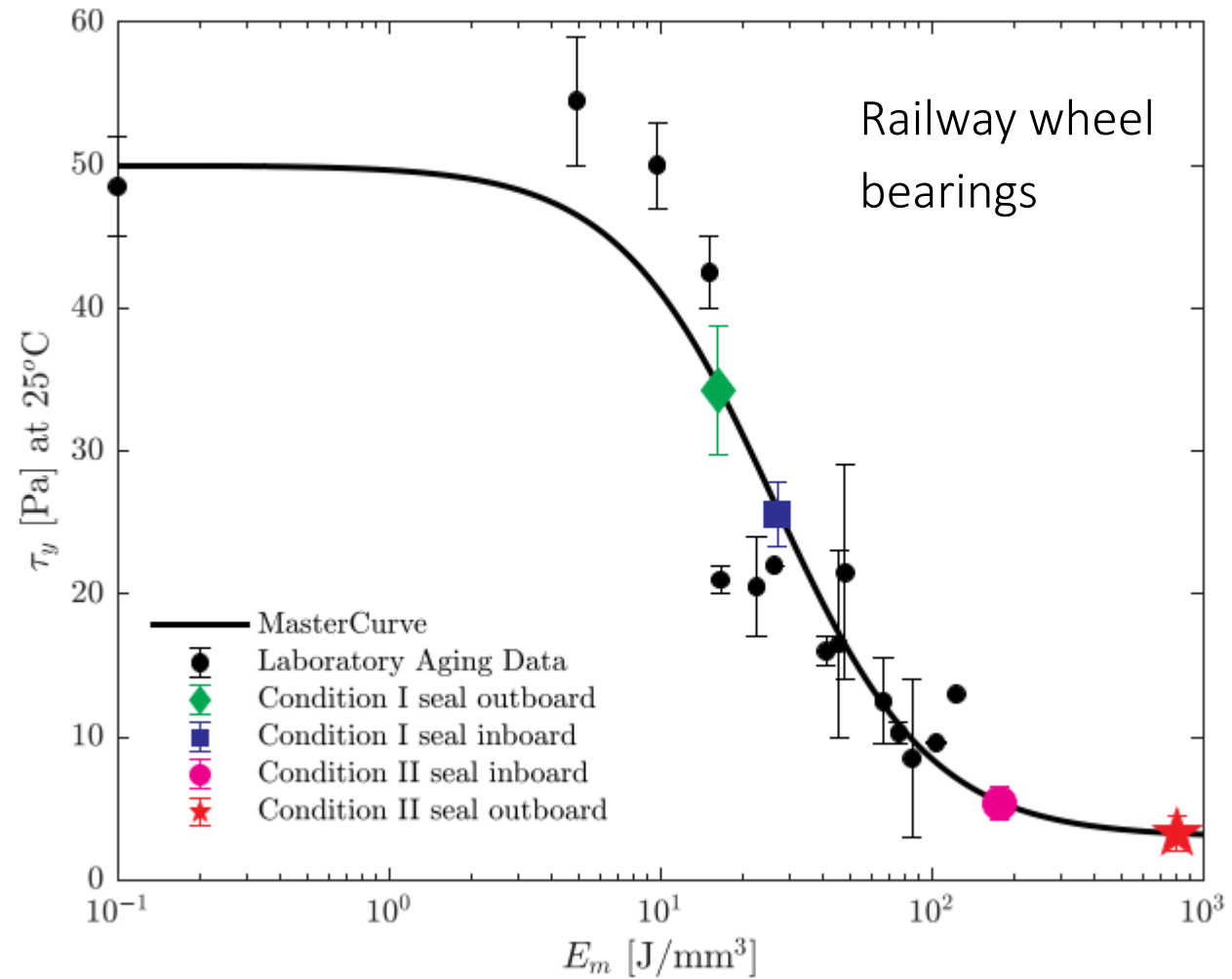


H. Ito, M. Tomaru, and T. Suzuki. Physical and chemical aspects of grease deterioration in sealed ball bearings. *Lubrication Engineering*, 44(10):872–879, 1988.

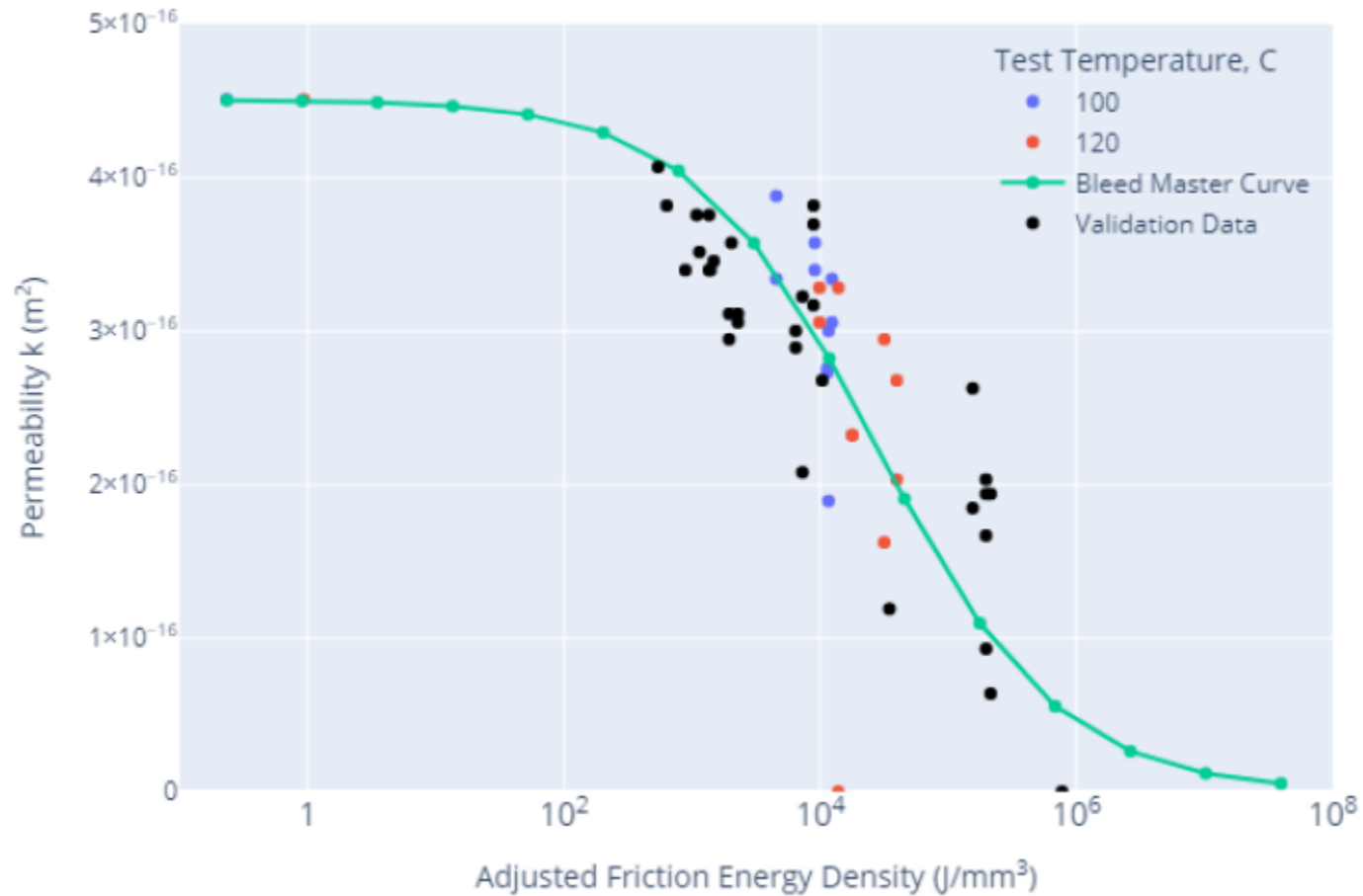
L.A. Smook, S. Chatra K R., and P. M. Lugt. Evaluating the oxidation properties of lubricants via non-isothermal thermogravimetric analysis: estimating induction times and oxidation stability. *Tribology International*, 171:107569, 2022.

P. Shetty, R.J. Meijer, and P. M. Lugt. An evaporation model for base oil from grease lubricated rolling bearings including breathing. *Tribology Transactions*, 64(5):891–902, 2021.

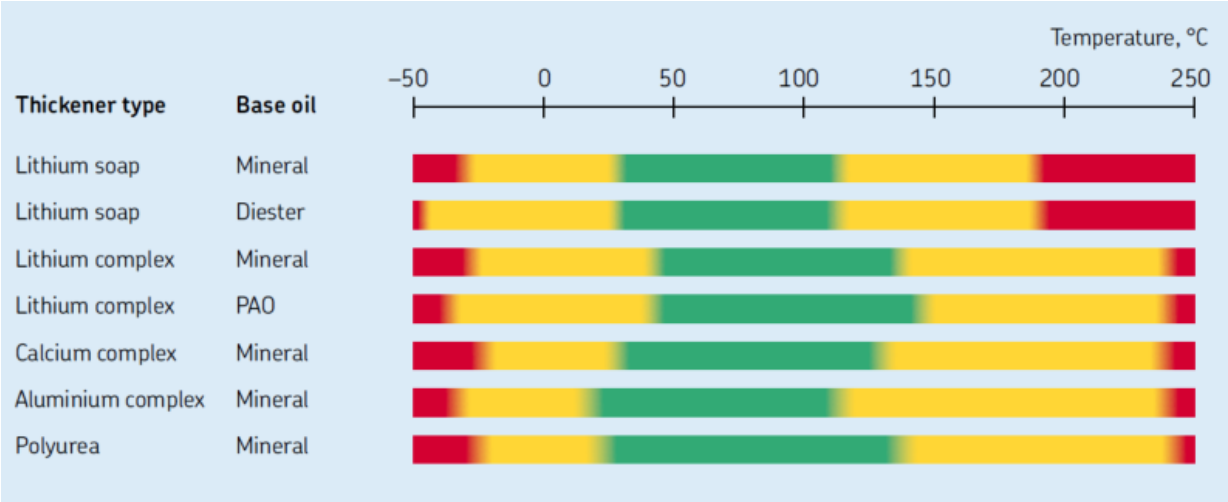
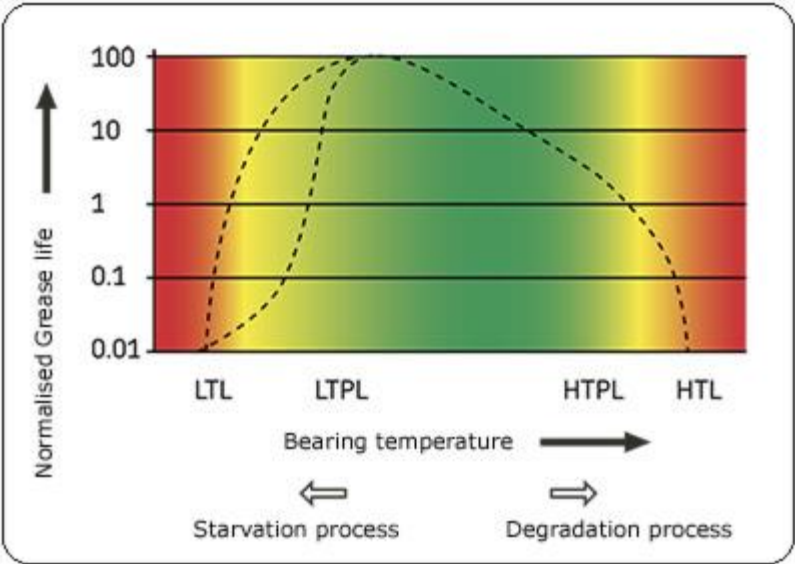
Mechanical degradation: evolution of consistency



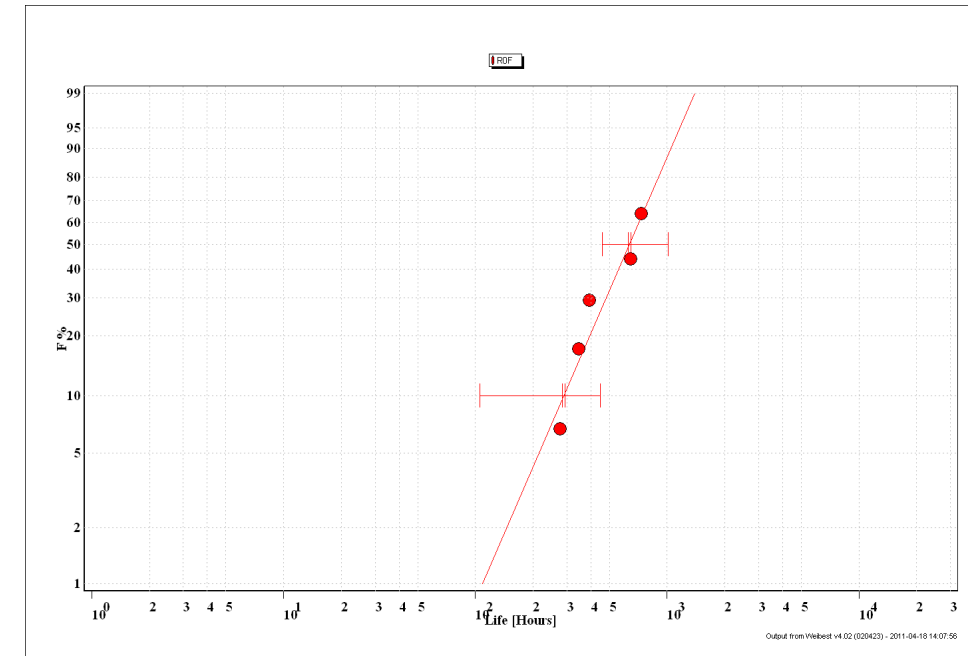
Mechanical degradation: evolution of bleed



Theory and practice comes together in the traffic light concept and grease life models



Grease life testing: R0F+ test methodology

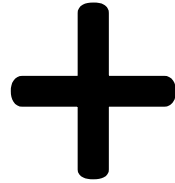


Science helps us to deliver customer value

Testing

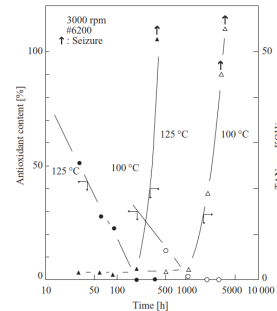


Extrapolation from testing alone cannot deliver resilient predictions for all situations.

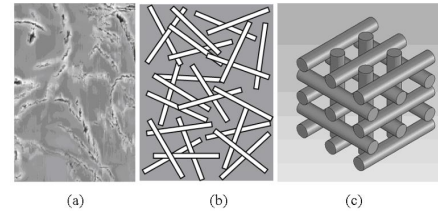


Models

Chemistry



Physics



Scientific understanding of bearing lubrication allows us to create models.

Value



Understanding of the lubrication process and validation by testing allows for the best possible prediction and optimisation of lubrication. For example, where testing is not possible or cost-effective.

Relubrication “correction factors”

- **Vertical shaft:** double intervals
- **Vibrations:** reduce relubrication intervals
- **Outer ring rotation:** use cage speed
- **Contamination:** reduce intervals;
- **Very heavy loads:** reduce intervals
- **Large bearings:** shorter initial relubrication intervals

Grease selection: LubeSelect

You can benefit from our
expertise for free !

SKF | SKF Lube Select For SKF Greases

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Application conditions

[Start](#)
[Application conditions](#)
[Results](#)
[Details](#)

[Feedback](#)

Fields marked with * are mandatory
[Help on conditions](#)
[Other languages](#)

Select on application conditions

Dimensions:

Bearing designation

or

Bearing type

Inner diameter d mm*

Outer diameter D mm*

Bearing width/height mm

Bearing Series (Only spherical roller bearings)

Load ratio $F_a / F_{r1} > e$ (Only spherical roller bearings)
☒ No ☐ Yes

Bearing Arrangement (Only cylindrical roller bearings)

Outer ring temperature:

Typical temperature °C*

Minimum temperature (start-up) °C

Maximum temperature (peak) °C

Rotational speed RPM*

Filling Type
SKF Lube Select For SKF Greases concerns SKF greases only.

Load (C/P)*
☐ Low (>15)
☐ Medium (8-15)
☐ High (4-8)
☐ Very high (<4)

Shock load*
☒ No ☐ Yes

Ambient Temperature*
☐ Less than -10°C
☐ Between -10 and 35°C
☐ More than 35°C

Optional conditions:

Fields marked with + are used for grease/oil advice (others for grease only)

Vertical shaft ☒ No ☐ Yes

Oscillating movements ☒ No ☐ Yes

Outer ring rotation ☒ No ☐ Yes

not relevant

relevant

important

very important

Central lubrication system ☒

High rust protection ☒

Water resistance ☒

Low noise ☒

Frequent startup/shutdown+ ☒

Heavily vibrating installation ☒

Very low friction ☒

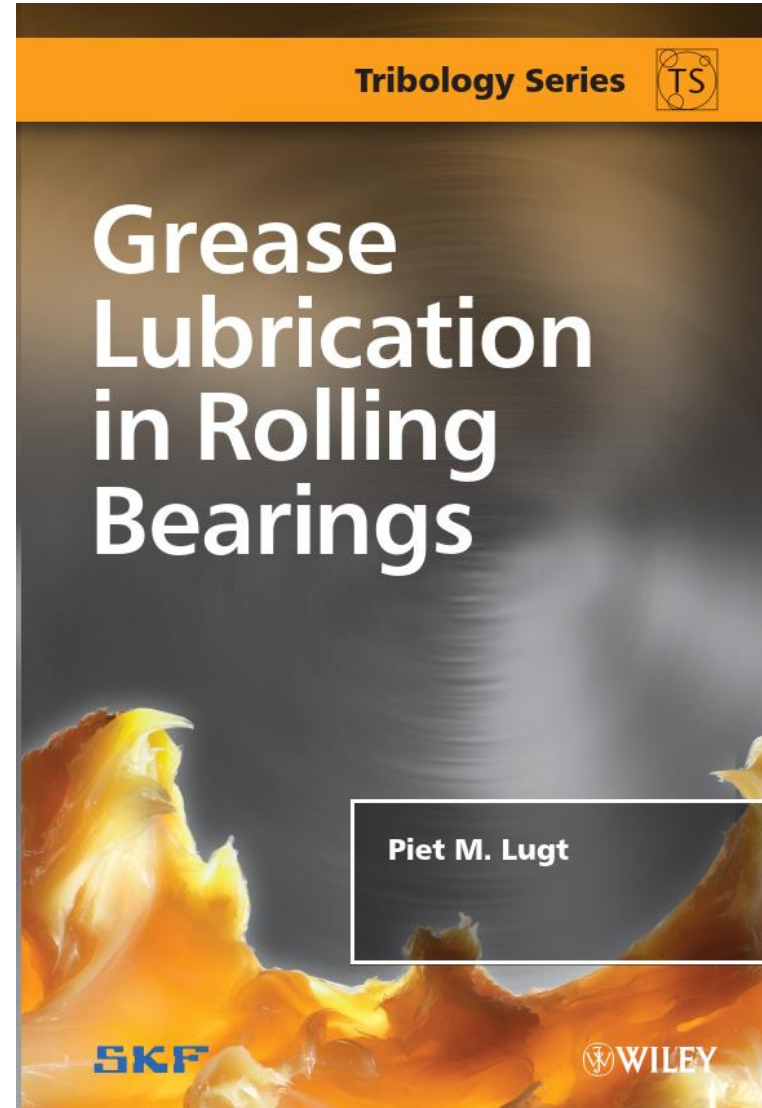
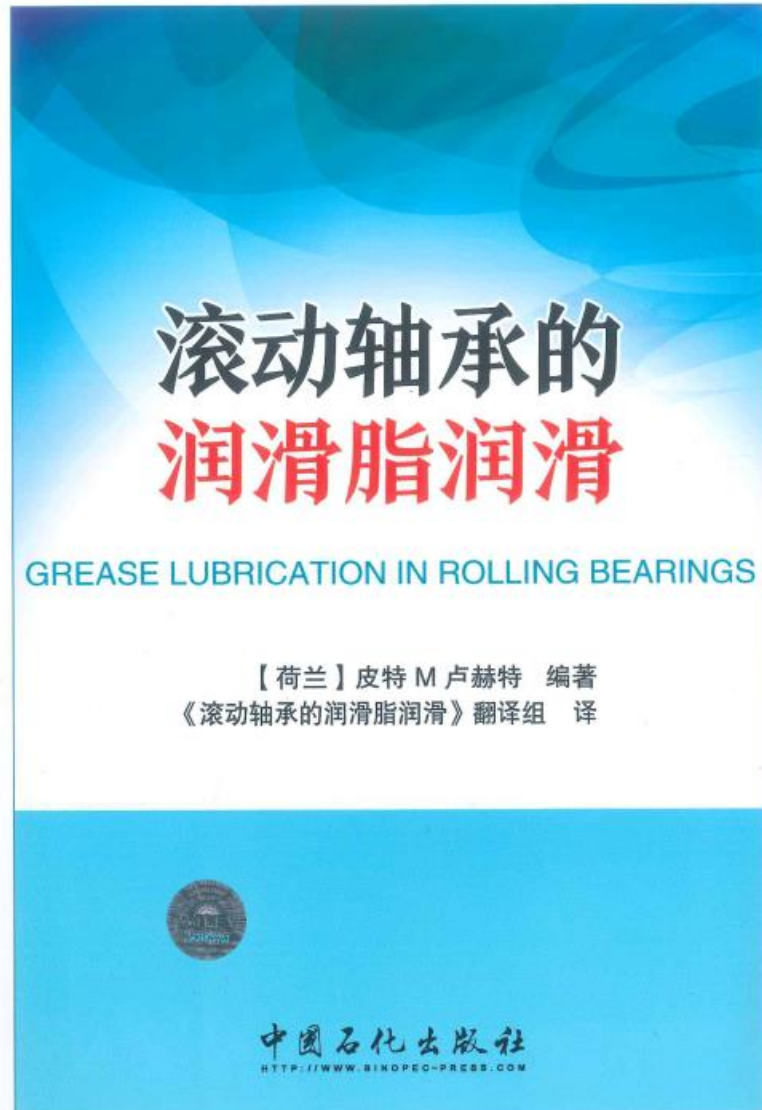
Very long grease life ☒

Food grade ☒

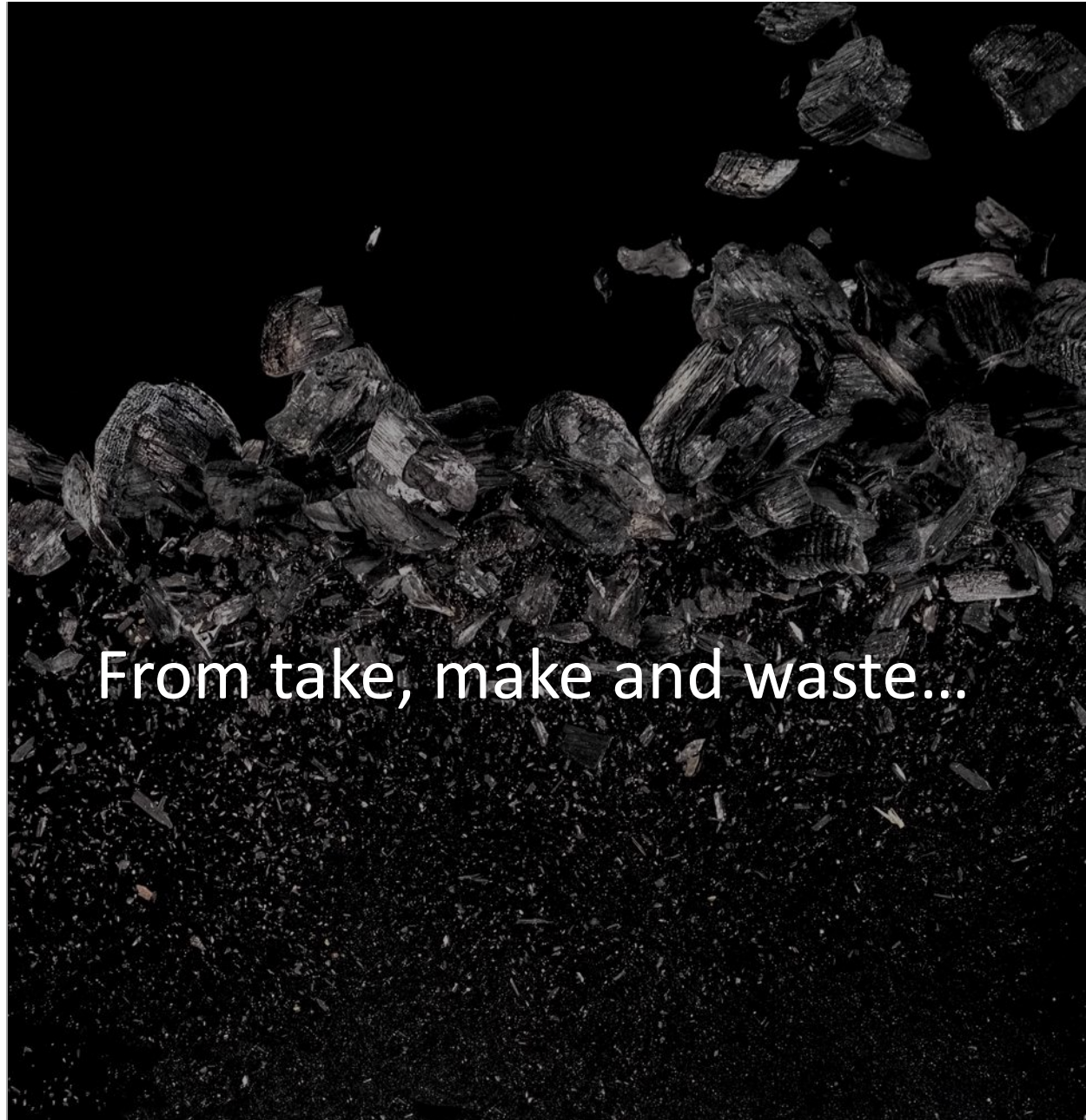
Biodegradability ☒

Radiation resistance ☒

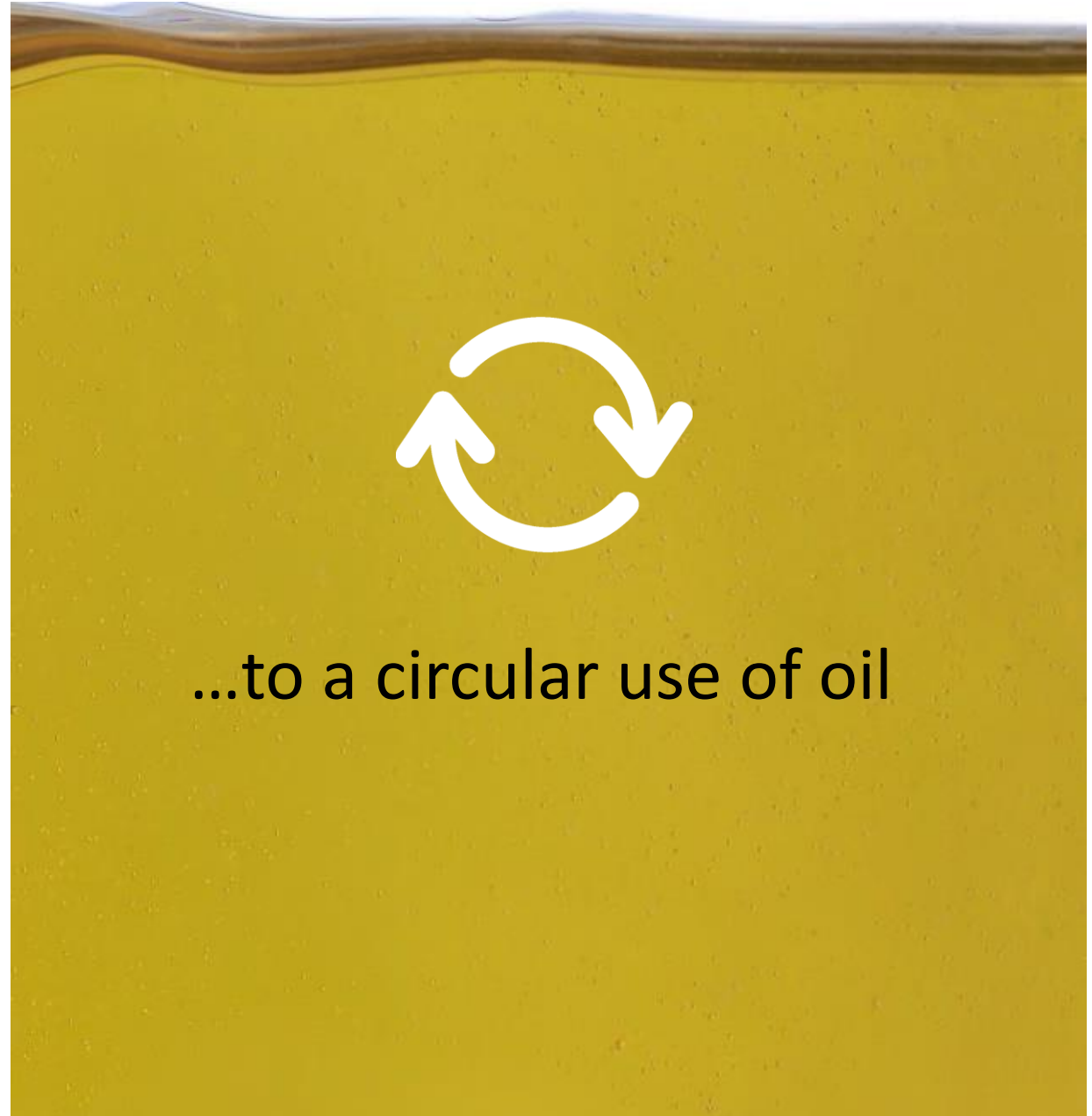
Details can be found in:



BEYOND FILTERING – NEW APPROACHES FOR OIL CLEANLINESS

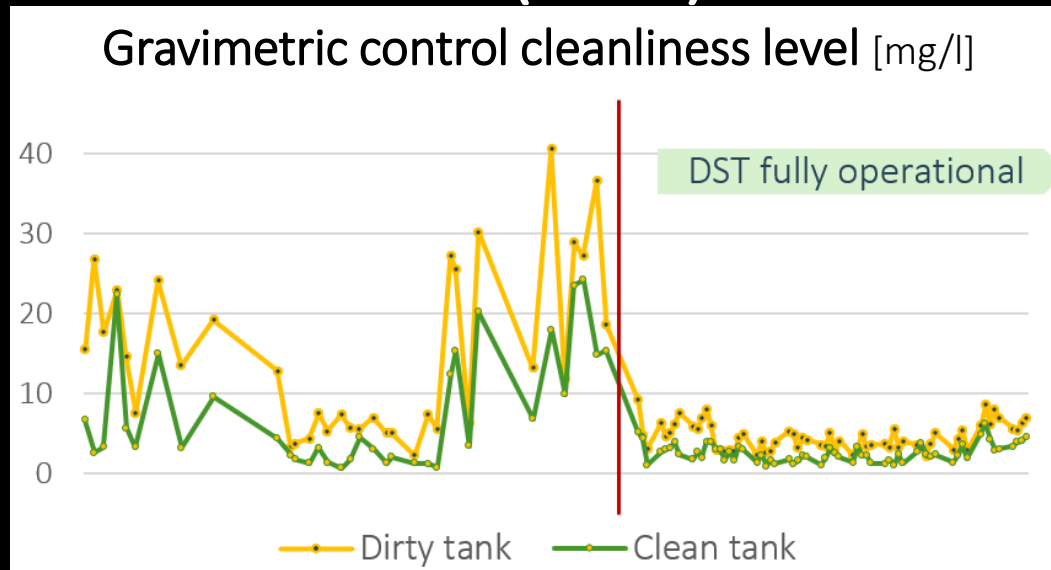


From take, make and waste...



...to a circular use of oil

Results Airasca (HBU)



Average Ra*

Down

20%

→ impacting
bearing life,
friction etc.

*Ra = Surface Roughness

10%

Reduction of
N&V*

*N&V = Noise & Vibration

38%

Roundness
increase

SKF Automotive factory – Airasca, Italy



....In addition:

Less scrap

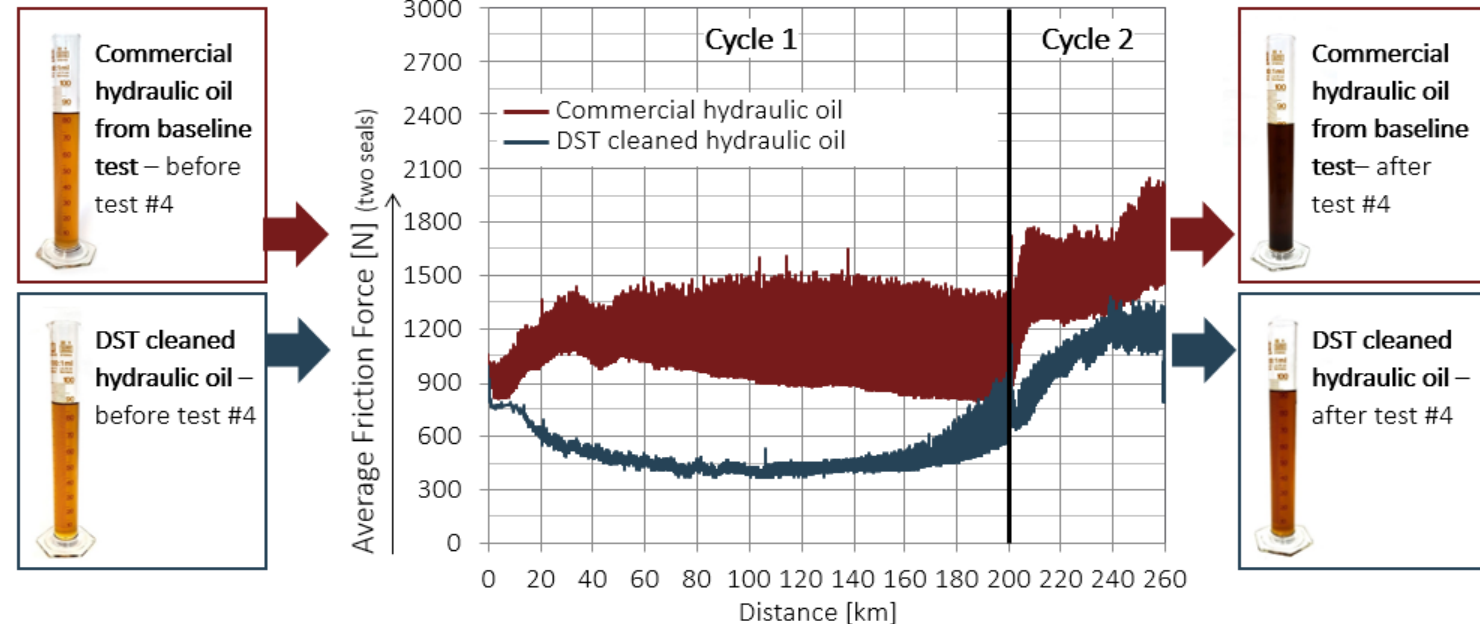
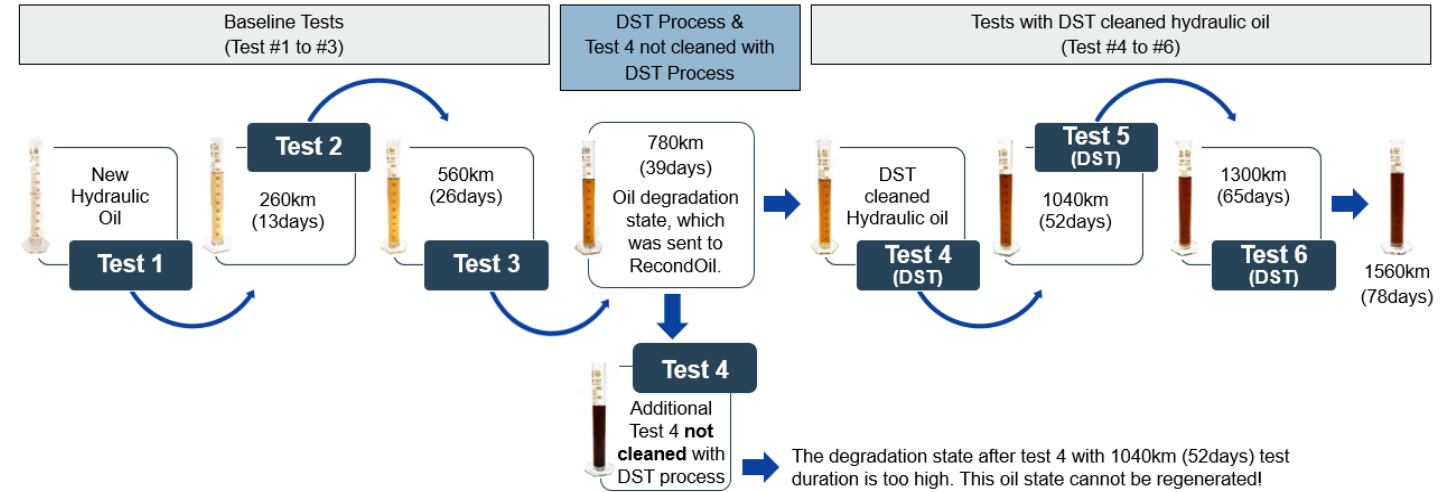
Improved N&V results lead to
less bearings being scrapped
and a general tighter
tolerance for our products –
a business benefit!

Hydraulic seals: Heavy duty test programme

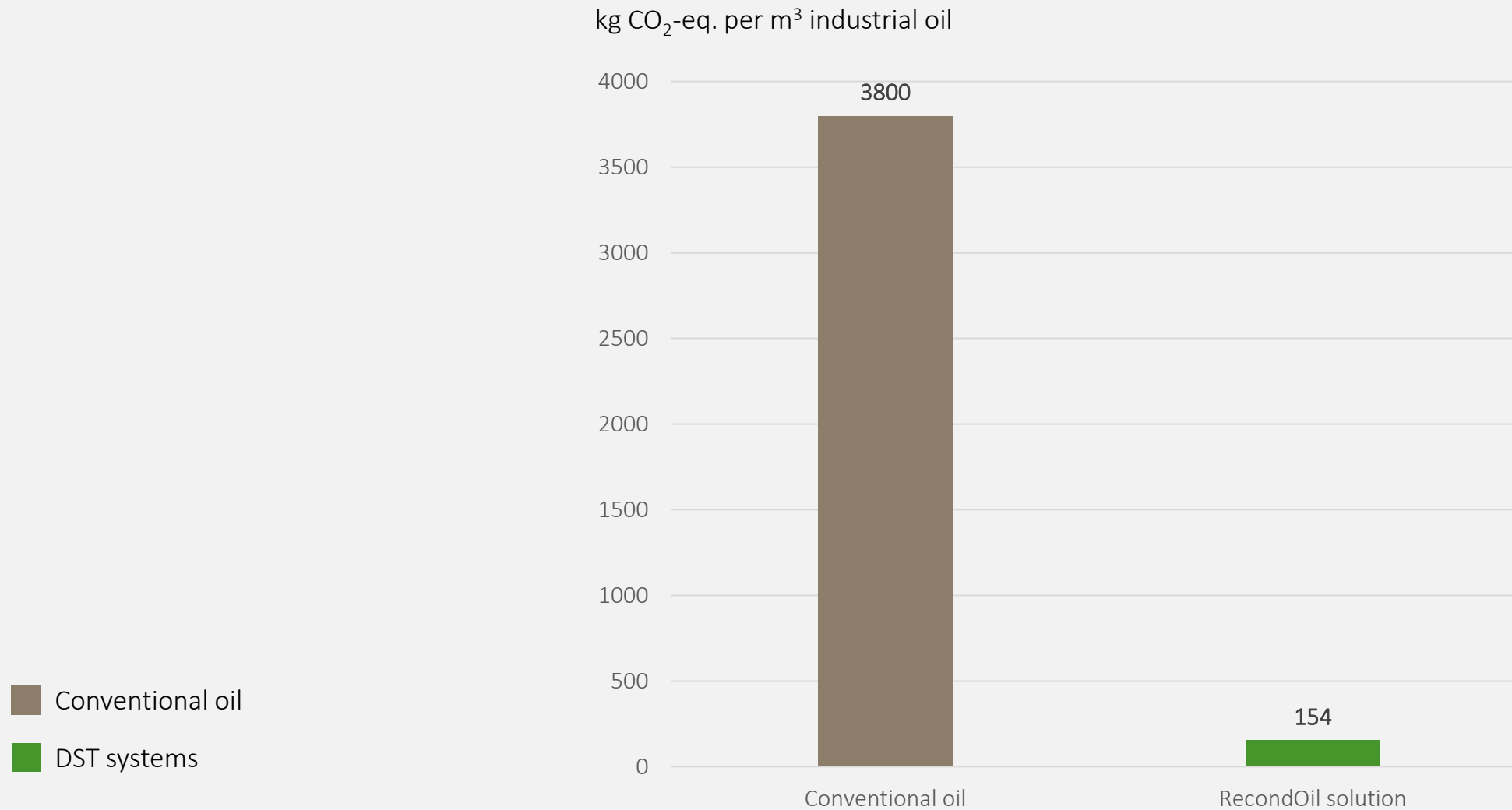
Hydraulic oil in heavy-duty seal test for leakage, friction and wear



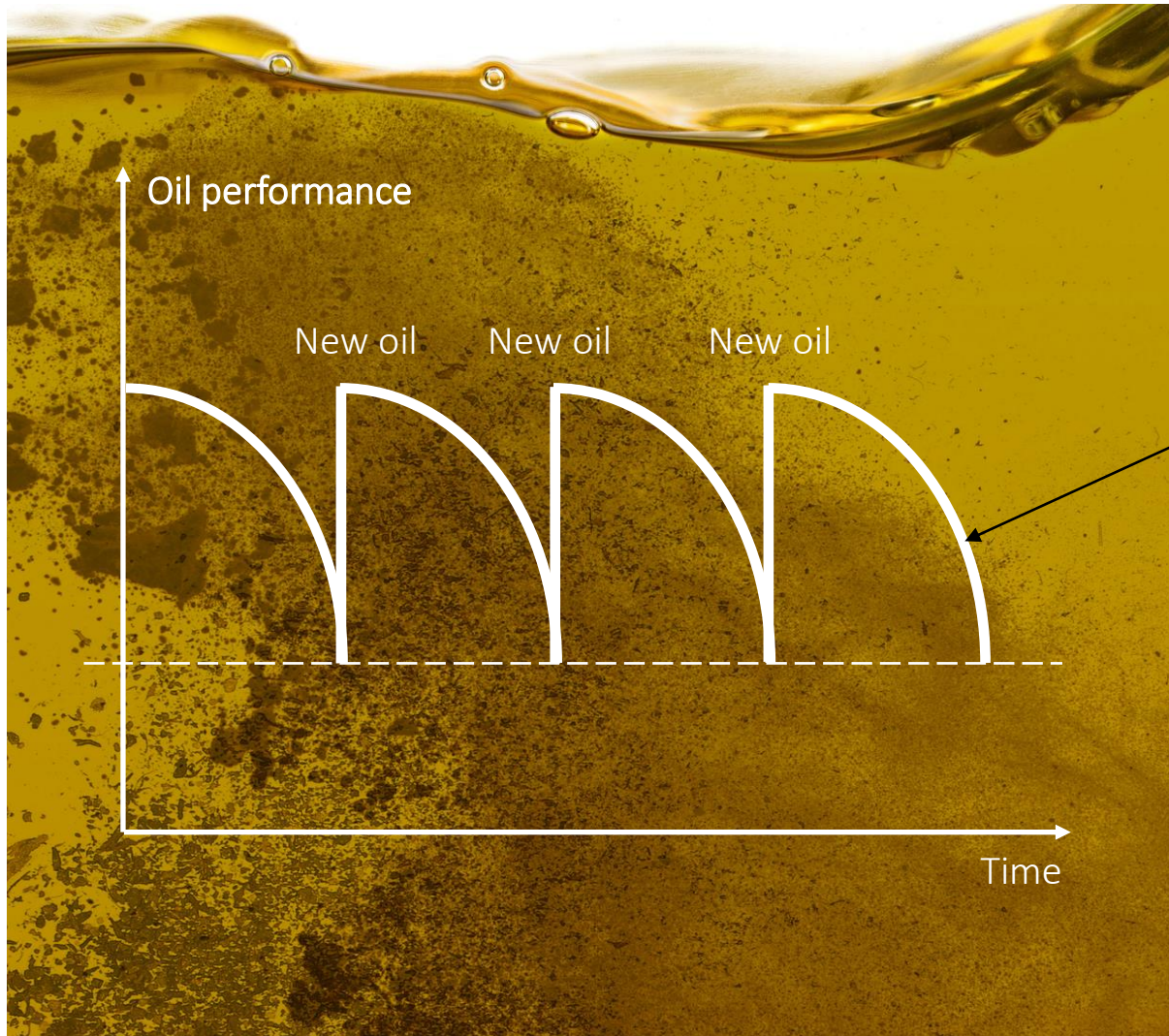
4 test cycles each including 200km @80°C and 60km @110°C with pressures > 200 bar



A circular use of oil reduces CO₂ emissions by more than 96%



Why we change oil



Contamination

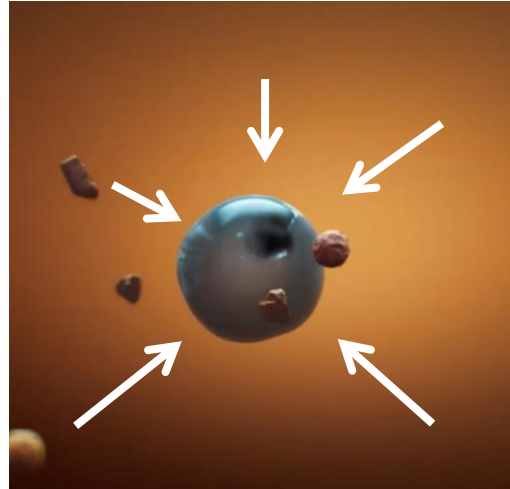
Oxidation

Additive consumption

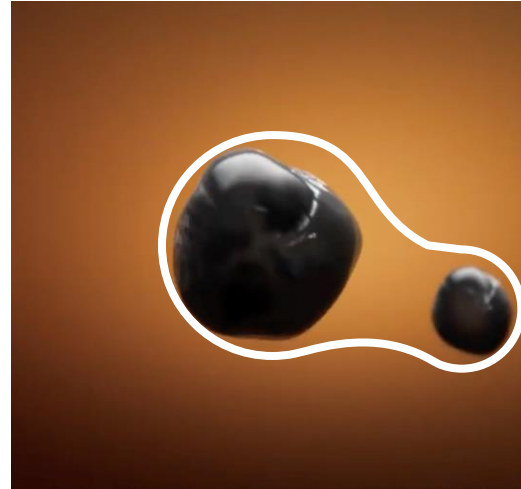
How DST works



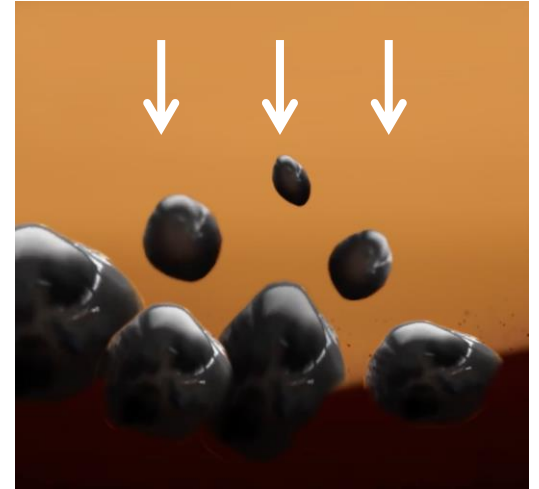
The booster is mixed with the oil



The booster attracts particles of all kinds and all sizes to lumps

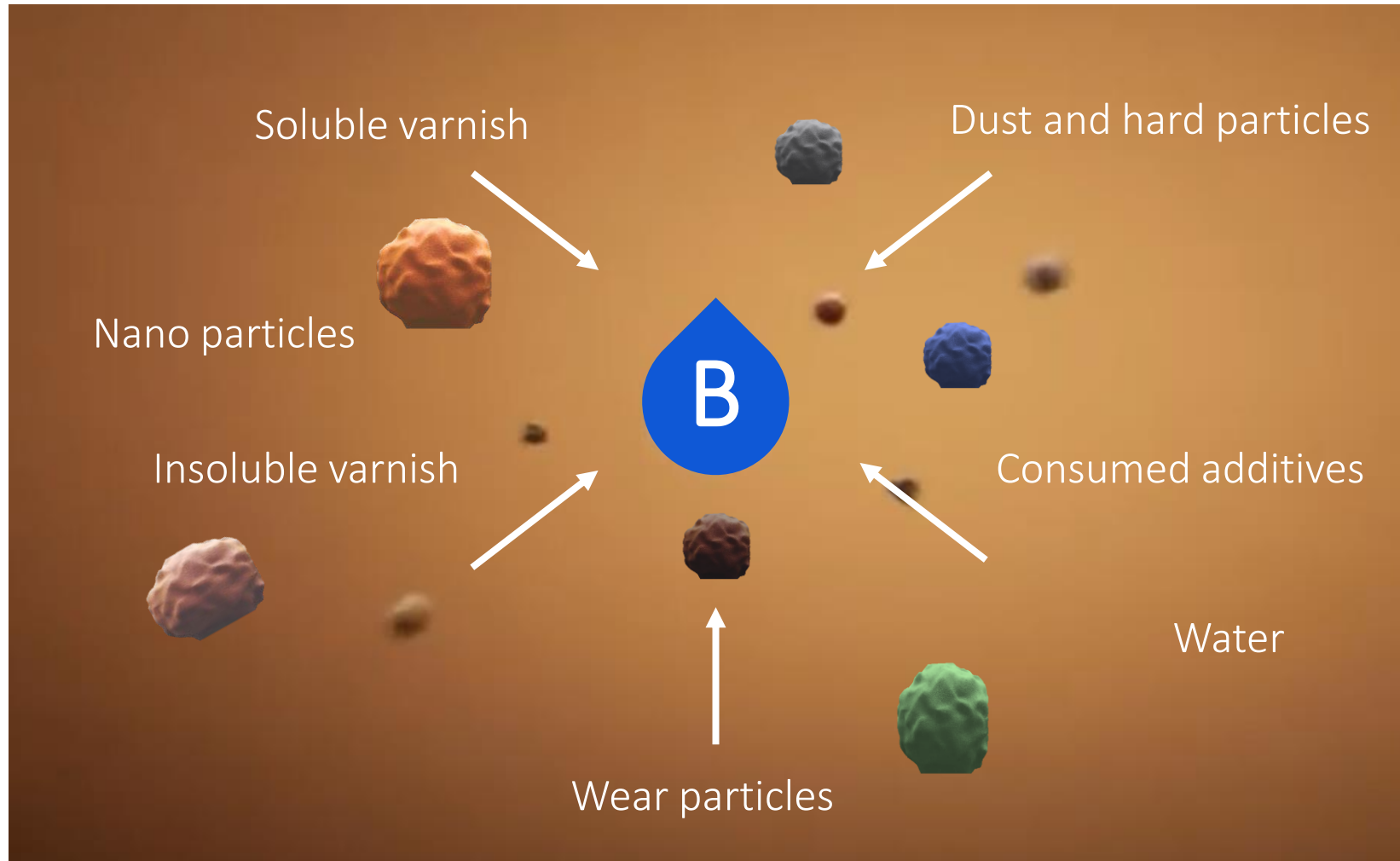


The lumps coalesce into larger lumps



The lumps are now easy to separate from the oil via sedimentation and filtering.

The booster attracts all kinds of particles, of all sizes



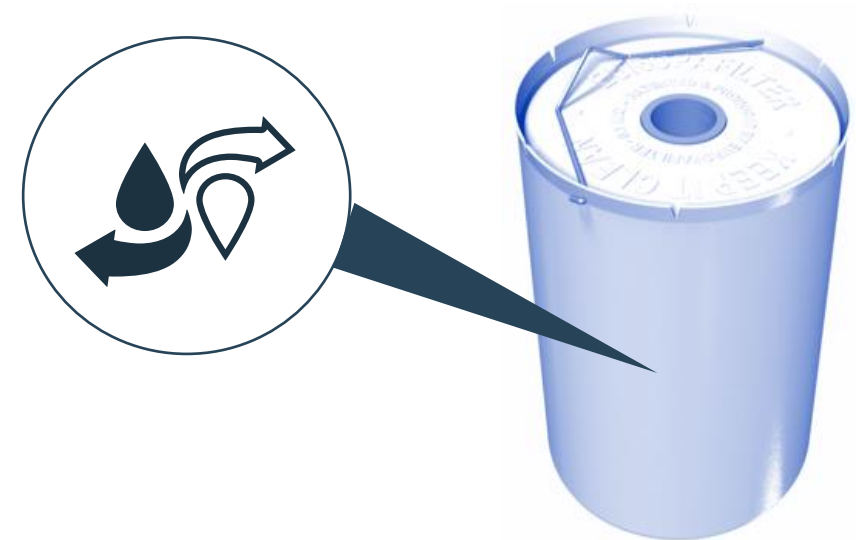
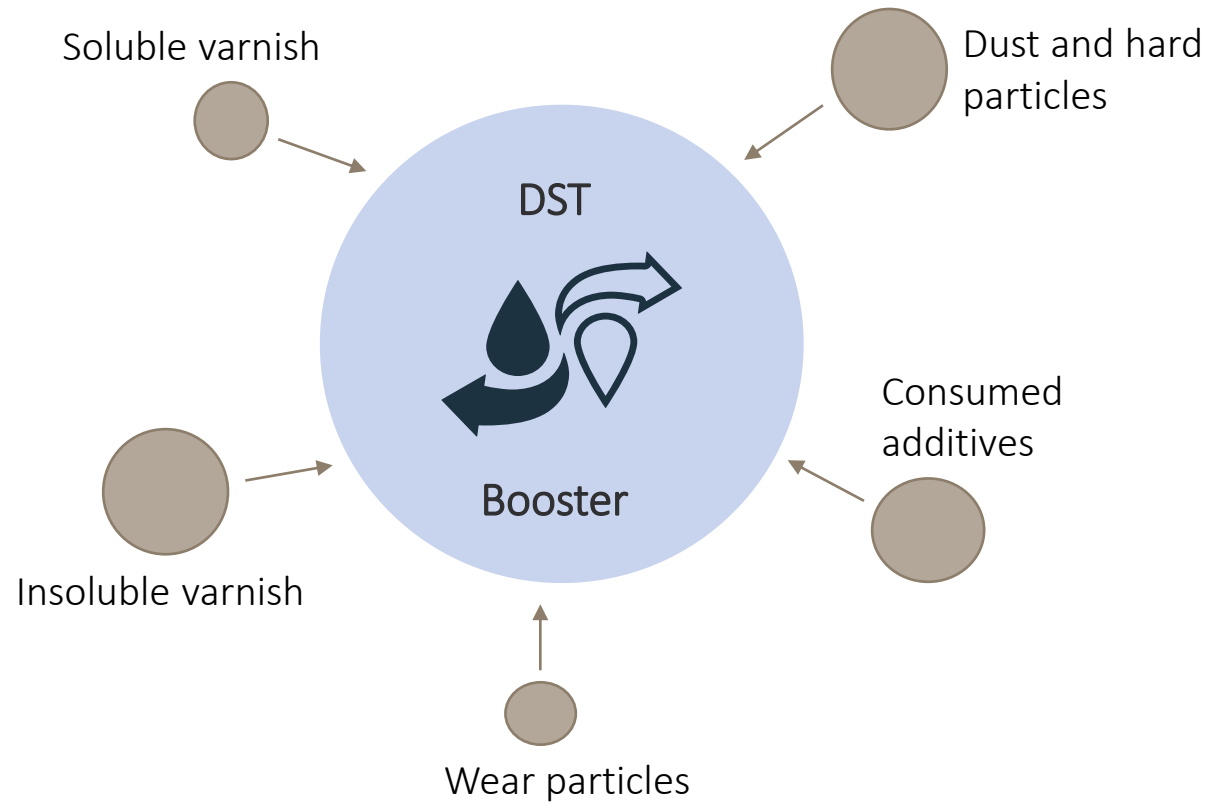


Integrated DST system



Stand-alone DST system

Double-Separation Technology (DST)





One system

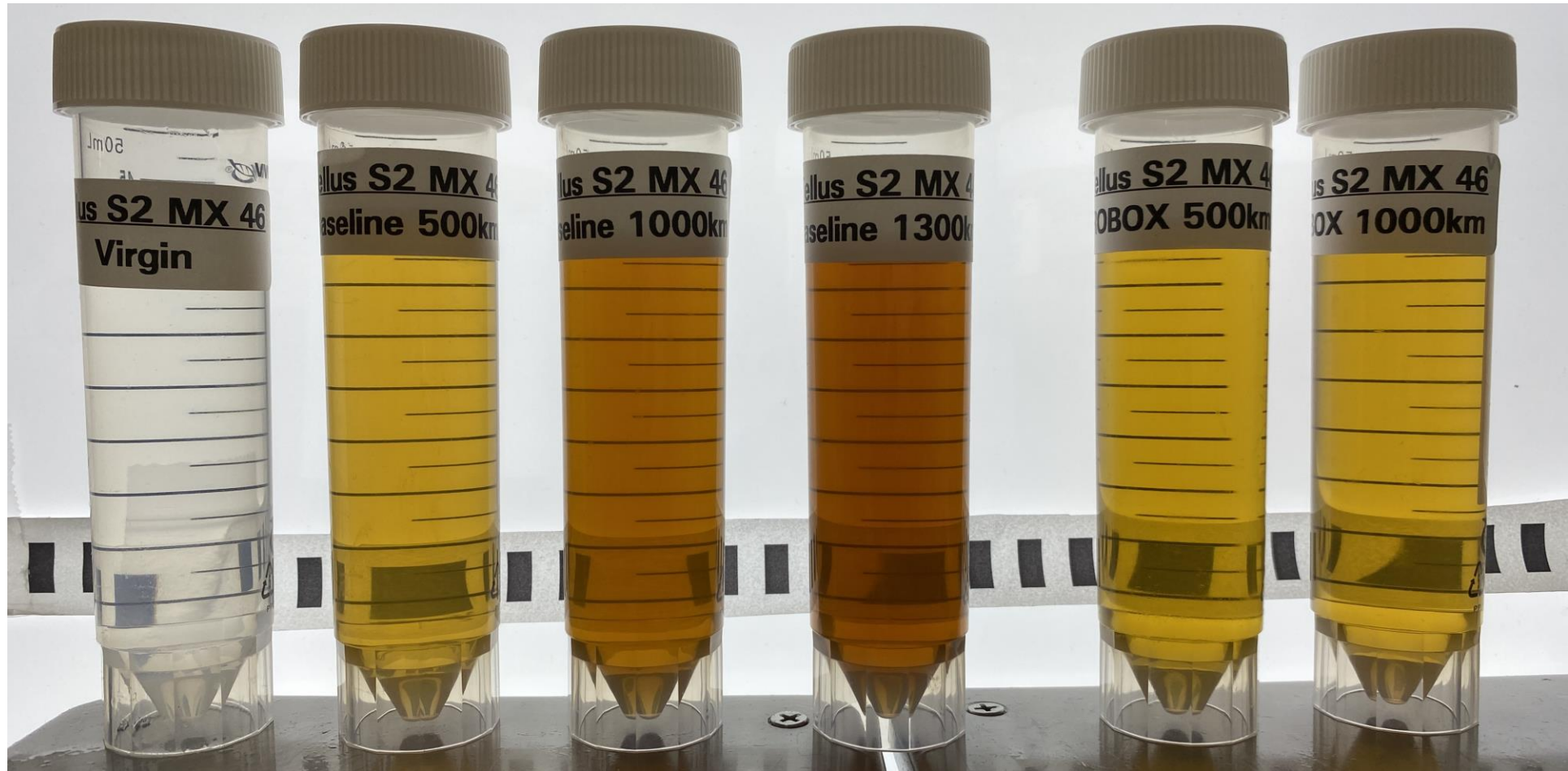
Three functions

Nanofiltration

Varnish removal

Water removal

An image is worth a thousand words...



Virgin

500 km

1000 km

1300 km

500 km

1000 km

Baseline without RO-BOX

With RO-BOX

SKF®