



Turbomachinery Varnish: Solutions

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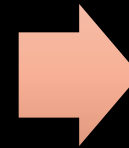
Fluitec

What you'll learn today

What is this
varnish stuff



What
Solutions Exist

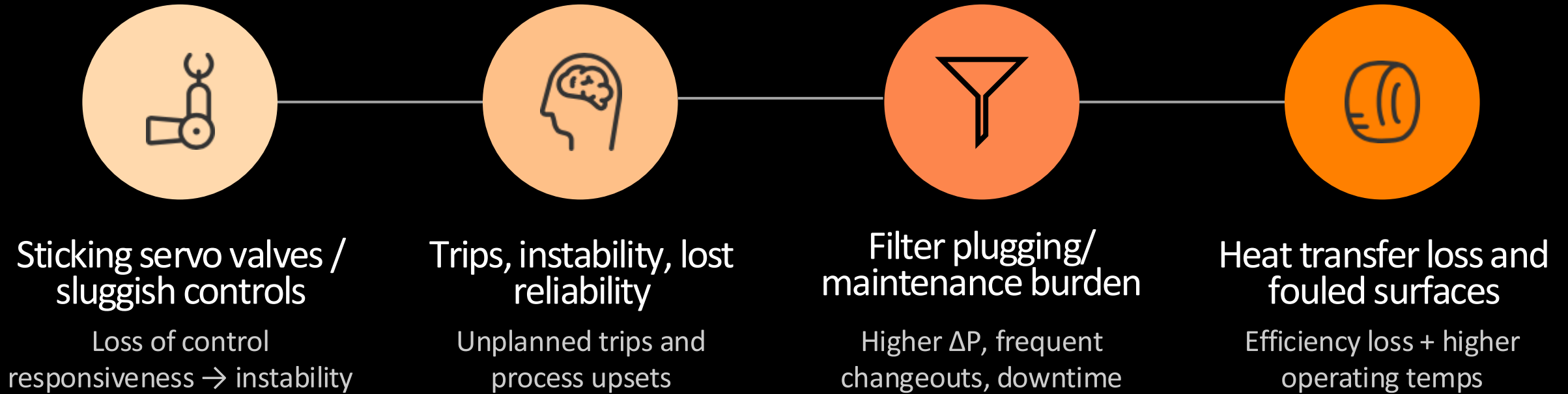


What Solution
to use When



Diagnose before
Prescribe

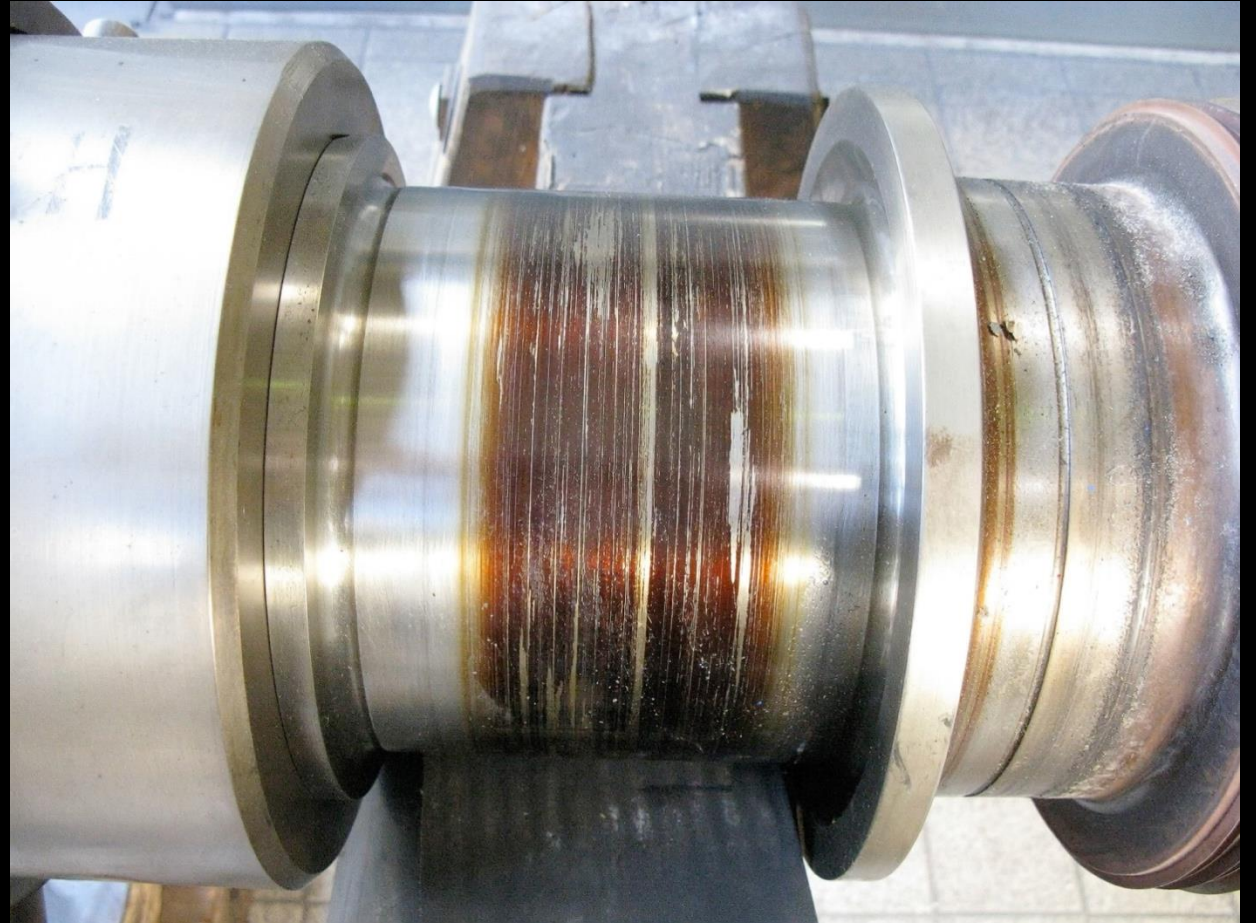
Varnish: Small Deposits. Big Downtime.



The cost isn't varnish — it's the trips, downtime, and performance loss it triggers.

What is varnish?

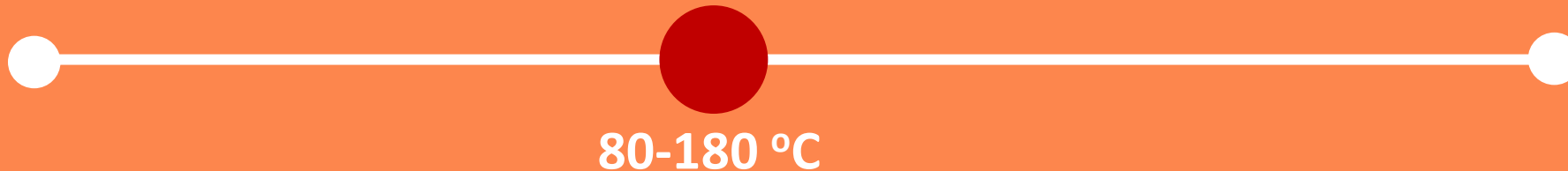
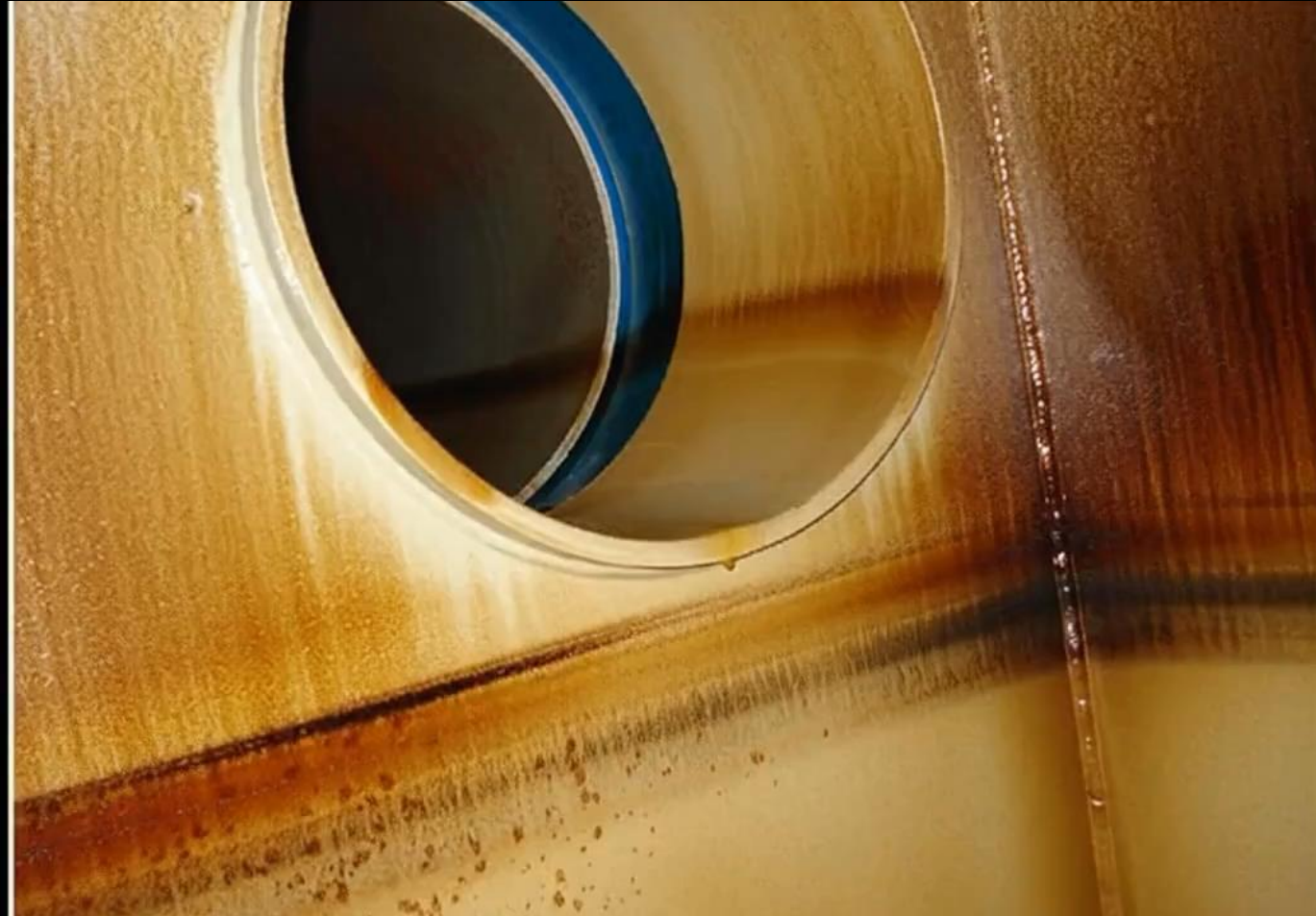
Varnish is an Oil-Derived Deposit



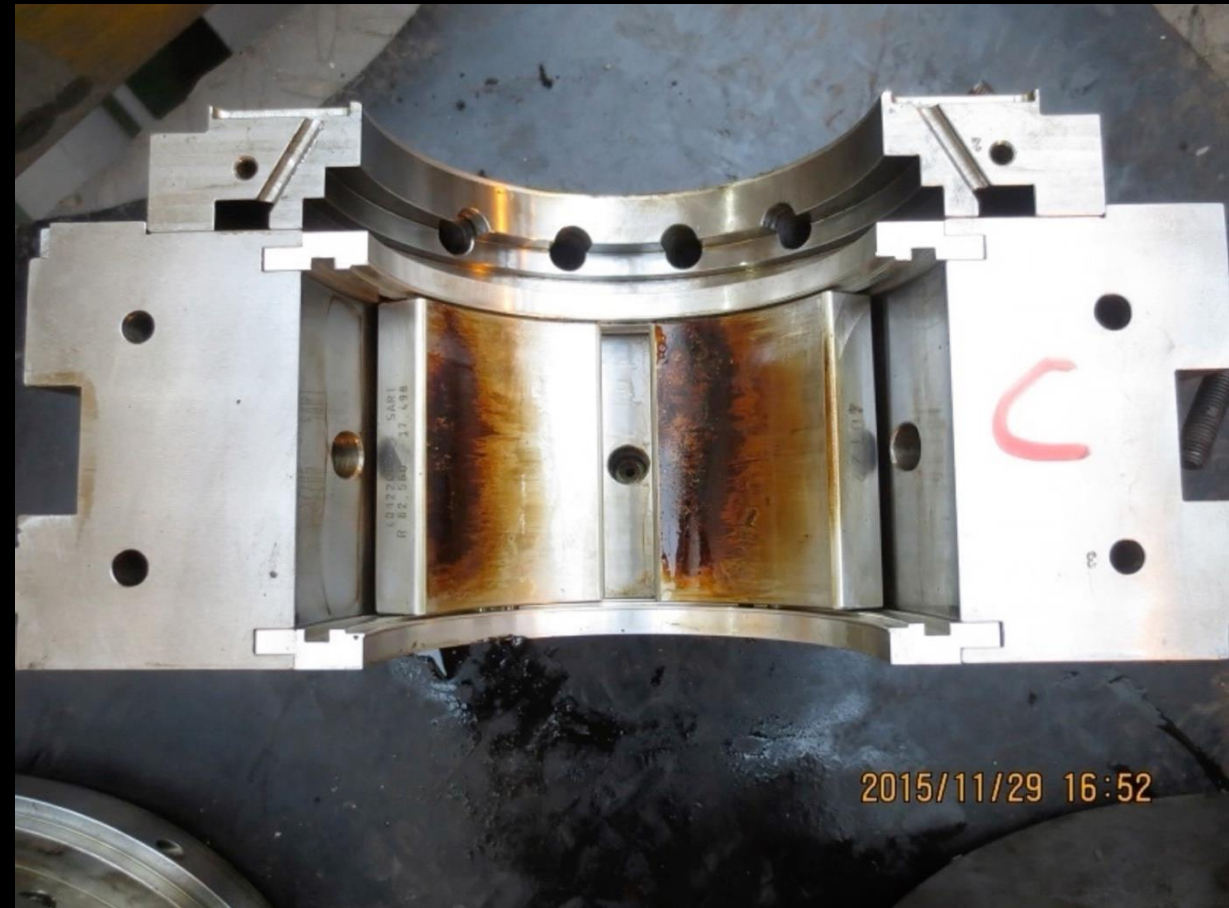
Sludge: Oxidation + Moisture



(Cold) Varnish: Oxidation + Thermal Degradation



Shear Stress Deposits (Hot Varnish): Thermal Degradation



Coking: Pyrolysis



Solving Turbomachinery Varnish

1. What is the cause?

2. Better Oil

3. Resin Filtration

4. Solubility Enhancer



1. BETTER OIL



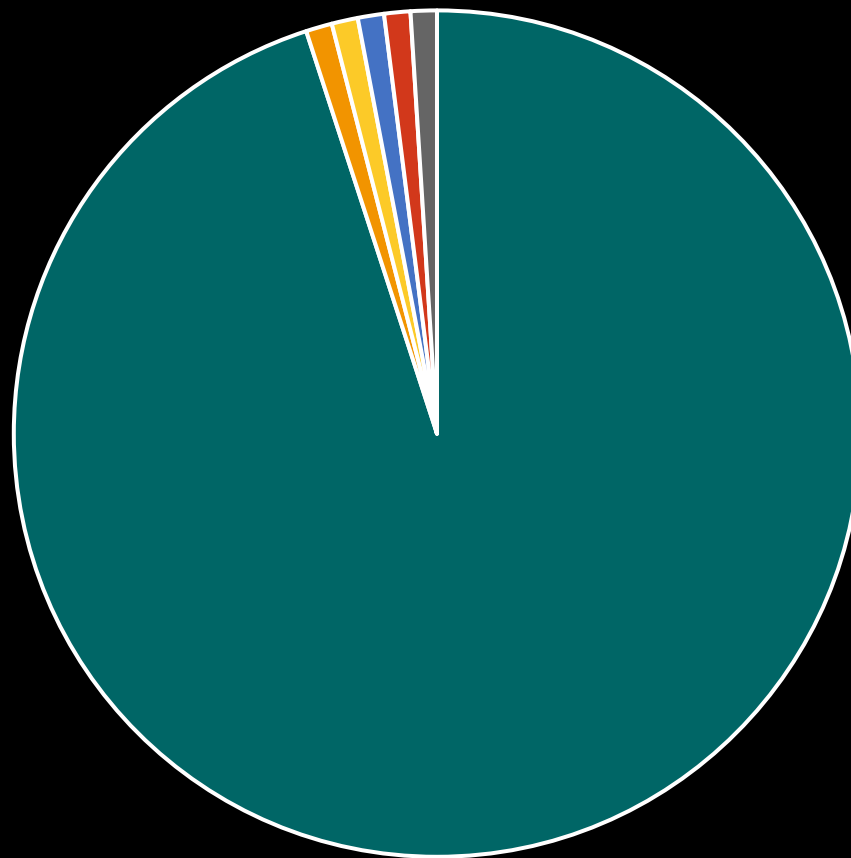
Selecting Turbine Oil: Expectations vs Reality

Oil Selection Criteria - **Expectation**



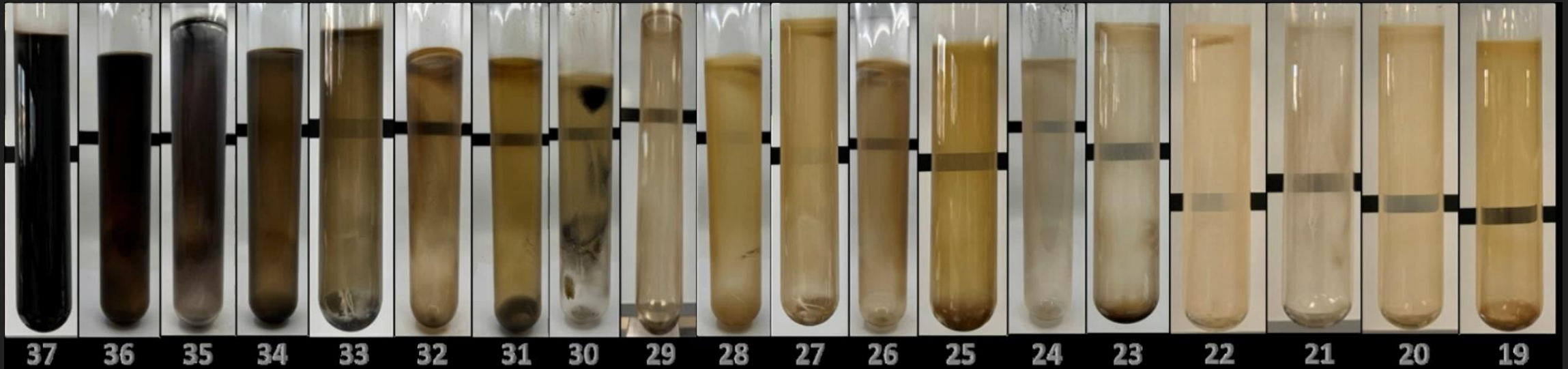
Price Marketing Hype Contract
Availability Spec History

Oil Selection Criteria – **Reality**

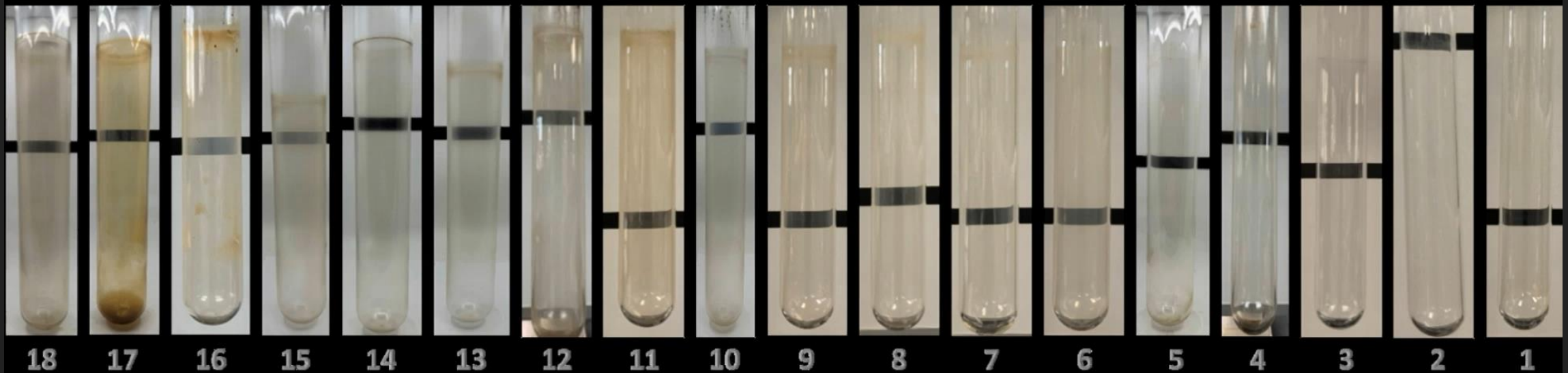


Price Marketing Hype Contract
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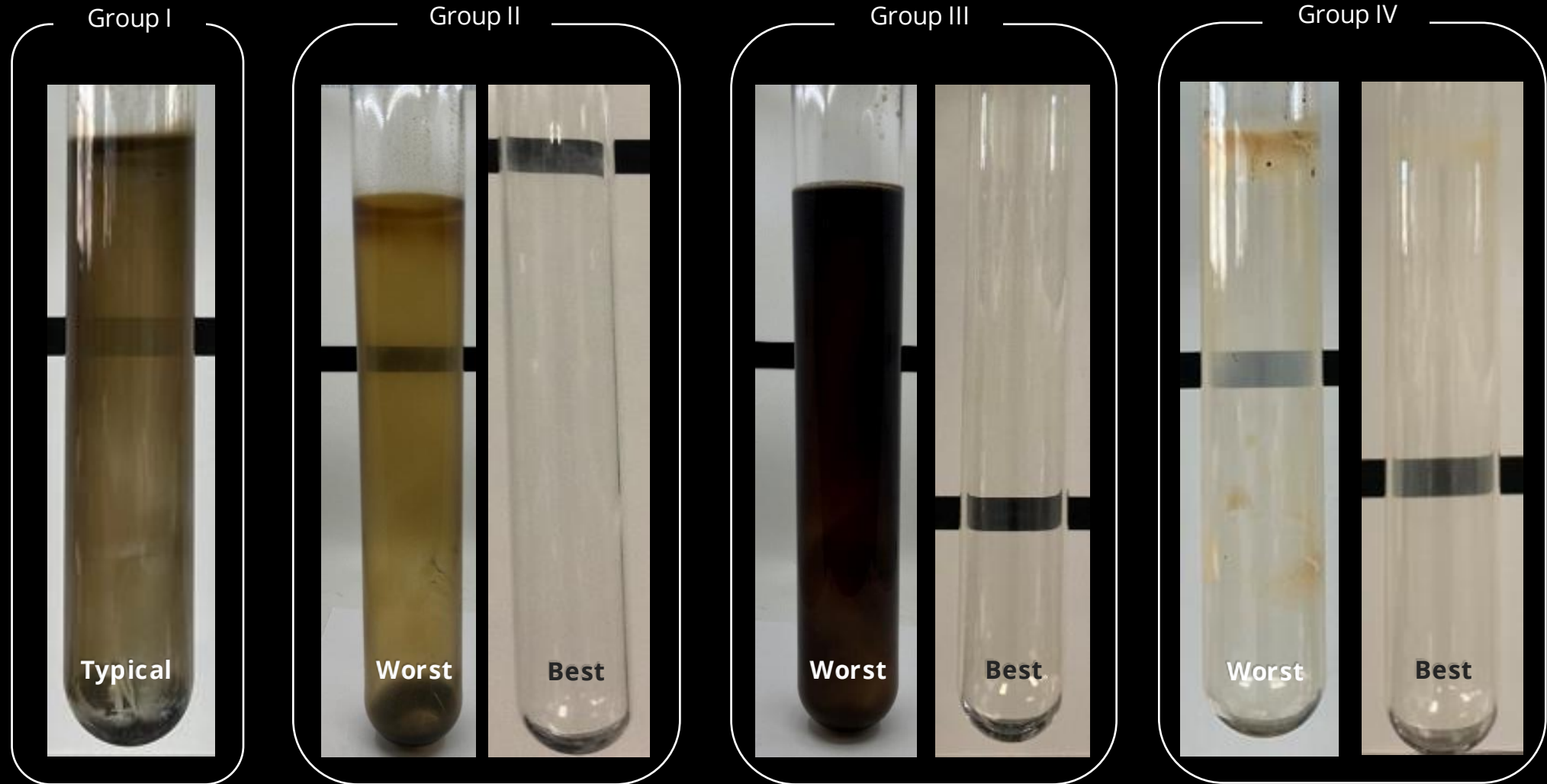
Not All Turbine Oils are created equally



12-Week Glassware after the TOPP test. 37 Commercially available turbine oils.

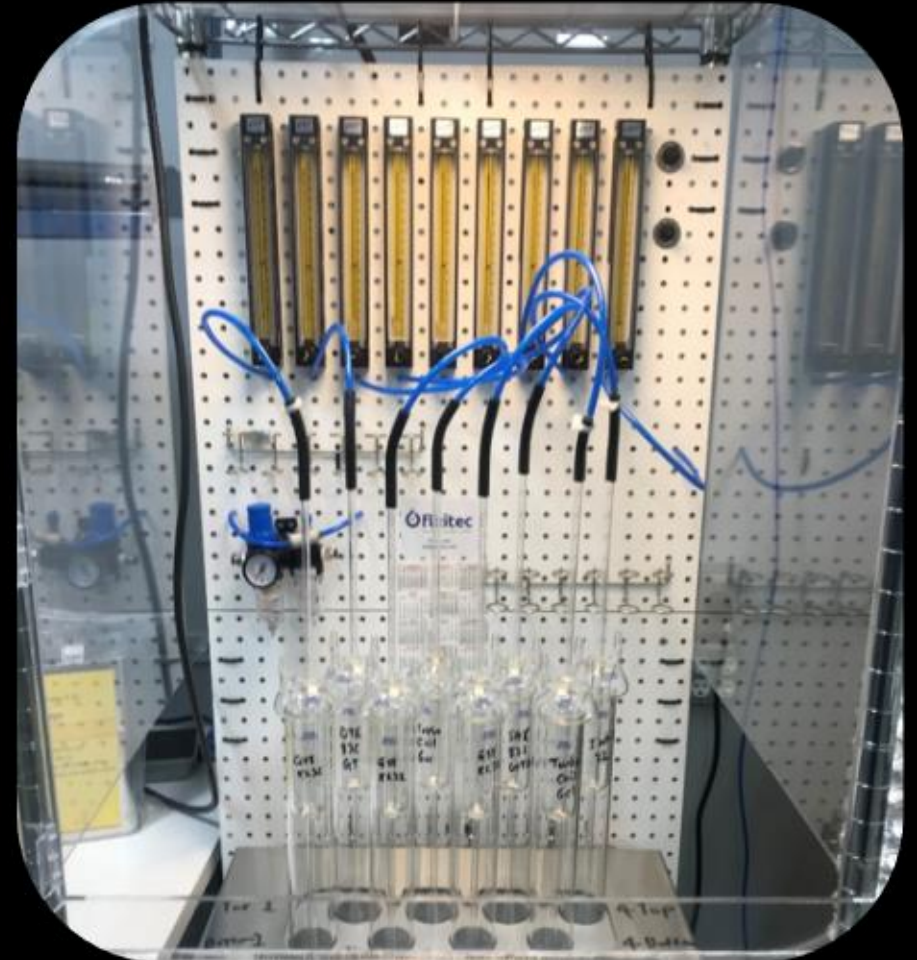


Synthetic oils are not necessarily the solution



Turbine Oil Performance Prediction (TOPP)

- Oil is stressed at **120 °C** for 12-weeks with a steel/copper catalyst
- Samples are pulled at: **3, 6, 9, and 12 weeks**.
- The following analyses are conducted on each aged sample:
 - **Kinematic Viscosity**
 - **Acid Number (AN)**
 - **Rotating Pressure Vessel Oxidation Test (RPVOT)**
 - **Membrane Patch Colorimetry (MPC)**
 - **Remaining Useful Life Evaluation Routine (RULER)**



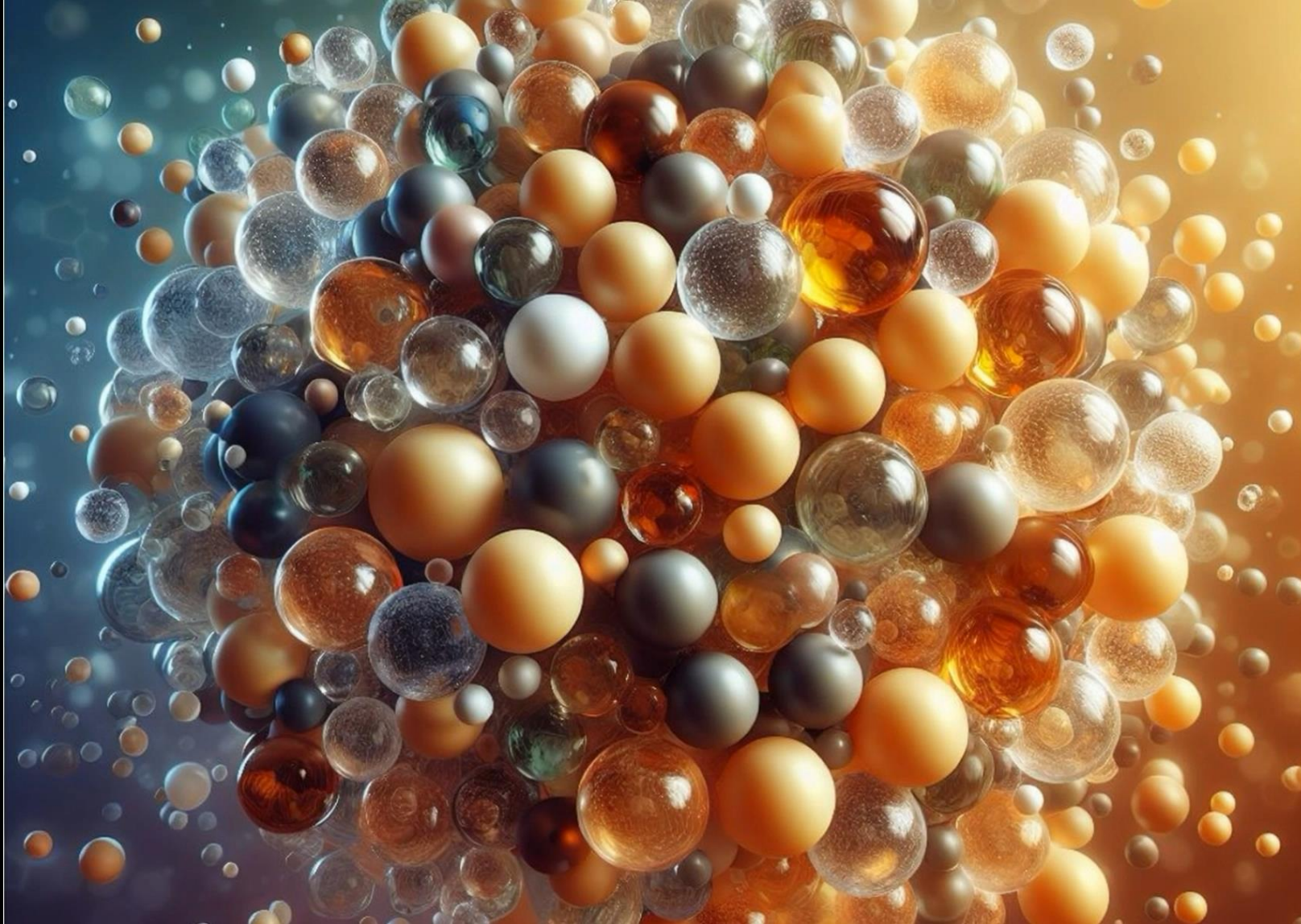


2. RESIN FILTRATION

Varnish is Soluble



Resin is the only proven filtration media



Resin Filtration Units

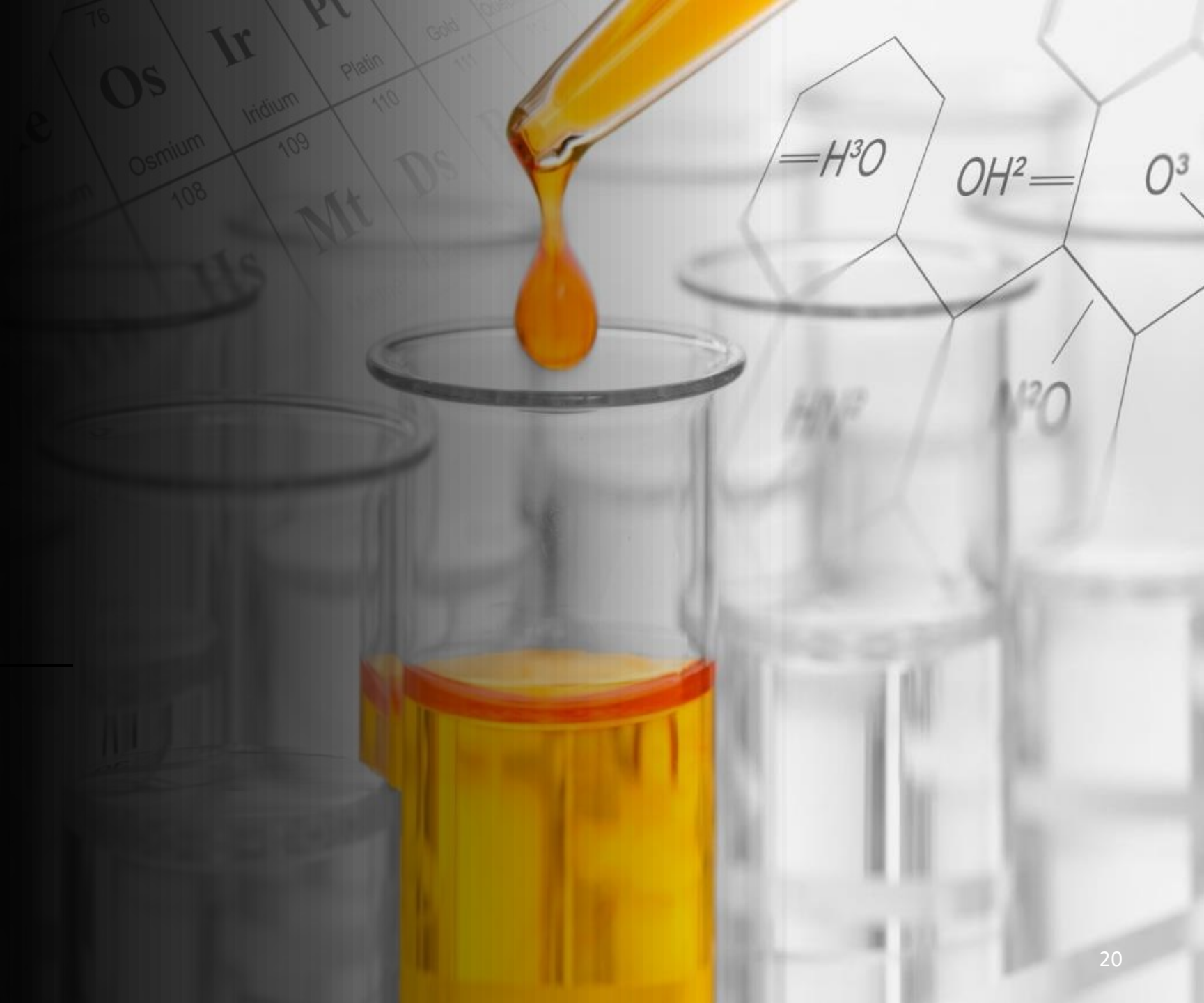
- Kidney loop filtration systems
- Designed for targeted removal of oil degradation products that are both in solution and in suspension.
- Not only removes degradation products but also extends oil life.



Resin Filtration installed inline
on a gas turbine



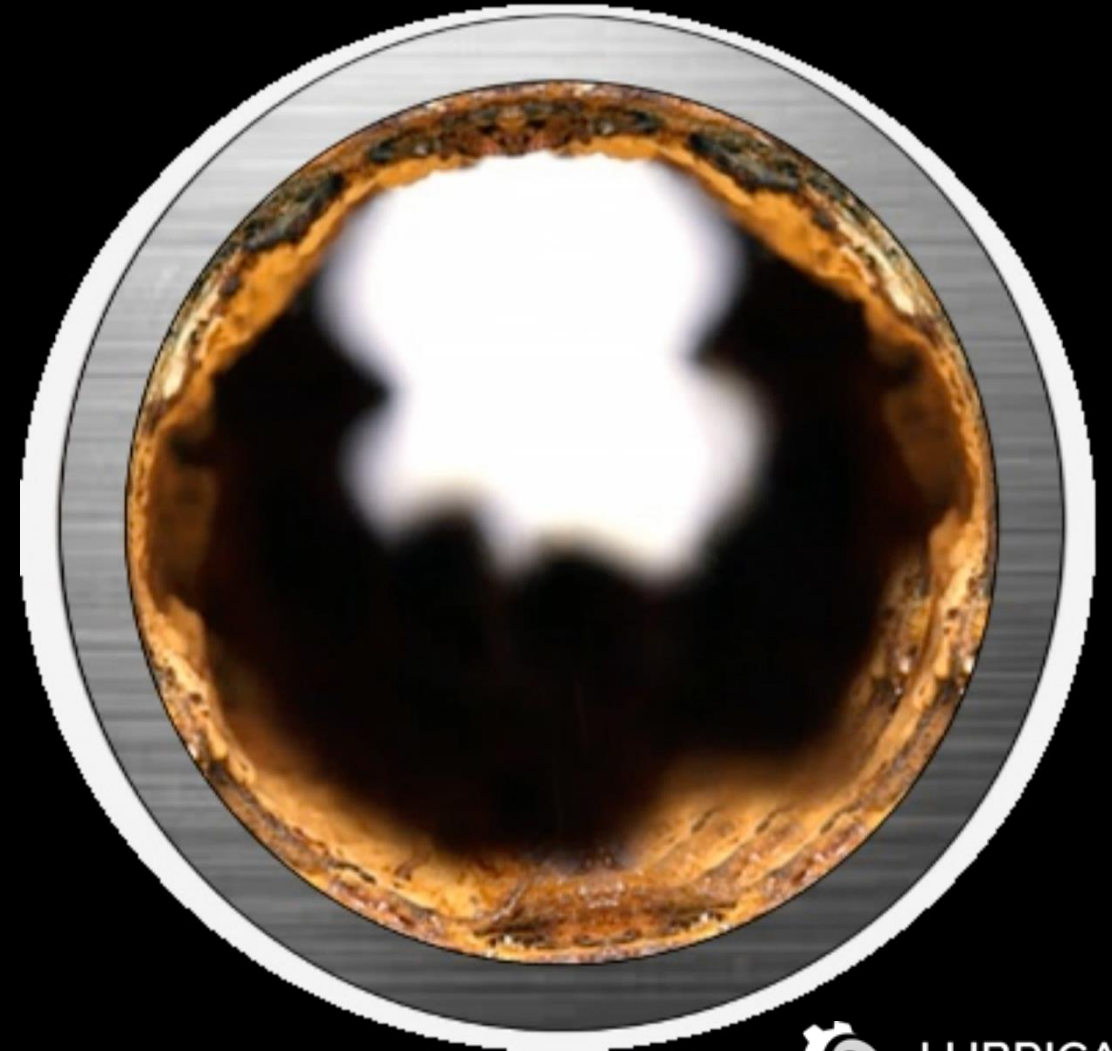
3. SOLUBILITY ENHANCERS



Solubility Enhancers

- Designed to be added into an in-service oil at a 3-10% treat rate
- Effective at dissolving contaminants in the system
- More economical and effective than performing a high velocity system flush in between oil changes

With adequate testing adding and approvals, some can be added for long-term protection.



From “Taboo” to Standard Practice: Solubility Enhancers treating in-service oils

THEN
(Taboo)

Legacy mindset

- Adding anything to an in-service oil was considered taboo
- Risks centered on compatibility, warranty, and unpredictable chemistry

NOW

(Standard Practice)

Industry reality

- Years of testing and field trials have defined safe application boundaries
- Major OEMs endorse this practice when applied correctly
- Many oil companies now offer a solubility enhancer option



OEM Acceptance



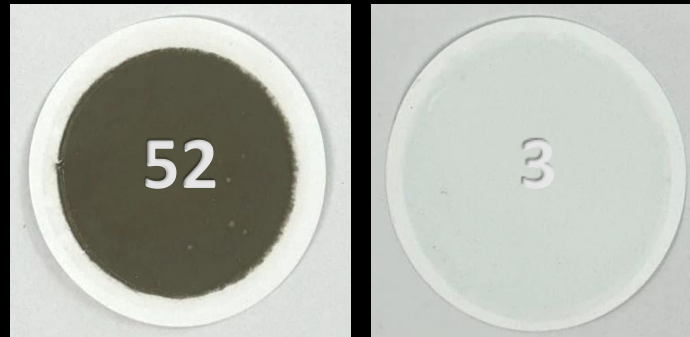
Oil Company Adoption



Field Proven

Solubility Enhancer Performance in Turbine Oil 1

Sample ID	TO 1	TO 1	TO 1 + 3% SE
Weeks Stressed	0 - Weeks	12 - Weeks	12 - Weeks
40°C Viscosity, ASTM D445 cSt	34.25	34.34	33.64
Total Acid Number, ASTM D664, mg KOH/g	0.03	0.02	0.04
RPVOT, ASTM D2272, minutes	4255	2553	3853
RPVOT, % Compared to New	100	60	91
RULER, ASTM D6971			
% Aminic	100	69	61
% Phenolic	100	54	40
Area Aminic		13307	15520
Area Phenolic		2536	2321
Membrane Patch Colorimetry			
ΔE	2	51.7	2.6



Without SE



With SE

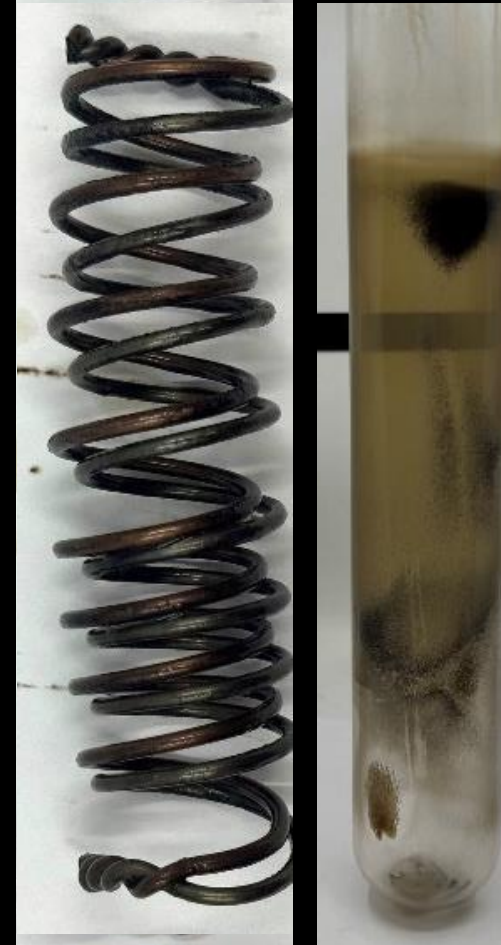


Solubility Enhancer Performance in Turbine Oil 2

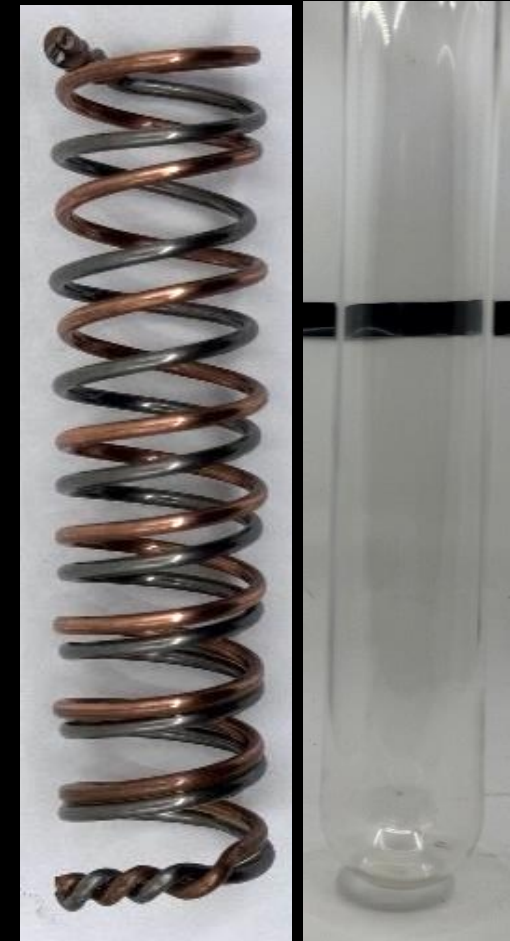
	TO 2	TO 2	TO 2 + 3% SE
Weeks Stressed	0 - Weeks	12-Weeks	12-weeks
40°C Viscosity, ASTM D445 cSt	33.58	34.29	33.88
Total Acid Number, ASTM D664, mg KOH/g	0.09	0.06	0.05
RPVOT, ASTM D2272, minutes	1055	619	750
RPVOT, % Compared to New	100%	58%	53%
RULER, ASTM D6971			
% Aminic	Baseline	40.2%	46.4
% Phenolic	Baseline	0.0%	0
Area Aminic		4525	4345.4
Area Phenolic		0	0
Membrane Patch Colorimetry			
ΔE	2.1	73.8	4.6



Without SE



With SE



Selecting the Best Varnish Solution

Changing your oil?

- Upgrade to an Improved Formulation

Sludge?

- Resin Filtration
- Maybe Vacuum Dehydration

(Cold) Varnish?

- Resin Filtration
- Solubility Enhancement

Hot Varnish?

- Solubility Enhancement

Coking?

- Solubility Enhancement

Conclusion

- Varnish is still considered a multimillion-dollar issue in turbomachinery
- Diagnose then Prescribe.
- Known solutions include:
 - Using superior oil formulation
 - Resin Filtration
 - Solubility Enhancement

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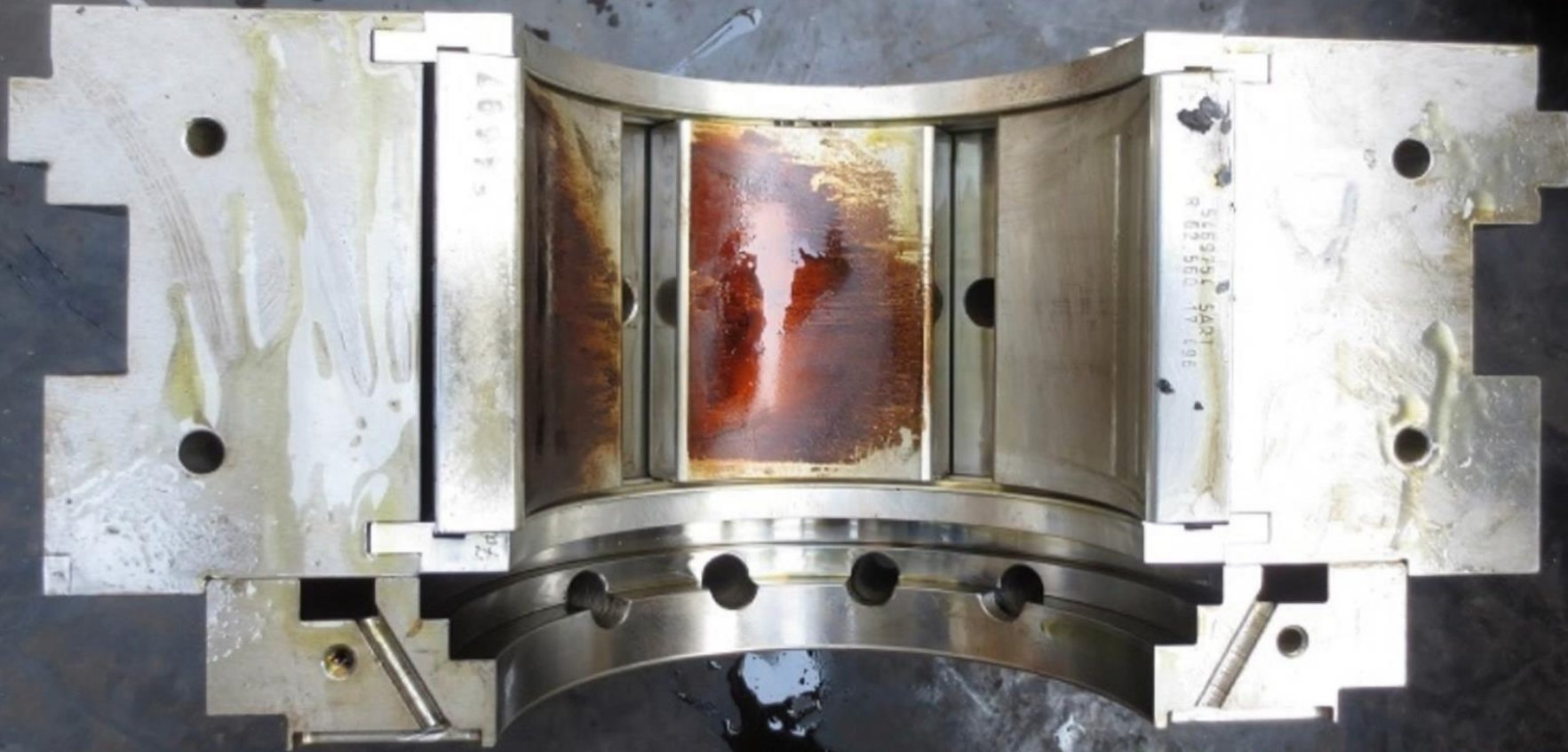


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May your days be varnish-free



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