The Invisible Saboteur: Combating Microbial Degradation in Marine System Oil

From Cause and Detection to a Comprehensive Defense Strategy

SYSTEM OIL • MICROBIAL CONTAMINATION • PASTEURIZATION • VLSFO

A Perfect Storm in the Engine Room: The New Fuels and Modern Oils

The IMO 2020 Effect

- Introduction of VLSFO and Biofuels (FAME).

⚠️ These fuels are more hygroscopic (attract water) and biodegradable. A fuel leak is no longer just a leak; it's a nutrient source.

The Paradox of Long-Life Oils

- System oils are designed for tens of thousands of hours.

⚠️ Additives like ZDDP, containing Phosphorus (P) and Sulphur (S), unintentionally become a perfect supplement for microbial growth.

The Recipe for Infestation: Three Essential Ingredients

FREE WATER

The absolute prerequisite. No water, no growth.

NUTRIENTS

Hydrocarbons, additives (P, S, N), and leaked fuel.

ENVIRONMENT

20–40°C is the optimal breeding zone, common during anchorage or slow steaming.

The Breach: Common Pathways for Water Ingress

Cooler Leaks (Most Common)

Piston Cooling or Jacket Water systems.
Corrosion inhibitors (nitrite-borate) in the water provide ideal nitrogen/phosphorus nutrients.

Stuffing Box Failure

Allows acidic scavenge space condensation to enter the crankcase.

Operational Factors

Purifier water seal failure, condensation in hot climates.

The threshold for an outbreak is just 0.1% sustained water content.

The Chemical Assault: How Microbes Turn Your Oil Acidic

Total Acid Number (TAN)

Microbial metabolism produces organic acids (acetic, butyric), causing a rapid spike in TAN.

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Base Number (BN)

The rising acid levels rapidly neutralize the oil's alkaline reserve (BN), stripping the engine of its corrosion protection.

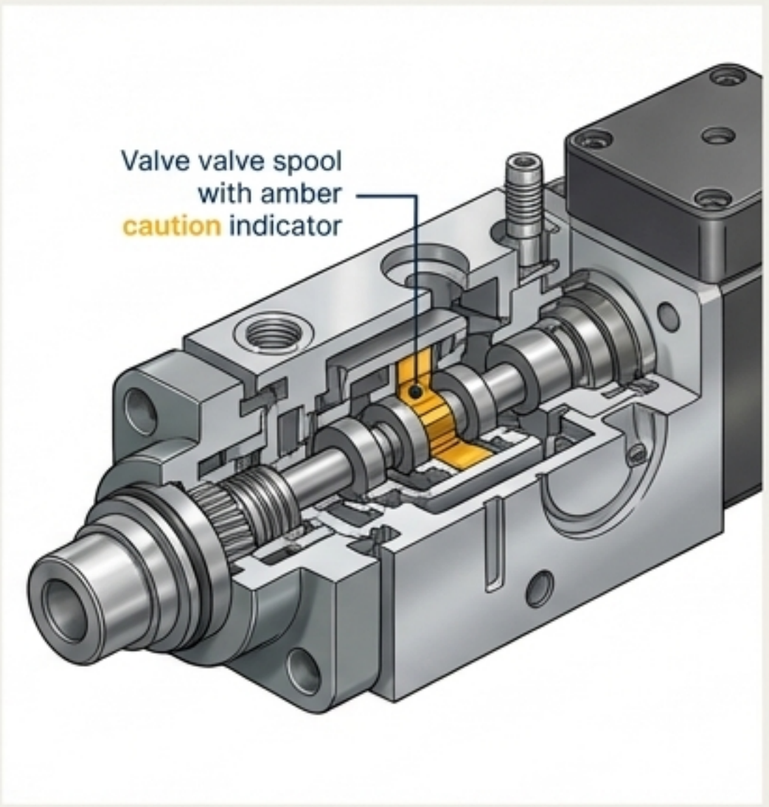
Physical Sabotage: Sludge, Slime, and Seizures

Emulsification

Bacteria secrete bio-surfactants, creating stable emulsions that defeat purifiers.

Blockages

Sticky biomass and biofilm clog filters and are difficult to remove.



The Electronic Threat

For modern engines, biomass can cause high-precision servo valves to stick, leading to timing failures or engine start failure.

Case Study: A Simple Leak, A Costly Mistake

The Swedish Club, 2024

1. THE EVENT

A cooling water leak was detected.
Water content reached 0.17%.

2. THE MISTAKE

The crew fixed the leak but **did not drain the contaminated oil**. They only topped up with fresh oil.

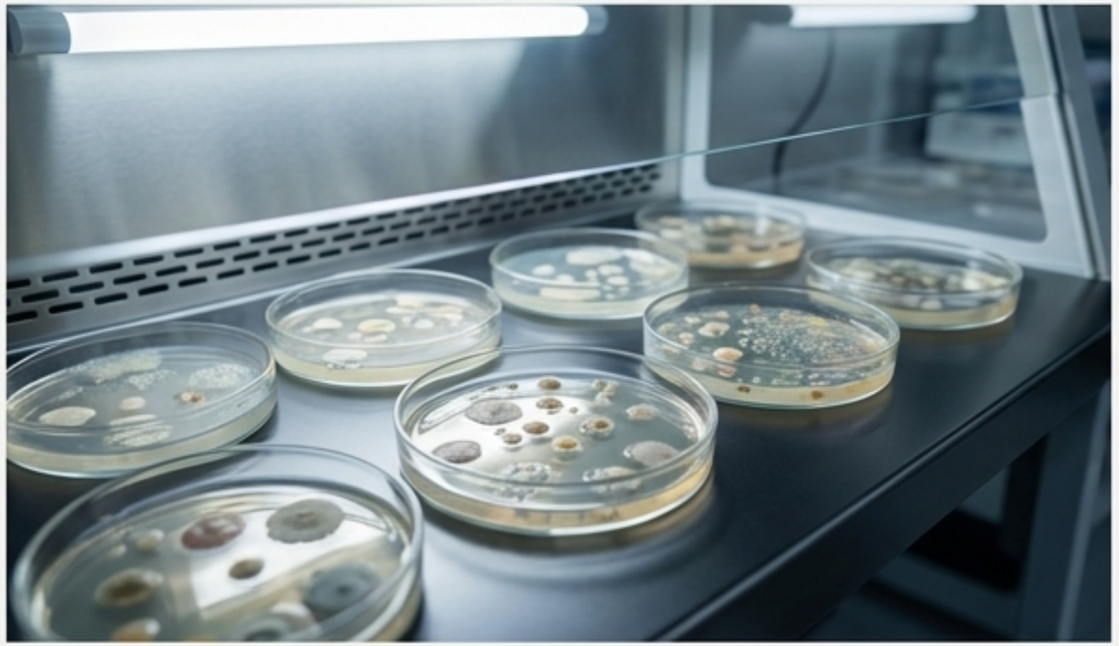
3. THE CONSEQUENCE

Unchecked microbial growth led to oil failure and catastrophic seizure of the #3 main bearing.

Topping up is not a solution. Physical removal of water and biomass is the only way.

Know Your Enemy: From a 7-Day Wait to a 10-Minute Warning

The Lab Standard



Method: ASTM D6974 / IP 385 (Culture Method)
Result: Provides CFU/L count. (>10,000 CFU/L is severe).
Drawback: Takes 3-7 days. Too slow for immediate action.

The Onboard Advantage

Method: ASTM D7687 (ATP Testing)
Result: Measures Adenosine Triphosphate (ATP) from living cells.
Advantage: Results in under 10 minutes. A direct, actionable indicator of live microbial activity.

Sampling is key (ASTM D7464). Always sample from the bottom of the circulating tank or purifier sludge outlet, not mid-stream.

Your First Line of Defense: Aggressive Water Management

Zero Tolerance for Water. The operational goal must be **less than 0.1%.**

Temperature is a Weapon

Maintain purifier inlet temperature at **90-95°C.**

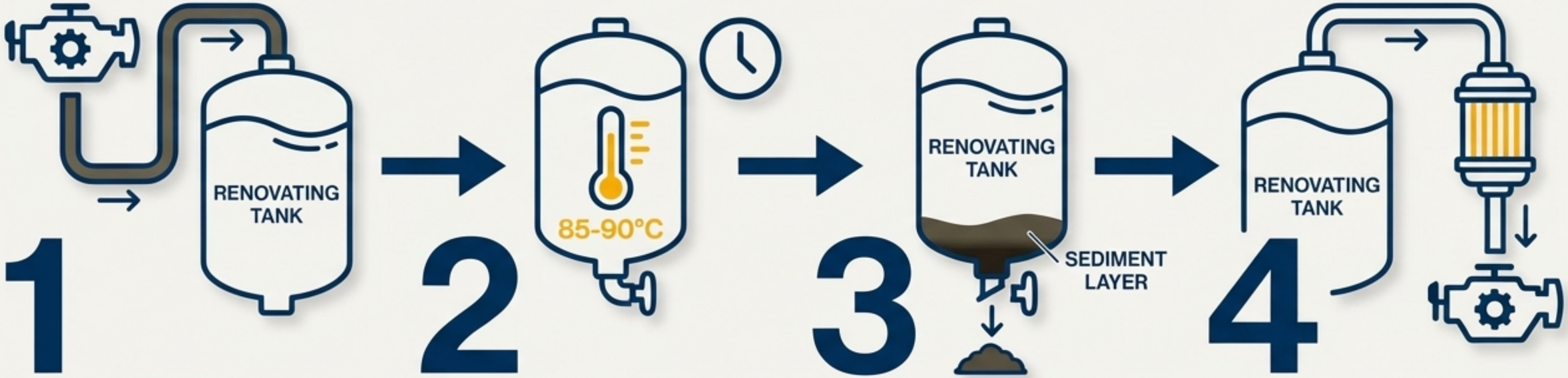
This high temperature inhibits bacterial growth and dramatically improves water separation efficiency.

Daily Discipline

Perform daily draining of circulating and settling tanks to remove any settled water.

The Ultimate Weapon: System Sterilization via Pasteurization

When to Use: When tests show microbial contamination or oil shows signs of slight emulsification.



TRANSFER

Move contaminated oil to the Renovating Tank.

HEAT & HOLD

Heat oil to **85-90°C** and maintain temperature for **24-48 hours**. This is the critical sterilization step.

SETTLE & DRAIN

Allow oil to cool and settle. Drain the bottom “biscuit layer” of dead microbes and sludge.

PURIFY & RETURN

Return the sterilized oil to the system via the purifier at a low flow rate for final polishing.

Last Resorts: When to Escalate (And The Risks Involved)

Chemical Biocides

Principle: Use only with **OEM approval.**

Risk: Compatibility issues. Acidic biocides can react with alkaline oil additives to form gels.

Warning: A successful kill can cause massive biofilm detachment, leading to severe, sudden filter clogging.

Full System Flush

Trigger: Mandatory when **TAN > 3.0** or oil is severely emulsified. The oil is unrecoverable.

Process: Follow MAN/WinGD procedures for a high-temperature, high-velocity flush.

Warning: Requires extensive manual cleaning of the crankcase and removal of sludge from all dead spots.

From Reactive Repair to Proactive Control

1. DENY WATER

Meticulous monitoring of coolers and stuffing boxes. Daily draining of tanks.

2. MANAGE TEMPERATURE

Use high temperature as your primary tool for prevention (purifier) and treatment (pasteurization).

3. MONITOR RELENTLESSLY

Implement onboard ATP testing for early warning. Don't rely solely on delayed lab results.

Microbial degradation is not a random equipment failure; it is a failure of process. Proactive management converts this hidden threat into a controllable maintenance task.