

THE VARNISH WORLD CUP

TURBINE OIL VARNISH REMOVAL CHAMPIONSHIP

OEM, MAINTENANCE, RELIABILITY, PROCUREMENT & OIL SUPPLIER ON THE FIELD

Team, we don't just play – we **remove** varnish at the **root!**

Play by the **spec!**

SPECS - DATA SHEETS - STANDARDS
APPROVALS - CONTRACTS

PROCUREMENT GOALKEEPER

CLEAN OIL

You can't **red-card** my deposits!

Reviewing patch...
No varnish allowed!

RELIABILITY TEAM

MAINTENANCE TEAM

MR. VARNISH

TURBINE OIL

OIL SUPPLIER PLAYMAKER

LAB REPORT VAR

PATCH RESULT:

SERVO VALVES

MPC MEMBRANE PATCH

TURBINE LUBE SYSTEM

ANALYZE RIGHT. FILTER RIGHT. SCORE RELIABILITY.

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

WOB'S ON THE FIELD?

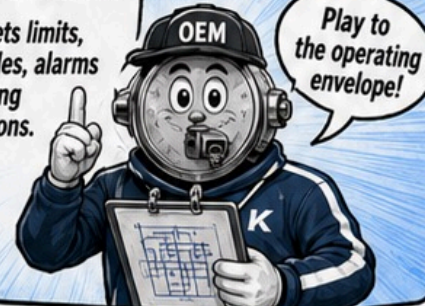
MEET THE VARNISH CUP TEAMS



In varnish control, **everyone** has a position!

1 OEM TEAM

OEM = sets limits, design rules, alarms and bearing expectations.



Play to the operating envelope!

2 MAINTENANCE TEAM

Maintenance = inspections, filter changes, valve checks, flushing discipline, field execution.



We stop the easy goals!

3 RELIABILITY TEAM

Reliability = MPC, RULER, TAN, ISO cleanliness, trend analysis, root cause.



Data wins matches!



VARNISH REMOVAL CHAMPIONSHIP

4 PROCUREMENT TEAM

Procurement = selects the right technology, scope, quality and support – not just the cheapest bid.



Cheap mistakes cost league titles!

- RIGHT TECH
- RIGHT SCOPE
- RIGHT QUALITY
- RIGHT SUPPORT

5 TURBINE OIL SUPPLIER

Oil Supplier = formulation, base oil/additives, oxidation resistance, compatibility and technical support.



Good chemistry supports the whole team!

6 VARNISH UNITED

Heat, oxidation, contamination, electrostatic discharge, micro-dieseling and poor oil condition create deposits.



I only need one weak link!



RIGHT TEAM. RIGHT STRATEGY. CLEAN OIL WINS.

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

Before we remove varnish, we must understand how it enters the match!

MEET THE ENEMY

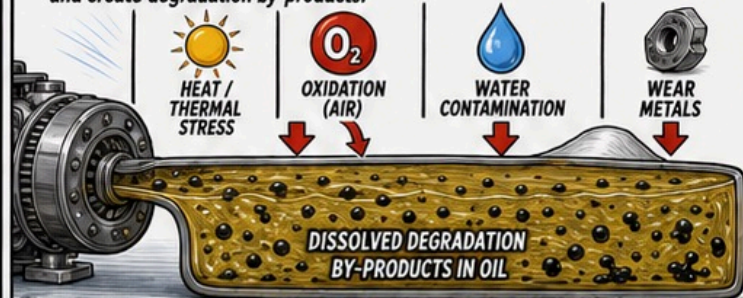
WHAT IS VARNISH?

THE STICKY STRIKER NOBODY WANTS



1 HOW VARNISH FORMS

Heat, air, water, and metals attack good oil and create degradation by-products.



Oil degradation creates **soft insoluble by-products**.

2 DISSOLVED FIRST, DEPOSIT LATER

Hot oil keeps by-products dissolved and moving... But when conditions change, they drop out of solution.



3 WHERE HE ATTACKS

Mr. Varnish targets critical components and quiet zones.

I don't need speed — I only need **low solubility!**

SERVO VALVE CLEARANCES



Sticks in tiny clearances. Causes sticking & delay.

JOURNAL BEARINGS



Builds on bearing surfaces. Increases friction & wear.

THRUST BEARINGS



Deposits on thrust surfaces. Reduces film & causes wear.

CONTROL LINES



Restricts flow. Hurts control response.

FILTERS



Blinds filters. Raises ΔP & causes bypass.

COOL SURFACES & RESERVOIR ZONES



Builds in cool zones & reservoir. Creates sludge & recontamination.

4 THE SCOREBOARD OF TROUBLE

WHEN MR. VARNISH SCORES...

⚽ HIGH MPC (DIRTY OIL)	1
⚽ STICKY / SLOW VALVES	1
⚽ TEMPERATURE RISE	1
⚽ FILTER PLUGGING	1
⚽ SLUGGISH CONTROLS	1
⚽ DEPOSITS ON PADS / BEARINGS	1

More deposits, more problems, more **wins** for me!



5 REMEMBER THE GAME PLAN

Varnish starts in the oil. If ignored, it attacks the machine and steals performance, reliability, and profit.

Don't let him keep the ball!



VARNISH STARTS IN THE OIL — THEN ATTACKS THE MACHINE.

If Mr. Varnish gets ball possession, the whole plant **loses the match!**

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

WORLD CUP 2026

OXIDATION TAKES THE FIRST SHOT

THE FIRST FOUL: OXIDATION



Oxidation always takes the first shot. Stop it early — or pay later!



Give me heat and oxygen... I'll make sludge famous.

OXIDATION DOESN'T NEED A FOUL TO CAUSE TROUBLE! IT NEEDS 4 THINGS.



TODAY'S GAME PLAN: ATTACK THE OIL!

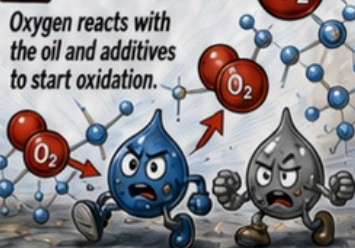
1 HEAT

High temperature speeds up chemical reactions.



2 OXYGEN

Oxygen reacts with the oil and additives to start oxidation.



3 TIME

The longer the oil stays hot and in service, the worse it gets.



4 STRESS / HIGH TEMP ZONES

Hot spots, shear, pressure and contaminants intensify the attack.



WE LOVE HOT SPOTS!



Heat + Oxygen + Time + Stress = Oxidation Attack!

HOW OXIDATION BREAKS DOWN YOUR OIL

Oxidation attacks the base oil and antioxidants.



Antioxidants are consumed trying to defend.



Additive depletion leaves the oil exposed.



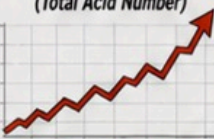
Oxidation by-products form sludge and varnish precursors.



GAME DAY SCORECARD

TAN TREND

(Total Acid Number)



RISING = MORE ACIDS

ANTIOXIDANT DEPLETION

(Phenols / Amines)



GOING DOWN = LESS PROTECTION

RPVOT MINUTES

(Oxidation Stability)



TRENDING DOWN = MORE RISK

FTIR OXIDATION INDEX

(Carbonyls / Oxidized Peaks)



TRENDING UP = MORE OXIDATION

RED CARD FOR OXIDATION!

WATCH THE SIGNS:

- ⚽ High TAN
- ⚽ Low antioxidants
- ⚽ Low RPVOT
- ⚽ High oxidation index
- ⚽ Sludge & varnish risk

EARLY DETECTION SAVES THE GAME!



TECHNICAL NOTES



Oxidation attacks the base oil and antioxidants.



Heat and oxygen accelerate oil aging.



As antioxidants deplete, the oil loses resistance.



Oxidation by-products can lead to sludge and varnish precursors.



OXIDATION STARTS THE ATTACK. VARNISH FINISHES IT.

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

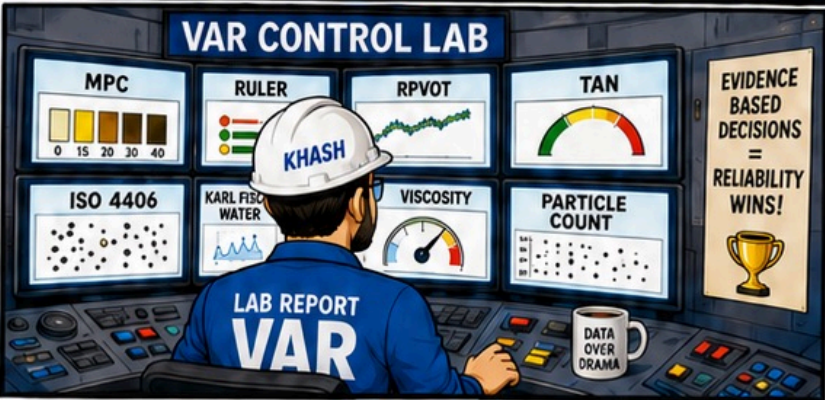
LET THE DATA REVIEW THE PLAY

LAB REPORT VAR

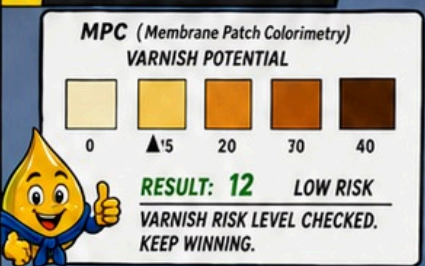
TRUST THE DATA, NOT THE NOISE!



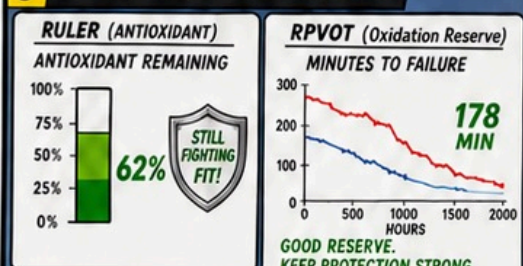
1 SAMPLE ENTERS REVIEW



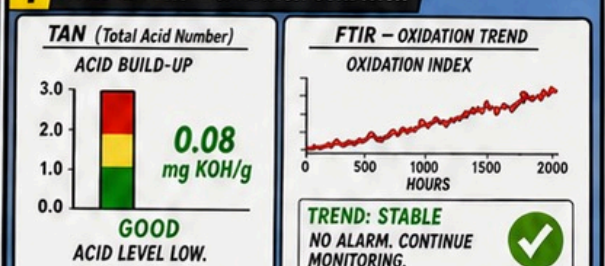
2 MPC – VARNISH POTENTIAL



3 RULER & RPVOT – OXIDATION DEFENSE



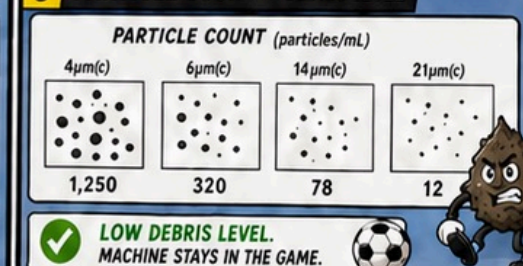
4 TAN & FTIR – OXIDATION CONDITION



5 ISO 4406 – CLEANLINESS CODE



6 PARTICLE COUNT – DEBRIS LEVEL



7 KARL FISCHER & VISCOSITY – CONDITION CHECK



VAR DECISION

OIL CONDITION:
GOOD – CONTINUE OPERATION
NO ACTION REQUIRED. KEEP MONITORING.



OIL ANALYSIS IS THE VAR OF RELIABILITY. THE LAB REPLAY SHOWS WHAT THE MACHINE CANNOT HIDE.

MPC SHOWS THE STAIN

PAGE 6 – MPC: THE VARNISH YELLOW CARD

COACH, THE PATCH IS DARKER THAN THE VILLAIN'S HEART.

FOUL!
EXCESS VARNISH POTENTIAL!



MPC REFEREE RELIABILITY CUP

1 WHAT IS MPC? 2 LIGHT PATCH vs DARK PATCH 3 DARKER PATCH = HIGHER RISK

MPC = MEMBRANE PATCH COLORIMETRY used to identify varnish potential through membrane patch discoloration.

- ✓ SIMPLE TEST.
- ✓ POWERFUL DATA.
- ✓ BIG IMPACT.

LIGHT PATCH (LOW MPC)	VS	DARK PATCH (HIGH MPC)
CLEAN LOOK. LOW VARNISH RISK.		DIRTY LOOK. HIGH VARNISH RISK.

DARKER PATCH = HIGHER VARNISH POTENTIAL.

MORE INSOLUBLE BY-PRODUCTS = HIGHER DEPOSIT RISK.

MPC IS YOUR EARLY WARNING SYSTEM.

4 WHAT THE PATCH CAPTURES

THE MEMBRANE CAPTURES SOFT CONTAMINATION / INSOLUBLE OXIDATION BY-PRODUCTS PRESENT IN THE OIL.

OIL

THE PATCH COLOR REFLECTS THE AMOUNT OF INSOLUBLE, SOFT CONTAMINATION.

5 TREND IT – DON'T JUST TEST IT!

TREND MPC OVER TIME, NOT ONLY ONE RESULT.

MPC (Membrane Patch Color)

RISING MPC = RISING RISK!

WATCH THE TREND. STOP THE END.

6 YELLOW CARD FOR HIGH MPC

WHEN MPC IS HIGH, VARNISH RISK IS ALREADY ON THE FIELD – PLAYING AGAINST YOU.

YELLOW CARD FOR EXCESS VARNISH POTENTIAL!

DON'T WAIT FOR RED CARD (DEPOSIT FAILURE)!

MPC QUICK GUIDE

	LOW MPC (0-15)	CLEAN OIL. LOW VARNISH RISK. KEEP IT UP!
	MODERATE MPC (16-30)	INCREASED RISK. INVESTIGATE AND TREND CLOSELY.
	HIGH MPC (>30)	HIGH VARNISH RISK. ACT NOW! PROTECT THE ASSET.

VARNISH RISK SCOREBOARD

GOOD OIL FC	HALF TIME	VARNISH VILLAINS
05		87

HIGH MPC MEANS VARNISH RISK IS ALREADY ON THE SCOREBOARD.

COACH KHASH SAYS...

- ✓ TEST SMART.
- ✓ TREND OFTEN.
- ✓ ACT EARLY.
- ✓ KEEP THE TURBINE IN THE GAME!

HIGH MPC MEANS VARNISH RISK IS ALREADY ON THE SCOREBOARD.

READ THE PATCH. TREND THE RISK. PROTECT THE TURBINE.

ARE THE DEFENDERS STILL FIT?

PAGE 7 - RULER: THE ANTIOXIDANT FITNESS TEST



Coach, Phenol is tired. Amine needs backup.

PHENOLS = FIRST-LINE ANTIOXIDANT DEFENSE.

Whew... feeling the heat.

AMINES = BACKUP / LONGER-TERM OXIDATION PROTECTION.

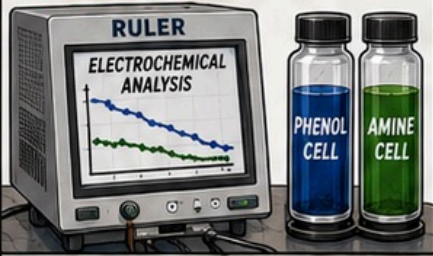
I'm holding the line, but pressure is building!

I'm waiting... when they weaken, I attack!



RULER FITNESS TEST STATION

RULER measures the REMAINING USEFUL LIFE of antioxidants.



- ✓ Tracks both PHENOLIC antioxidants.
- ✓ Tracks both AMINIC antioxidants.
- ✓ Quantifies REMAINING protection.

ANTIOXIDANT FITNESS SCOREBOARD

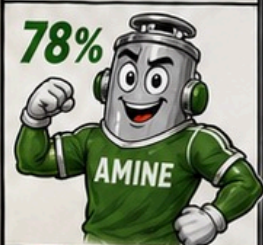
PHENOLIC (FIRST LINE)



% REMAINING ANTIOXIDANT



AMINIC (BACKUP)



OVERALL DEFENSE STATUS: CAUTION MONITOR & REPLENISH

WHAT THE SCORES MEAN

- STRONG DEFENDERS = BETTER PROTECTION**
Low oxidation. Low varnish risk. System stays clean.
- GETTING TIRED = WATCH THE TREND**
Protection dropping. Act now to prevent vulnerability.
- EXHAUSTED DEFENDERS = HIGH RISK**
Oxidation accelerates. Varnish pressure rises. Costly damage ahead.

1 WHAT RULER DOES

RULER uses electrochemical testing to measure how much antioxidant is STILL ACTIVE.



KNOW WHAT'S LEFT. PROTECT WHAT MATTERS.

2 TWO LINES OF DEFENSE

PHENOLIC (FIRST LINE) stops early oxidation.

AMINIC (BACKUP) protects longer-term by scavenging peroxides and breaking chain reactions.

BOTH ARE CRITICAL. BOTH MUST LAST.

3 DEPLETION = RISK

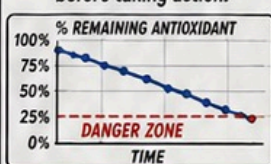
As antioxidants deplete, oxidation resistance drops and varnish can form.



LESS PROTECTION = MORE OXIDATION.

4 TREND, DON'T WAIT

Track the TREND over time. Don't wait for total exhaustion before taking action.



TREND THE DEPLETION, NOT JUST THE RESULT.

5 USE THE FULL PLAYBOOK

Don't rely on one test alone. Combine RULER with other key indicators.

- MPC - VARNISH RISK
- TAN - ACID BUILD-UP
- RPVOT - OXIDATION RESERVE
- OXIDATION TREND - OVER TIME

ONE TEAM. ONE PLAN. CLEAN OIL WINS.



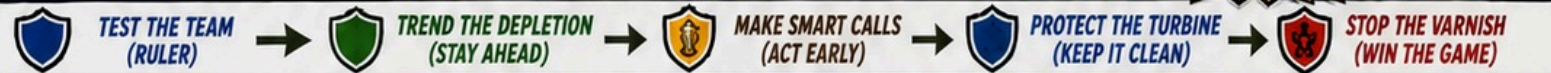
FIT TEAM. CLEAN OIL. WIN THE MATCH!

WHEN ANTIOXIDANTS DROP, VARNISH PRESSURE RISES.



RULER IS THE FITNESS TEST OF THE OIL'S ANTIOXIDANT DEFENSE TEAM.

FITNESS TEST BEFORE FAILURE!

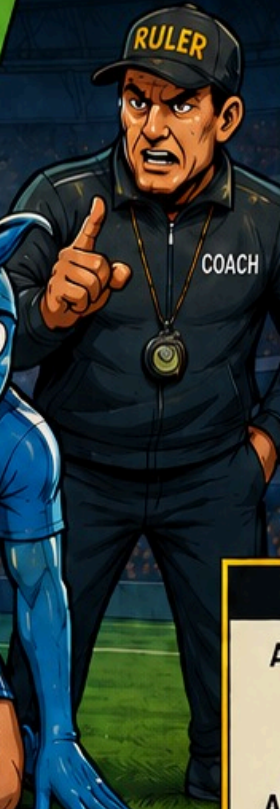


RULER: THE ANTIOXIDANT FITNESS TEST

ARE THE DEFENDERS STILL FIT?

COACH, PHENOL IS TIRED.

AMINE NEEDS BACKUP.



RULER TRACKS REMAINING ANTIOXIDANT PROTECTION



PHENOLIC ANTIOXIDANTS
(Primary Defense)



AMINE ANTIOXIDANTS
(Secondary Defense)

% REMAINING

LOW

OPTIMAL

HIGH



WHY IT MATTERS

ANTIOXIDANTS FIGHT OXYGEN AND FREE RADICALS. WHEN THEY DROP, THE OIL LOSES ITS DEFENSE AND **VARNISH PRESSURE RISES.**

COACH'S TIP

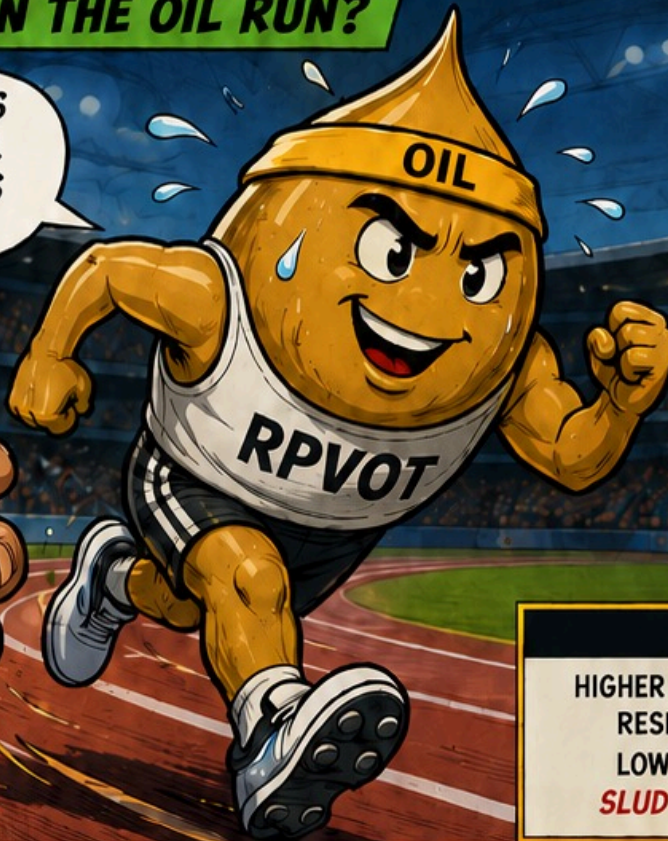
RULER = RESERVE ALKALINITY + ANTIOXIDANT DEPLETION (% REMAINING)

WHEN ANTIOXIDANTS DROP, VARNISH PRESSURE RISES.

RPVOT: STAMINA IN MINUTES

HOW LONG CAN THE OIL RUN?

MINUTES MATTER. EXCUSES DON'T.



RPVOT TEST

ROTATING PRESSURE VESSEL OXIDATION TEST

MEASURES OXIDATION STABILITY UNDER ACCELERATED CONDITIONS



REPORTED IN MINUTES

RPVOT GUIDE

> 75% OF NEW OIL	STRONG
50-75% OF NEW OIL	WATCH
25-50% OF NEW OIL	CAUTION
< 25% OF NEW OIL	CRITICAL

WHY IT MATTERS

HIGHER MINUTES MEAN BETTER OXIDATION RESISTANCE AND LONGER OIL LIFE. LOWER MINUTES = HIGHER RISK OF **SLUDGE, VARNISH AND DEPOSITS.**

RPVOT IS STAMINA — NOT THE FULL MATCH STRATEGY.
Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

THE SERVO VALVE PENALTY BOX

VARNISH LOVES TIGHT CLEARANCES

I ONLY NEED A THIN STICKY FILM TO RUIN YOUR DAY.



VARNISH AFFECTS:



SERVO VALVES



TRIP VALVES



BEARINGS



COOLERS



CONTROL COMPONENTS

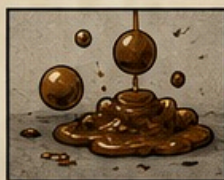


COACH'S TIP

VARNISH IS INSIDIOUS. IT BUILDS SLOWLY. IT STICKS TENACIOUSLY. IT COSTS EXPENSIVELY.

HOW VARNISH WINS:

1. FORMS



Oxidation creates varnish precursors.

2. DEPOSITS



Deposits build in tight clearances.

3. STICKS



Heat and pressure bake it on.

4. RESTRICTS



Flow restriction and sticking occurs.

5. FAILS



Control performance is compromised.

SMALL DEPOSITS CAN CREATE BIG CONTROL PROBLEMS.

KEEP THE REF (LAB) HAPPY:

- ✓ Monitor oil condition regularly.
- ✓ Maintain filtration and cleanliness.
- ✓ Control operating temperature.
- ✓ Use quality oil and additives.
- ✓ Act on data — early.
- ✓ Keep varnish out of the game.



LAB REF



SIGNED:

Reliability Coach

MAINTENANCE TEAM DEFENSE

1. BREATHERS

WEAK DEFENSE → **STRONG DEFENSE**

DESICCANT BREATHER

Keep airborne contamination and moisture out.

2. SEALS

LEAK ATTACK!

GOOD SEALS

Good seals stop ingress and oil loss.

3. RESERVOIR CLEANLINESS

CLEAN TANK vs **DIRTY SLUDGE**

Clean tank. Clean surfaces. Less varnish stress.

4. OIL TOP-UP PRACTICE

DO IT RIGHT vs **DO IT WRONG**

CLEAN SEALED CONTAINER + FILTER vs OPEN DIRTY BUCKET

Top up clean — never feed contamination.

5. FLUSHING

CONNECT FILTER → FLUSH FLOW → RETURN TO TANK

Proper flushing removes debris and loosened deposits before restart.

6. INSPECTION WINDOWS

SEE IT. KNOW IT. CONTROL IT.

See the condition early. Catch trouble before it scores.

7. KEEP THE VILLAINS OUT — PROTECT THE SYSTEM!

LEAKS, **DIRTY BREATHERS**, **DIRTY TOP-UPS**, **POOR SAMPLING**, **POOR HOUSEKEEPING**

BREATHERS, **SEALS**, **CLEAN TANK**, **CLEAN TOP-UP**, **FLUSHING**, **INSPECTION WINDOW**

BAD HOUSEKEEPING GIVES VARNISH FREE TICKETS.

WINNING STRATEGY:
GOOD MAINTENANCE CONTROLS INGRESS AND OPERATING STRESS.

MAINTENANCE STOPS THE EASY GOALS.

TRENDS WIN MATCHES

RELIABILITY **VARNISH**

3 0

MATCH TIME
73:24

1. VIBRATION

FEELS THE VIBES.
SPOTS THE CHANGE.

4. OPERATING HISTORY

KNOWS THE CONTEXT.
FINDS THE PATTERN.

WE DON'T CHASE THE BALL.
WE READ THE GAME.

2. TEMPERATURE

SPOTS HEAT RISE.
PREDICTS RISK.

3. OIL ANALYSIS

PARAMETER	TREND
ISO	↑
TAN	↓
RULER	↑
RPVOT	↓
WEAR	↑

READS THE OIL.
SEES THE FUTURE.

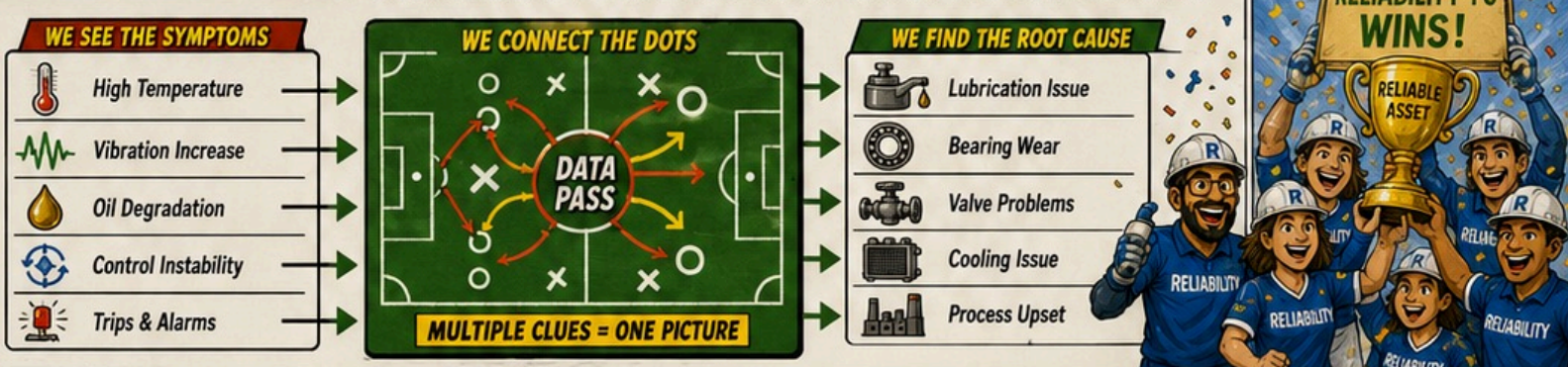


THE KEY TRENDS WE FOLLOW

<p>1. BEARING TEMPERATURE</p> <p>Heat up today, failure tomorrow.</p>	<p>2. VALVE RESPONSE</p> <p>Slow or sticky? We see it early.</p>	<p>3. TURBINE TRIPS</p> <p>Trips don't happen without a reason.</p>	<p>4. MPC</p> <p>Control is a clue. We watch the loop.</p>	<p>5. RULER</p> <p>Wear metals never lie.</p>	<p>6. TAN</p> <p>Acid rising? Trouble brewing.</p>	<p>7. RPVOT</p> <p>Oxidation ticking. Stability dropping.</p>	<p>8. ISO CLEANLINESS</p> <p>ISO CODE 18/16/13</p> <p>Clean oil, long life.</p>
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OUR CORE PLAY

RELIABILITY CONNECTS SYMPTOMS TO ROOT CAUSES.



COACH KHASH SAYS:

"Data without context is just noise. But trending with teamwork turns noise into knowledge and knowledge into winning decisions."

TREND THE DATA. CONTROL THE MATCH.

GAME PLAN CHECKLIST

- ✓ Trend what matters.
- ✓ Connect the dots.
- ✓ Find root cause.
- ✓ Act before failure.
- ✓ Rinse. Repeat. Win.



OEM REFEREE

PLAY BY THE MANUAL – PROTECT THE MACHINE



1. WRONG OIL

Using the wrong oil introduces chemistry, viscosity, or additives that can lead to varnish, wear, or component damage.

- ✓ Viscosity Grade
- ✗ Base Oil Type
- ✗ Additive Chemistry
- ✓ Compatibility

THE WRONG OIL IS A FOUL AGAINST RELIABILITY.

2. WRONG FILTRATION

Improper filtration or setup can't remove varnish effectively and can even make conditions worse.

- ✓ Filtration Technology Selection
- ✓ Flow Path & Design
- ✓ Offline / Online Arrangement
- ✓ Servo Sensitivity Protection

BAD FILTRATION = MISSED VARNISH, ADDED RISK.

3. WRONG PROCEDURE

Bad procedures create contamination, instability, and varnish – and may void warranties.

- ✗ Random Flushing
- ✗ Mixing Oils
- ✗ Changing Settings Without OEM Approval
- ✗ Skipping Steps or Testing

THERE IS A RIGHT WAY – FOLLOW IT.

4. OIL SELECTION

OEM requirements matter. Use approved products and follow the specified oil performance criteria.

- ✓ Meets OEM Spec
- ✓ Approved Products
- ✓ Performance Criteria
- ✓ Tested & Validated

THE RIGHT OIL. THE RIGHT SPEC. THE RIGHT RESULT.

5. COMPATIBILITY

Ensure compatibility with seals, coatings, materials, and existing oil to avoid reactions and failures.

NEW FLUID vs EXISTING OIL

Seals, Coatings, Materials, Existing Oil

INCOMPATIBILITY CREATES CHEMISTRY PROBLEMS.

6. CLEARANCES & SERVO SYSTEMS

Tight design clearances and sensitive control systems demand the right fluid and cleanliness control.

SERVO VALVE vs JOURNAL & THRUST SYSTEM

Tight Clearances (µm Level), Servo Valve Sensitivity, Cleanliness Control, Stable Fluid Performance

DESIGN CLEARANCES DON'T FORGIVE SHORTCUTS.

7. WARRANTY / DESIGN INTENT

Following OEM guidance protects warranties, ensures reliability, and preserves the design intent engineered into the machine.

- ✓ Protects Warranties
- ✓ Maintains Reliability
- ✓ Preserves Design Intent
- ✓ Reduces Risk & Cost



OEM GUIDANCE PROTECTS DESIGN INTENT.

BUY THE SOLUTION, NOT THE BROCHURE



WHAT GOOD GOALKEEPER (PROCUREMENT) EVALUATES BEFORE BUYING

<h3>1. CONTAMINANT TARGET</h3> <p>Define what must be removed for your system.</p> <ul style="list-style-type: none"> Varnish Potential (Soft Contaminants) Water (Moisture) Particles (ISO Cleanliness) <p>WHAT'S THE GOAL? BE CLEAR!</p>	<h3>2. FLOW RATE</h3> <p>Confirm the system flow is adequate for the reservoir and duty.</p> <p>RIGHT FLOW = RIGHT PERFORMANCE.</p>	<h3>3. RESIN / MEDIA CAPACITY</h3> <p>Check service life, dirt-holding or varnish-removal capacity.</p> <p>MORE CAPACITY = LONGER PROTECTION.</p>	<h3>4. COMPATIBILITY</h3> <p>Oil chemistry and material compatibility matter.</p> <p>RIGHT MATCH. NO REACTION. NO LEAKS.</p>
<h3>5. SERVICE PLAN</h3> <p>Changeout support, monitoring, and follow-up are required.</p> <ul style="list-style-type: none"> Changeout Support Condition Monitoring Sampling & Analysis Technical Support Follow-Up / Review <p>SUPPORT IS PART OF THE SOLUTION.</p>	<h3>6. EVIDENCE</h3> <p>Ask for data, test results, and measurable performance.</p> <p>SHOW ME THE DATA.</p>	<h3>7. REFERENCES</h3> <p>Look for proven field experience and credible installations.</p> <p>OTHERS TRUSTED THEM. YOU CAN TOO.</p>	<h3>8. KPIs (WHAT MATTERS)</h3> <p>Measure what matters for your asset.</p> <ul style="list-style-type: none"> MPC Reduction (ppm) Cleanliness Improvement (ISO Code) Moisture Control (ppm) Stable Operation (Alarms / Trips) <p>DEFINE. MEASURE. IMPROVE. WIN.</p>



BUY THE SOLUTION, NOT THE BROCHURE.

<p>RIGHT FIT. RIGHT FLOW. REAL RESULTS.</p>	<p>CLEAR CRITERIA. SMARTER BUY. BETTER VALUE.</p>	<p>PROTECT THE ASSET. REDUCE RISK. WIN THE GAME.</p>	<p>PROCUREMENT IS THE LAST LINE OF DEFENSE.</p>	<p>#1</p>
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TURBINE OIL SUPPLIER PLAYMAKER



BAD CHEMISTRY MAKES EASY GOALS FOR VARNISH.

YOUR CHEMISTRY DECISIONS INFLUENCE THE WHOLE MATCH.

1. OIL SELECTION

Choose the right turbine oil. Base oil quality and additive system matter.

WINNING FORMULA

- ✓ Base Oil Quality
- ✓ Additive Package
- ✓ Viscosity Grade
- ✓ Oxidation Stability
- ✓ Demulsibility
- ✓ Seal Compatibility

QUALITY BEATS LUCK EVERY TIME.

RIGHT OIL. RIGHT SYSTEM. RIGHT RESULTS.

2. COMPATIBILITY CHECKS

Every mix or top-up decision should be evaluated—don't just guess.

COMPATIBLE MIX
GOOD CHEMISTRY

- ✓ Same Chemistry Family
- ✓ Similar Additive Systems
- ✓ Proven Compatibility

RISKY MIX
BAD CHEMISTRY

- ✗ Unknown Chemistry
- ✗ Clashing Additives
- ✗ Increased Varnish Risk

CHECK BEFORE YOU MIX—AVOID CHEMISTRY FOULS.

3. ADDITIVE HEALTH

Healthy additives defend the system. Monitor and manage additive condition.

PHENOLS
OXIDATION DEFENDER

AMINES
ACID NEUTRALIZER

ADDITIVE PACKAGE
TEAM STRENGTH

CONDITION CHECK

Total Phenolics OK

Total Amines OK

Additive Health OK

KEEP THEM FIT

- ✓ Monitor Regularly
- ✓ Trend Over Time
- ✓ Replace or Replenish When Needed

STRONG ADDITIVES. STRONG DEFENSE.

4. RECLAIM STRATEGY

Work with your supplier to plan and execute varnish removal the right way.

COACH THE CLEANUP, DON'T HOPE IT HAPPENS.

RECLAIM PLAYBOOK

- VARNISH MITIGATION
- OIL RECLAMATION
- FILTRATION & MONITORING
- CONFIRM CLEAN CHEMISTRY

PLAN. EXECUTE. VERIFY. REPEAT.

5. TOP-UP DECISIONS

Top up the right way—protect the chemistry you've built.

PROPER TOP-UP

- Identify the Oil
- Match the Spec
- Maintain Traceability
- Record What You Add

RANDOM TOP-UP
DON'T GAMBLE

- ✗ Unknown Oil
- ✗ No Records
- ✗ Greater Risk

TOP UP SMART. PROTECT THE GAME.

6. WHOLE SYSTEM BENEFIT

Good formulation choices deliver reliability across the entire system.

RELIABLE TURBINE PERFORMANCE

- CLEANER OIL
- LONGER OIL LIFE
- LOWER WEAR
- BETTER EFFICIENCY
- FEWER TRIPS
- HIGHER AVAILABILITY

PROTECT CHEMISTRY. PROTECT PERFORMANCE.



THE SUPPLIER HELPS PROTECT THE CHEMISTRY.

BASE OIL QUALITY BUILDS THE FOUNDATION.

ADDITIVES DEFEND AGAINST OXIDATION AND DEPOSITS.

COMPATIBILITY PREVENTS CHEMISTRY MISMATCHES.

RECLAIM + FILTRATION RESTORES CLEAN CHEMISTRY.

SMART TOP-UPS PRESERVE WHAT YOU PROTECT.

#1

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

CHOOSING THE VARNISH REMOVAL STRATEGY

RIGHT TACTIC. RIGHT TECHNOLOGY.

YOU DON'T USE A GOALKEEPER AS A STRIKER.

PLAN
PICK
EXECUTE
WIN



MATCH THE TECHNOLOGY TO THE CONTAMINANT.

1. DEPTH FILTRATION



Captures particles and soft varnish sludge throughout the oil.

BEST FOR:

Soft deposits, particulates, oxidation products.

KEY BENEFITS:

- ✓ High dirt holding capacity
- ✓ Broad range of micron ratings
- ✓ Cost effective first line defense

2. ELECTROSTATIC CLEANING



Charges and removes polarized varnish and sub-micron contaminants.

BEST FOR:

Varnish, fine particles, water breakdown control.

KEY BENEFITS:

- ✓ Removes varnish that filters miss
- ✓ Extends fluid life
- ✓ Runs online or offline

3. ION EXCHANGE



Removes acids, oxidation by-products and polar contaminants.

BEST FOR:

Acidic oil, TAN reduction, RPVOT stability.

KEY BENEFITS:

- ✓ Extends oil oxidation life
- ✓ Improves RPVOT and stability
- ✓ Regenerable media

4. ADSORPTION MEDIA



Adsorbs varnish precursors, sludge micelles and contaminants.

BEST FOR:

Varnish precursors, color removal, oxidation control.

KEY BENEFITS:

- ✓ Deep cleans the oil
- ✓ Improves color and cleanliness
- ✓ Long service life with high capacity

5. DEHYDRATION (WATER REMOVAL)



Removes dissolved and free water from the oil.

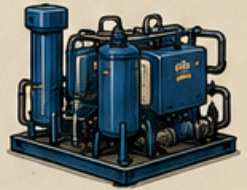
BEST FOR:

Water ingress, emulsion control, oxidation prevention.

KEY BENEFITS:

- ✓ Prevents hydrolysis and acid formation
- ✓ Improves dielectric and reliability
- ✓ Protects additives and varnish control

6. OFFLINE KIDNEY-LOOP CONDITIONING



Continuous offline conditioning with multi-technology filtration.

BEST FOR:

Severe varnish, large systems, continuous control.

KEY BENEFITS:

- ✓ No shutdown required
- ✓ Consistent oil quality control
- ✓ Reduces wear and failures

COACH'S TIP

THE BEST RESULTS COME FROM USING THE **RIGHT COMBINATION** IN THE **RIGHT SEQUENCE**.



RIGHT TACTIC. RIGHT TECHNOLOGY. WIN RELIABILITY.

SIGNED:

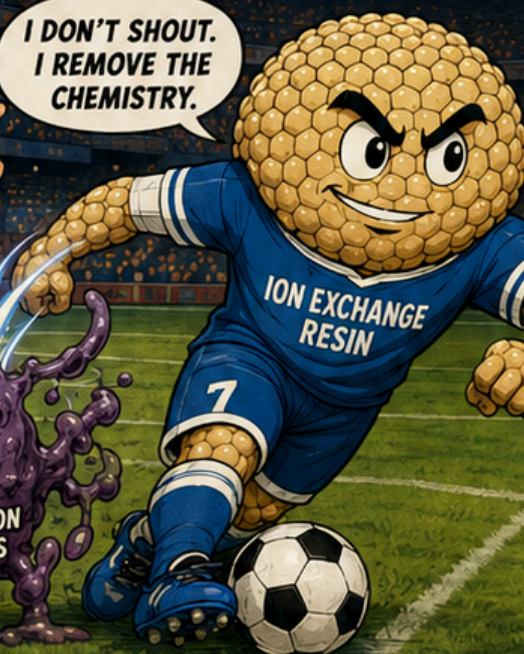
Reliability Coach

ION EXCHANGE ENTERS THE MATCH

TODAY, WE DEPLOY THE CHEMISTRY PLAYMAKER!



I DON'T SHOUT. I REMOVE THE CHEMISTRY.

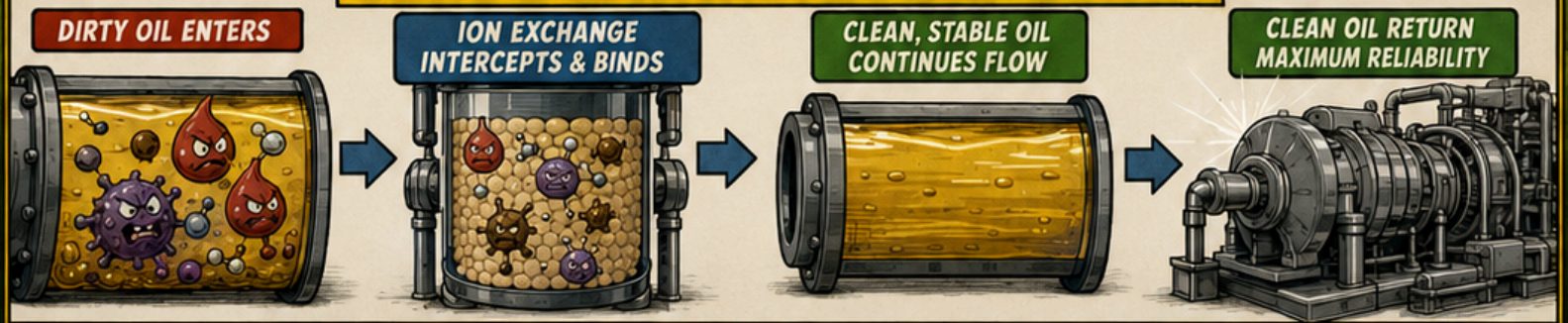


NOT JUST SURFACE CLEANING. CHEMISTRY-BASED REMOVAL!

- ION EXCHANGE TACKLES:**
- ⚽ POLAR MOLECULES
 - ⚽ ACIDIC COMPOUNDS
 - ⚽ SOLUBLE VARNISH PRECURSORS
 - ⚽ OXIDATION BY-PRODUCTS



THE PLAY SEQUENCE: CHEMISTRY REMOVED BEFORE IT CAUSES DAMAGE



<p>1. POLAR DEGRADATION PRODUCTS</p> <p>Polar oxidation products are attracted to the resin and removed from the oil.</p> <p>KEY POINT: Polarity drives attraction.</p>	<p>2. ACIDIC BY-PRODUCTS</p> <p>Organic acids and other acidic species are captured, improving oil neutrality and protecting surfaces.</p> <p>KEY POINT: Neutralize the acid. Protect the system.</p>	<p>3. SOLUBLE VARNISH PRECURSORS</p> <p>Soluble precursors are removed before they polymerize, deposit, and cause varnish.</p> <p>KEY POINT: Stop deposits before they form.</p>	<p>4. PROPER MEDIA SELECTION</p> <ul style="list-style-type: none"> ✓ Match resin type to oil chemistry and target. ✓ Strong exchange capacity. ✓ Good kinetics. ✓ Thermal & oxidative stability. <p>KEY POINT: Right resin. Right results.</p>	<p>5. COMPATIBILITY MATTERS</p> <ul style="list-style-type: none"> ✓ Compatible with base oil and additives. ✓ No swelling or leaching. ✓ Stable across operating temperature. ✓ System materials compatibility. <p>KEY POINT: Compatibility keeps performance safe.</p>	<p>6. CLEAN OIL RETURN</p> <p>Cleaner oil = fewer deposits, less wear, better efficiency, longer oil & asset life.</p> <p>KEY POINT: Clean chemistry. Reliable operation.</p>
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COACH KHASH SAYS

WINNING ISN'T ABOUT BRUTE FORCE. IT'S ABOUT SMART CHEMISTRY AND THE RIGHT SELECTION!



REMOVE THE CAUSE, NOT ONLY THE STAIN.

SIGNED: *Khash*

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

THE FANCY WINGER

FAST FEET, CLEAR LIMITS



ELECTROSTATIC FILTRATION IS A FAST, SKILLED WINGER AGAINST FINE INSOLUBLE CONTAMINATION!



I'M STYLISH, BUT DON'T ASK ME TO PLAY EVERY POSITION.



FINE INSOLUBLE PARTICLES

ELECTROSTATIC SYSTEMS CAN HELP WITH FINE INSOLUBLE CONTAMINATION.

THEY ARE **NOT** AUTOMATICALLY THE COMPLETE ANSWER FOR ACIDS, WATER, OR SOLUBLE VARNISH.

1. WHAT IT DOES WELL

Electrostatic filtration targets what it's built for – very fine insoluble contamination.

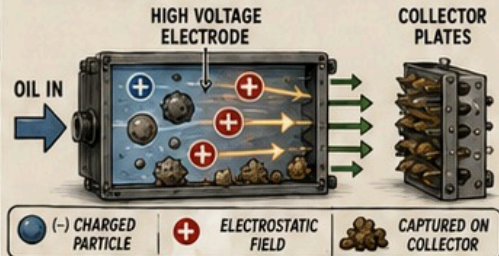
- ✓ Fine Insoluble Particles
- ✓ Soft Sludge Fines
- ✓ Oxidation By-Products That Are Already Insoluble
- ✓ Cleanliness Support



FAST FEET FOR THE TINY, TOUGH STUFF.

2. HOW IT PLAYS

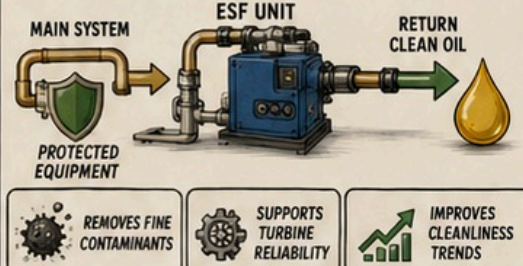
Uses high voltage to create an electrostatic field. Particles are charged, attracted, and captured on collector media.



CHARGE IT. ATTRACT IT. CAPTURE IT.

3. WHERE IT HELPS

Best as a kidney-loop (side-stream) system to continuously polish oil and control fine contaminants.



SIDE-STREAM SUPPORT. BIG IMPACT.

4. CLEAR LIMITS

Great winger, but not the full solution for every contaminant.

- ✗ **ACIDS** Does not remove acids. May help protect equipment, but not an acid control system.
- ✗ **WATER** Does not remove water. Dehydration is a separate process.
- ✗ **SOLUBLE VARNISH PRECURSORS** Does not remove soluble varnish precursors. May improve varnish control in some situations, depending on what is actually present.

NOT A MAGIC WAND FOR EVERYTHING.

5. DON'T ASK ME TO PLAY EVERY POSITION

Electrostatic filtration is a winger – not a full team.

I'M STYLISH, BUT DON'T ASK ME TO PLAY EVERY POSITION.

- ✗ **STRIKER** Not for removing chemistry (acids).
- ✗ **GOALKEEPER** Not for removing water.
- ✗ **DEFENDER** Not for soluble varnish precursors.

KNOW THE ROLE. GET THE RIGHT RESULT.

6. BEST USE

Match the technology to the contaminant and the objective.

- Identify the real contaminants and root causes.
- Select the right technology for each challenge.
- Combine systems for total reliability and performance.
- Right technology. Right placement. Right results.



MATCH THE TECH. WIN THE GAME.

MATCH RESULT		
FINE INSOLUBLE	WIN	✓
ACIDS	NO WIN	✗
WATER	NO WIN	✗
SOLUBLE VARNISH	NO WIN	✗



USEFUL TECHNOLOGY. NOT MAGIC.



- KNOW THE PLAYER. KNOW THE LIMITS.
- MATCH THE TECH TO THE PROBLEM.
- BUILD THE RIGHT TEAM. WIN RELIABILITY.
- CLEANER OIL. STRONGER TURBINE. BETTER PERFORMANCE.

AFTERMARKET CHEMICALS: THE SHORT WIN TRAP

A LITTLE
CHEMICAL AND
IT WILL BE
CLEAN!

VARNISH ISSUES ARE NOT A CHEMICAL PROBLEM TO DISSOLVE.

NOT ALLOWED!
RISK TO ASSETS,
WARRANTY AND
RELIABILITY.



NOT ALLOWED:

- ✗ SOLVENTS
- ✗ DETERGENTS
- ✗ HARSH CLEANERS
- ✗ OILY DISPLACERS
- ✗ DIY FORMULATIONS

= SHORT WIN,
LONG-TERM PAIN

THE PROMISE (THEY SELL)

- DISSOLVES VARNISH FAST
- CLEANS SYSTEM QUICKLY
- RESTORES PERFORMANCE IMMEDIATELY
- LOW COST, EASY TO USE

THE REALITY (THEY HIDE)

- DISTURBS DEPOSITS → MORE CIRCULATION → MORE DAMAGE
- BREAKS DOWN ADDITIVES AND OIL CHEMISTRY
- CREATES MORE OXIDATION AND SLUDGE LATER
- HARMFUL TO SEALS, VARNISH SENSORS, AND SERVO VALVES
- VOIDS WARRANTIES AND INSURANCE COVER
- SHORT WIN TODAY, EXPENSIVE LOSS TOMORROW

VARNISH IS A SYMPTOM. THE CAUSE IS CHEMISTRY, HEAT, AIR, AND TIME.

INSTEAD OF CHEMICALS, PLAY THE RIGHT STRATEGY

- FIND THE ROOT CAUSE**
Oxidation, contamination, wrong oil, high temperature, poor maintenance
- CONTROL INGRESS & OPERATING STRESS**
Air, water, dirt out. Temperature in control.
- USE PROVEN TECHNOLOGIES**
Depth filtration, ion exchange, adsorption, electrostatic, dehydration.
- RESTORE CHEMISTRY & CLEANLINESS**
Remove acids, remove particles, protect the oil.
- TREND, VERIFY, SUSTAIN**
Data confirms improvement. Keep it that way.



THE SCOREBOARD

CHEMICAL SHORT WIN VS RELIABILITY LONG GAME

SHORT TERM

Looks better fast Improves step by step

LONG TERM

More deposits, more risk Stable oil, reliable system

COST

Cheap now, expensive later Smart investment, lower total cost

RISK

High risk of failure Low risk, high confidence

REMEMBER:



THERE ARE NO
SHORTCUTS TO
RELIABILITY.



WIN THE MATCH
THE RIGHT WAY.

DON'T DISSOLVE THE FUTURE.
PROTECT IT.

SIGNED:

Reliability Coach

FINAL MATCH: CLEAN OIL SCORES VARNISH GETS RED CARDED

GOOOOAL!
Clean oil takes the lead!



RED CARD TO VARNISH! GAME OVER!

TEAMWORK. TECHNOLOGY. CLEAN OIL. CHAMPIONS AGAIN!



MATCH RESULTS: BEFORE vs AFTER

1. HIGH MPC → CONTROLLED MPC		2. STICKY VALVES → RESPONSIVE VALVES		3. DIRTY OIL → CLEAN OIL		4. REACTIVE WORK → PLANNED RELIABILITY	
BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
HIGH MPC OUT OF CONTROL	CONTROLLED MPC IN CONTROL	STICKY VALVES SLOW. STICKY.	RESPONSIVE VALVES FAST. RELIABLE.	DIRTY OIL DEPOSITS. SLUDGE.	CLEAN OIL CLEAN. PROTECTED.	REACTIVE WORK FIRES. STRESS.	PLANNED RELIABILITY PLANS. RESULTS.



OUR WINNING STRATEGY

- ✓ Analyze the data
- ✓ Filter the oil
- ✓ Fix the causes
- ✓ Plan the work
- ✓ Repeat the wins

PLAY SMART. PLAY CLEAN. WIN BIG.



WHEN TEAMS WORK TOGETHER, VARNISH LOSES.

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

CLEAN OIL WINS THE CUP

**CHAMPIONS OF RELIABILITY!
CHAMPIONS OF TEAMWORK!**

**ONE TEAM.
ONE STRATEGY.
ONE GOAL.
ONE CUP!**

**WELL PLAYED!
WELL MANAGED!
WELL EARNED!**

RELIABILITY WINS!

**WE SPUN WITH PURPOSE!
WE FINISHED AS CHAMPIONS!**

**GREAT SAVES!
GREAT DEALS!
GREAT IMPACT!**



PROCUREMENT GOALKEEPER

CLEAN OIL CHAMPIONS!

TURBINE OIL SUPPLIER PLAYMAKER

CAPTAIN TURBINE

FIVE LESSONS. ONE STRATEGY. ENDLESS RELIABILITY.

1. ANALYZE RIGHT



Understand the system.
Find the root causes.

2. SELECT RIGHT



Choose the right solution
and the right technology.

3. FILTER RIGHT



Remove the right contaminants
with the right method.

4. VERIFY WITH DATA



Measure, trend, and prove
improvement.

5. PROTECT CONTINUOUSLY



Keep monitoring, keep improving,
keep the system clean.

VARNISH REMOVAL IS NOT A PRODUCT. IT IS A TEAM STRATEGY.

Khash, MLE, CLS, MLA III, MLT II, VIM, VPR

**—KHASH
RELIABILITY COACH**