MPC VARNISH POTENTIAL TESTING

By Larry Jordan, Sr. Technical Advisor, RIG

Whitepaper

SYNOPSIS

Membrane Patch Colorimetry (MPC) varnish potential testing is the industry gold standard to test oil for varnish. It's recommended you have MPC testing conducted monthly. In this brief guide, we provide a rundown of MPC varnish potential testing, walking you through: what it is. what the various test parameters mean; and the materials are required to conduct proper MPC testing.

OVERVIEW

Oil varnish deposits cause major problems in turbines and other industrial equipment, from hurting system performance and reducing system lifecycles to destroying key parts and causing costly, unplanned shutdowns. With the probability of varnish-related failures reported as high as 100 percent, it's mission-critical to know if your lubricant is forming varnish deposits.

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- What it is
- What the various test parameters mean
- And the materials are required to conduct proper MPC testing

This actionable guide is for you if you are responsible for the maintenance and proper functioning of turbines and other plant equipment.

MPC VARNISH POTENTIAL TESTING BASICS

Membrane patch colorimetry (MPC) varnish potential testing (ASTM D7843) is an analytical test to determine the propensity for a lubricant to form varnish deposits. The ASTM-approved MPC test isn't terribly complex and can be integrated into existing lubricant analysis testing programs. It can also be performed on-site with a modified test method for rapid assessment of possible varnish-induced problems.

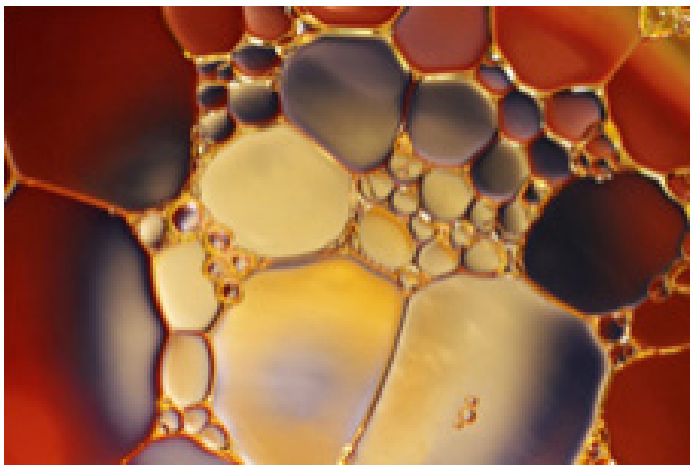

Figure 1. Membrane Patch Colorimetry

TESTING PROCESS

MPC varnish potential testing is two-step process: filtration and color measurement.

1. Filtration
- Start by testing 50 mL of your oil lubricant
- Dilute it with an equal volume of petroleum ether
- Filter the mixture through a 0.45 µm nitrocellulose patch
- Rinse the patch with petroleum ether
- Dry the patch

2. Color Testing
- Measure the intensity and color of the patch against a control patch
- Use a spectrophotometer to calculate the color difference, also known as ΔE value
- Assess the ΔE value and corresponding propensity for varnish deposit formation using an MPC scale

INTERPRETING RESULTS WITH AN MPC SCALE

- Use an MPC Scale as a guideline to assess your lubricant's potential for varnish formation

There are 4 ranges on the varnish potential scale, displayed in Table 1:

ΔE value	Condition
<15	Good
15 – 25	Monitor
25-35	Abnormal
>35	Critical

Table 1. Varnish Potential Scale

In this case, a lower number is good. The higher the MPC value, the more varnish and precursors are dissolved in your lubricant and the higher its propensity to form damaging deposits.

UNDERSTANDING MPC VALUES

To minimize varnish deposits, ideal lubricant operating condition is at an MPC ΔE value of <15.
But what does that mean?

MPC VALUE BASICS

- Lower MPC ΔE value means higher oil solvency
- High oil solvency prevents varnish deposit formation
- It also means existing deposits will be dissolved, making them less harmful

When your lubricant's MPC ΔE value is maintained below 15, it contains few varnish precursors and isn't prone to deposit formation. It's also at its most solvent and actively removes existing varnish deposits from metal surfaces—that's good.

MPC VALUES AND THE VARNISH FORMATION PROCESS

It's key to understand what you're up against when we talk about MPC values:

- MPC values increase as dissolved oil breakdown products (varnish precursors produced by oxidation) accumulate
- Products build up from the time your oil goes into service
- All oil has a limited ability—a saturation point—to hold dissolved oxidation products in solution
- Once that point is reached, the oil is saturated and excess products escape solution, forming harmful varnish deposits
- Due to polar attraction between varnish and metal, varnish coats metal surfaces, hurting performance and causing failure

The saturation point varies with dynamic parameters:

- Lubricant temperature
- Lubricant pressure
- Lubricant flow

As a result of dynamic variables, varnish often forms deposits in key mechanical areas before forming them in oil reservoirs. It's crucial to implement a varnish prevention program to address deposits during normal turbine operation—while varnish precursors are still dissolved.

MATERIALS REQUIRED FOR POTENTIAL TESTING

There are four main apparatus and three main consumables required to complete MPC testing.

APPARATUS

- Patch test kit
- Vacuum pump—hand pump for field use or electric vacuum pump for lab use
- Spectrophotometer
- Oven—if you use the ASTM testing method

CONSUMABLES

- Petroleum Ether—50–100 mL petroleum ether required per test.
- Filter patch
- Plastic ware—100ml graduated beaker to mix solvent and lubricant & 100ml+ solvent wash bottle to rinse the patch

SUMMARY

Varnish deposits are harmful to gas turbines and other industrial equipment. From the moment your oil is put into use, it will oxidize and increasingly form varnish in solution. Once the varnish buildup reaches a saturation point, the varnish will escape solutions and form harmful deposits—it's only a matter of time.
To stop this from happening, regular monthly MPC varnish potential testing of your oil is required. The MPC testing helps you determine whether or not it's at risk to form deposits.

MPC testing uses a two-step process

- Filtration
- Color analysis

Results are measured using a ΔE value comparing colors from the sample on a patch against colors on a control patch. A value of 15 or less means your oil has high solvency, few varnish particles in solution and low risk of deposit formation. The higher your oil's ΔE value, the lower its solvency and higher its risk of harmful deposit formation. To conduct the test, you'll need a testing kit complete with several key apparatus and consumables.

RIG RELIABLE INDUSTRIAL GROUP
CCT COGEN GLOBAL COGEN CLEANING TECHNOLOGY INC.
ESI ENERGY SERVICES INTERNATIONAL
PETROLINK USA

Contact us for more information:

info@therigteam.com
800-770-4510 (Domestic)
+1 281-339-5751 (International)
www.TheRigTeam.com