Mineral Oil-Free Rust Preventive

IMCD & Lubrizol

October, 2025

Creating a world of opportunity

Project Objectives

- Background: Some of our customers in Brazil, requested us solutions to attend the NR-15 rules. This is a labor rule that includes in the salary of workers in contact with harm agents (physical, chemical or biological). Mineral Oil is one of this agents classified in this rule.
- Project opened to develop a mineral oil-free rust preventive for Brazil / Latin America
- Performance requirements
  - Calcium base product to be environmentally friendly
  - Alox® 165BR product and Alox® MT1000 components used as reference for initial Research & Development
  - Testing comparison versus Alox® 2028BR, our successful incumbent technology in Brazil
  - Comparable Salt Spray protection and demulse performance at equal treat rate in solvent

Performance Testing

Property	Method	Rust Preventive Concentration
Corrosion protection	ASTM B117 salt spray	20% in D60 solvent
Stack stain	Modified Mil-C-22235A	20% in D60 solvent
Demulsification	LZ in-house water separation	20% in D60 solvent
Demulsification	LZ method WS-3	7% in solvent/oil mixture
Demulsification	ASTM D1401_54	20% in D60 solvent
Water displacement	Mil-PRF-16173E	5% in D60 solvent

Performance target: Equal performance to Alox® 2028BR control

ASTM B117 Salt Spray

- **Accelerated corrosion testing** for outdoor storage and salt atmosphere
  - 95 °F (35 °C) atmospheric temp.
  - 5.0% NaCl solution
- Rust preventives applied by dipping
  - 1008 steel Q panels used
  - Dipped panels are allowed to dry for 24 hours before placing in cabinet
- Run to failure
  - Fail = >5% rust on panel surface
  - Disregard outer 1/8 inch of panel

Water Separation (LZ In-House Method)

- Test to measure the ability of a rust preventive (RP) **to separate water carryover** from rinse operations
  - 75 mL RP solution (20% in D60 solvent)
  - 25 mL water
- Test procedure:
  - Place water followed by RP in 100 mL graduated cylinder
  - Invert six times
  - Record time to separate 25 mL of water

Water Separation (LZ WS-3 Method)

- Test to measure the ability of a rust preventive (RP) **to separate water carryover** from rinse operations
  - 40 mL solvent/oil RP blend
  - 40 mL water

Solvent/Oil RP Blend	
Rust preventive	7%
Butyl carbitol	2%
Naphthenic oil *	35%
D60 solvent	56%

- Test procedure:
  - Place water followed by RP in 100 mL graduated cylinder
  - Invert ten times
  - Record time to separate 40 mL of water

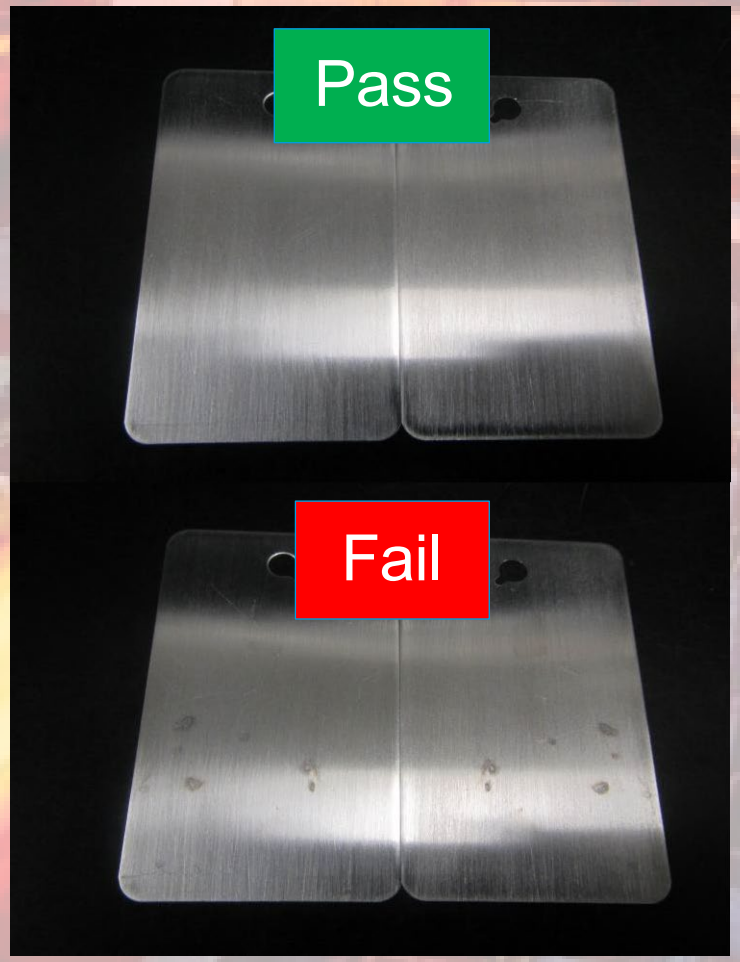
* Can be replaced by esters or vegetal oil

ASTM D1401 Demulsification Testing

- Test to measure **water separability** of petroleum oils
  - 40 mL RP solution (20% in D60 solvent used)
  - 40 mL deionized water
- Test procedure:
  - Place water followed by RP in 100 mL graduated cylinder
  - Invert several times
  - Place in 54 °C bath and lower stirring paddle into cylinder
  - Stir at 1500 rpm for 5 minutes
  - Examine every 5 minutes and record time to reach 40 mL oil, 40 mL water, and 0 mL emulsion

Modified Stack Stain Test: Mil-C-22235A

- Determines **the effect of water contamination, heat, and metal-to-metal contact** on coiled or stacked metal surfaces
  - Evaluate neat, and water-contaminated rust preventive solution
  - Coated panels stacked in a sandwich arrangement
  - Stored at 180 °F (82 °C) for 24 hours
- Fail = any sign of stain or rust



Water Displacement: Mil-PRF-16173E

- Determines the ability **to displace water from a metal surface**
  - Wet panel is dipped in modified rust preventive solution
  - Panel is exposed to static humidity chamber at 77 °F (25 °C) for 1h
- Fail = any sign of rust, mottling or surface stains

Initial Screening, Part 1

RP	AX2028BR	RP 1	RP 2	RP 3
20% RP in D60 Solvent				
ASTM B117 Hours to fail	75-85 50-66	85-93 77-85	170-186 62-70	126-134 146-162
Water Separation, minutes to separate				
LZ In-House	5:52	2:53	4:13	3:47
WS-3 Method	10:15	5:08	NR	2:56
ASTM D1401_54	5 (40-40-00)	10 (40-40-00)	30 (18-29-33)	20 (40-38-02)

Initial Screening, Part 2

RP	AX2028BR	RP 4	RP 5	RP 6
20% RP in D60 Solvent				
ASTM B117 Hours to fail	75-85 50-66	96-104 96-104	161-168 121-137	88-96 72-88
Water Separation, minutes to separate				
LZ In-House	5:52	30:00	18:38	16:48
WS-3 Method	10:15	10:32; hazy water	NR	4:34; hazy
ASTM D1401_54	5 (40-40-00)	5 (40-40-00)	30 (00-38-42)	10 (40-40-00)

Top Candidates

Best demulse

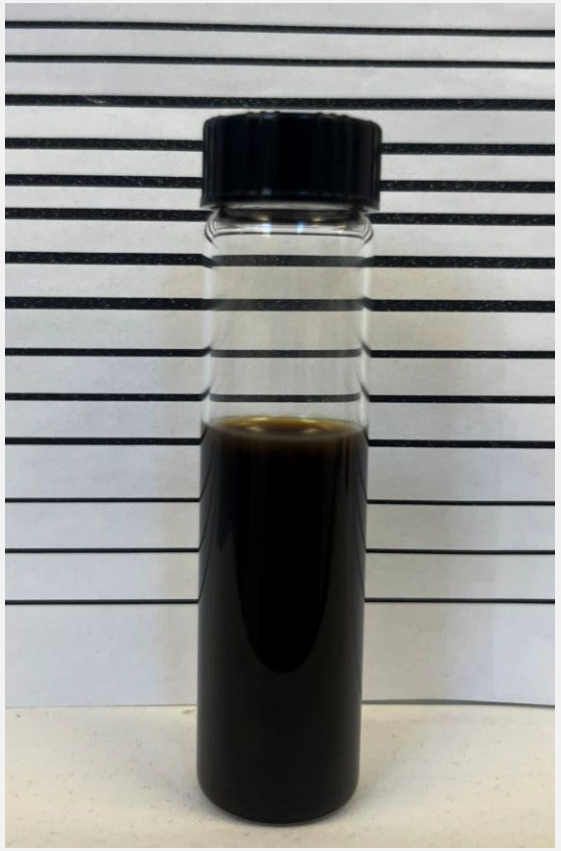
Best protection but worst demulse

Some gaps (WS-3 hazy and Stack Stain)

RP	AX2028BR	RP 1	RP 3	RP 6
20% RP in D60 Solvent				
ASTM B117 Hours to fail	75-85 50-66	85-93 77-85	126-134 146-162	88-96 72-88
Water Separation, minutes to separate				
LZ In-House	5:52	2:53	3:47	16:48
WS-3 Method	10:15	5:08	2:56	4:34; hazy
ASTM D1401_54	5 (40-40-00)	10 (40-40-00)	20 (40-38-02)	10 (40-40-00)
Water Displacement	Pass/Pass	Pass/Pass	Fail/Fail	Pass/Pass
Stack Stain	Pass/Pass	Pass/Pass	Pass/Pass	Pass/Fail

Chosen Formula

RP 1: Appearance

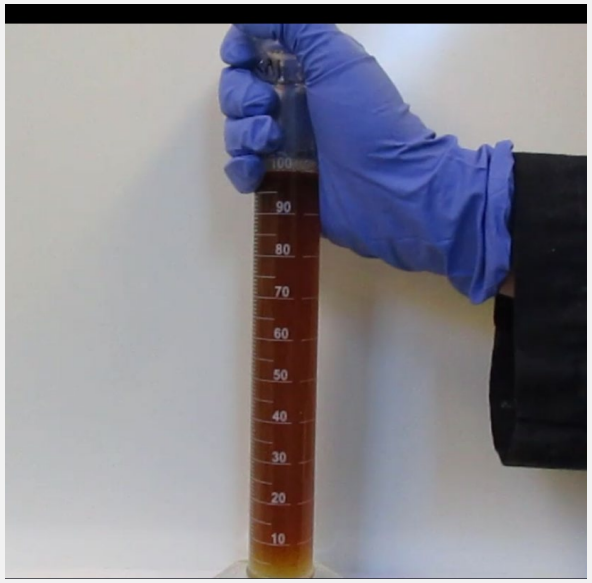


Rust preventive concentrate

Rust preventive dilution,
20% in mineral spirits

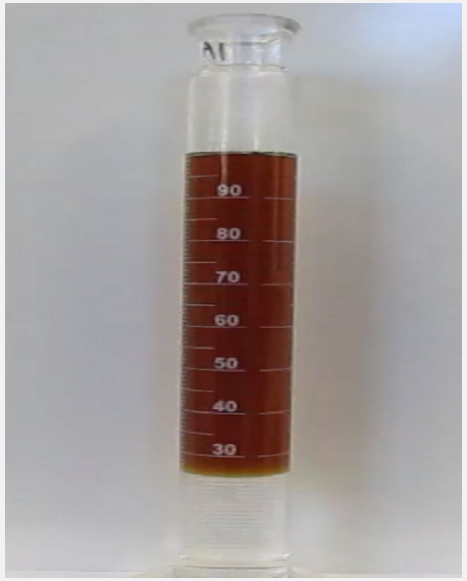
RP 1: Water Separation

LZ In-House Method
20% RP in mineral spirits
Time to separate: 2:53



0:00

1:25

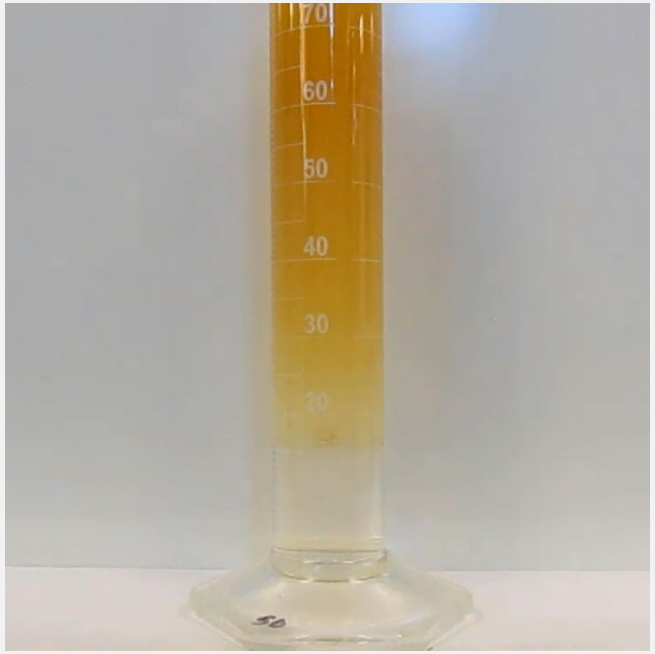


2:53

RP 1: Water Separation

LZ WS-3 Method
7% RP in solvent/oil dilution
Time to separate: 5:08

0:00



2:35

5:10

Conclusions

- RP 1 has shown the best results in comparison to reference Alox 2028BR
- RP 1 was selected to be future Alox Mineral Oil Free
- During Product / Plant set up, Regulatory doc. etc product will be called **OS648954**
- Product Lauch expected 1Q 2026.
- Lubrizol and IMCD can ship from USA to Brazil samples for customer evaluation and own developments during the internal process of New Product Launching.

IMCD

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Thank you!

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