

The background of the slide features a vibrant sunset sky in shades of orange, yellow, and pink. On the left, a portion of a red wind turbine is visible. On the right, a large array of solar panels is shown, tilted towards the sun. The overall scene conveys a sense of clean, sustainable energy.

Nanol

Performance optimization of your bearings

JT Energy Solutions

Contribute to sustainable energy

# A strong partnership



Bearing protection with Nanol

## Nanol Technologies AB

### *Our Company*

- Stockholm based privately owned advanced lubricant additive development company
- Focused on the new generation of environmental solutions for the lubrication sector
- Key research partner Fraunhofer Institute for Mechanics of Materials in Germany & University of Southampton
- Own R&D at Smart Chemistry Park in Raisio, Finland
- Diverse multi-disciplinary team of tribologists, chemical engineers and business professionals
- Established commercial sales in the marine industry
- Focus on wind turbine bearing and gear, mining, railway, and marine lubrication

### *Our Mission*

- Value creation by focusing on the environment and sustainability
- Passion for green chemistry
- Minimize environmental impact and accelerate the transition to clean energy
- Work smarter and more creatively through diverse teams

### *Company Purpose*

- Contribute to society with profitable solutions to problems for the planet and its people

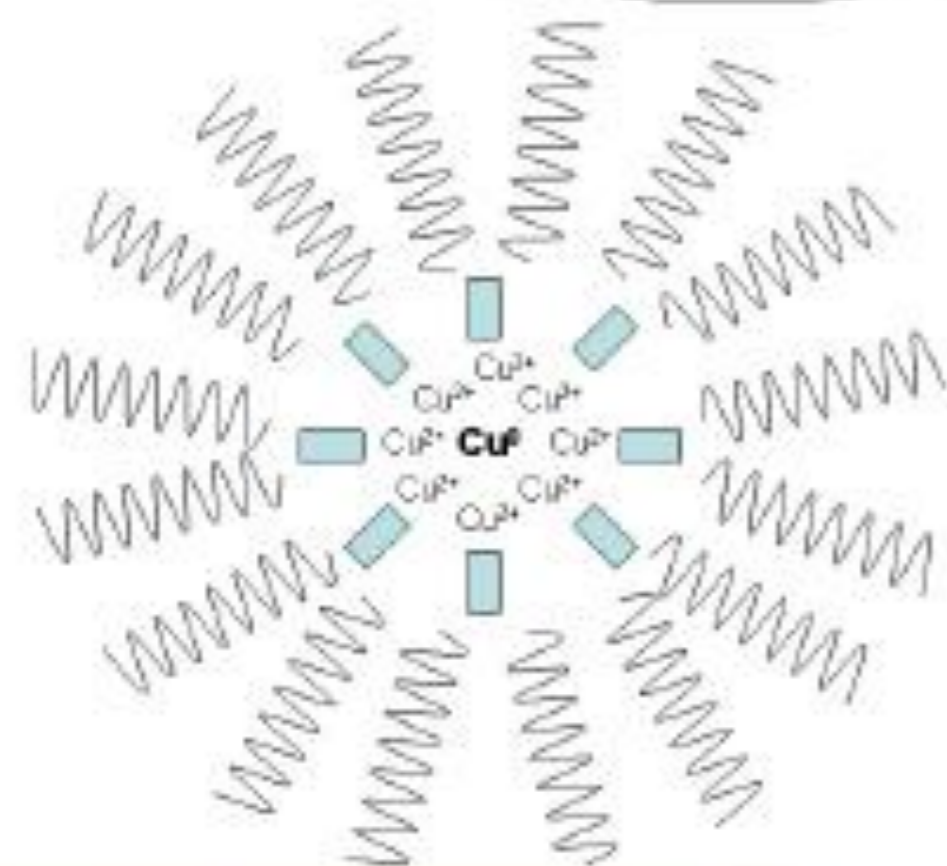
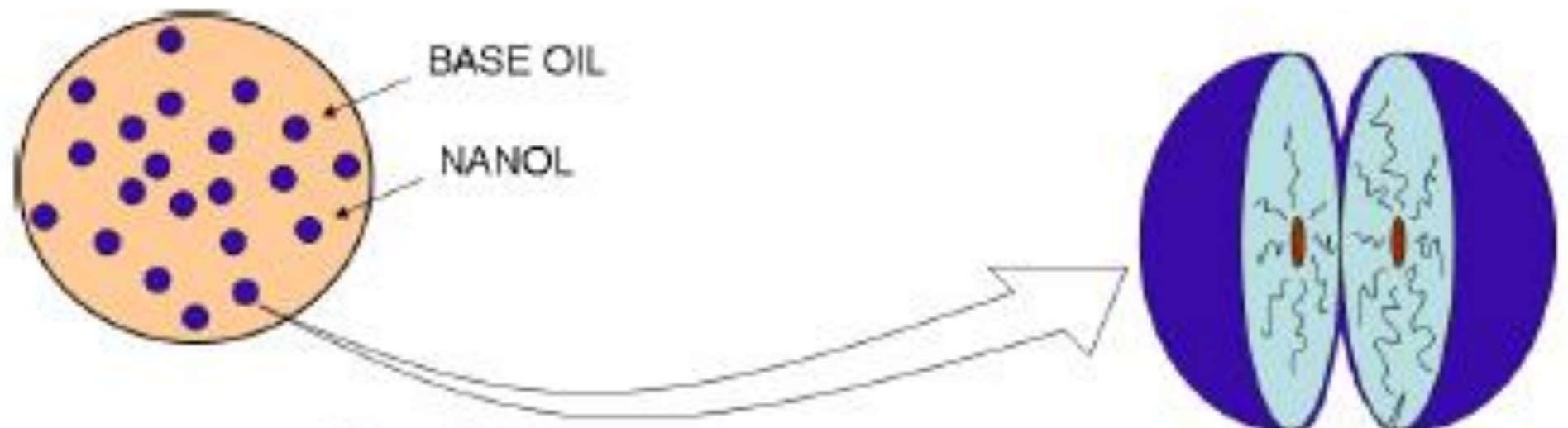


## STRUCTURE AND CHEMISTRY

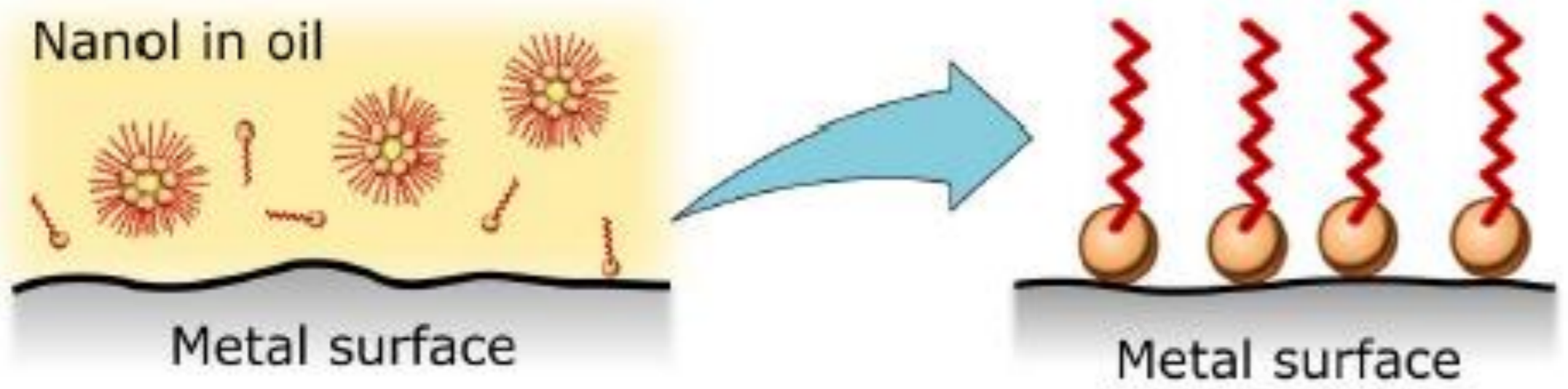


### Nanol Additive chemistry

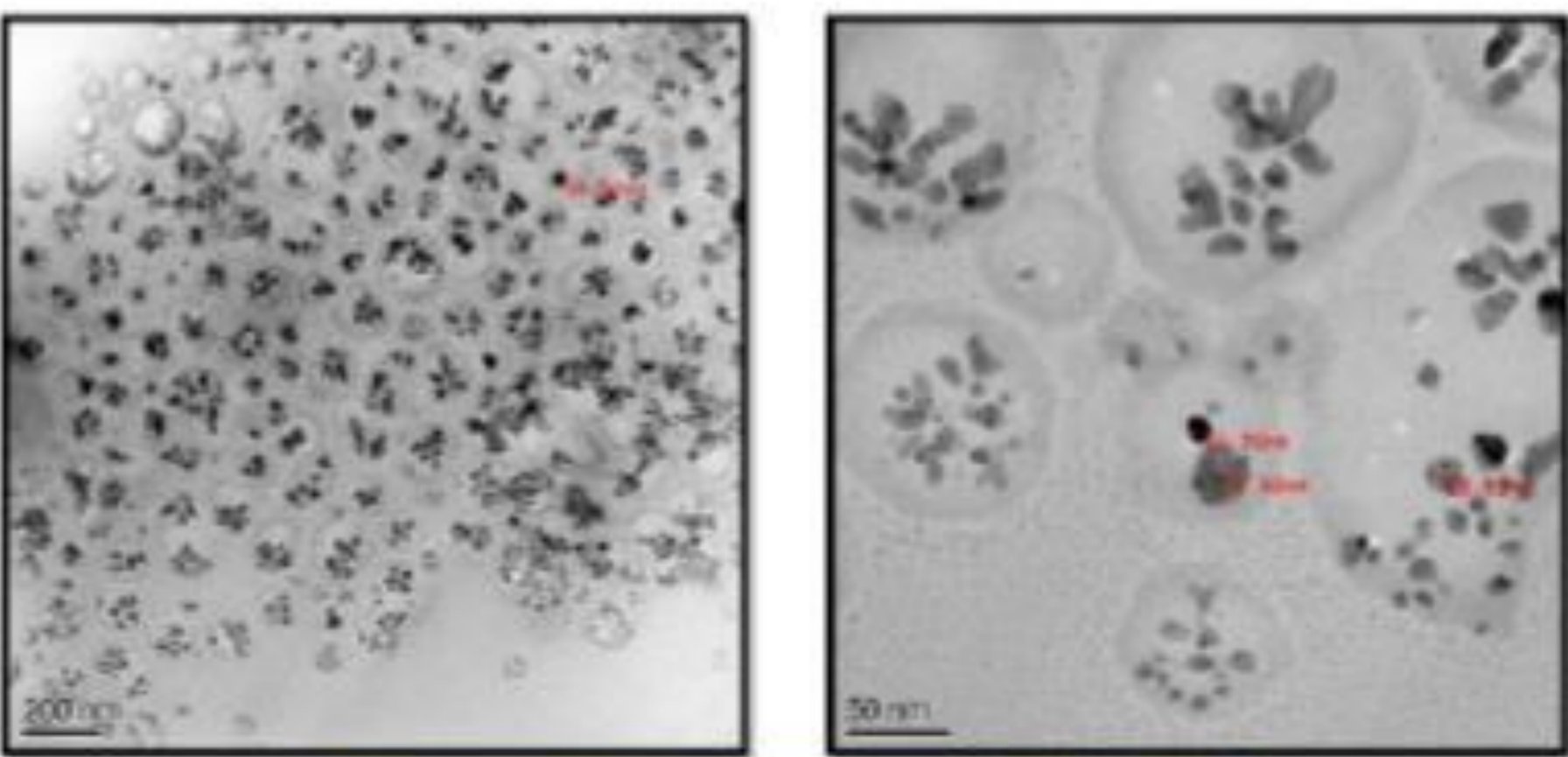
- The structure of Nanol comprises a central copper atom surrounded by  $Cu^{2+}$  ions connected to a hydrocarbon chain which is nonpolar towards the base oil – a reverse micelle
- The micelles float in the base oil and do not segregate. In addition, since the structure is nonpolar there are no adsorption to the surfaces, because due to friction the surfaces are mainly polar



*Nanol is kept dispersed in the lubricant oil thanks to a unique reversed micelle structure in a stable colloid.*



Perfect Dispersion by Unique Structure



Transmission electron microscopy pictures of the Nanol<sup>®</sup> additive contained in RM-micelles within a stable colloid showing perfectly dispersed structure.

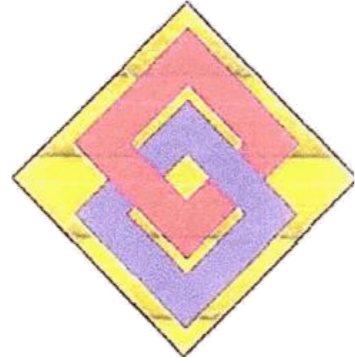
## Performance Benefits with Nanol in your Lubricant



- Copper tribofilms show excellent consistent friction reducing properties, with low activation energy
- Prevention of metal fatigue and bearing failure
- Regeneration of Nanol gives continuous bearing protection with no loss of performance
- 10 X Extension of Bearing Life
- Nanol copper thermally conducting film, reduces the temperature at the metal surface, preventing decomposition of lubricant, with lower Carbon and Iron deposits
- Copper nanoparticles and tribofim conduct electricity and have the potential to prevent damage due to electrical discharges
- Rust and corrosion resistance including saltwater environments

# Reference letters

Rederi AB Fjärdvägen



We have been testing a lubrication additive called Nanol from the company Ab Nanol Technologies Oy. We have been using the lubricant additive, Nanol, commercially since 2012 following an initial test. Testing was commenced in December 2010 and following a 12-month testing period we expanded use from one to both main engines onboard our ship m/s Fjärdvägen which continues to this day.

The ship m/s Fjärdvägen has operated since 1995 a constant daily route between Långnäs (Åland, Finland) And Naantali (Finland).

A comparison of the data year 2011 to 2012 from the two main engines, during 12 month testing period, showed a reduction of both fuel and lubrication oil consumption. Reduction in fuel was estimated to be 4% and for the lubrication oil 10%. These reductions can, in our opinion, be attributed to Nanol. And 2012 we expanded the use of Nanol to the other main engine (portside engine).

We have been thoroughly monitoring the engine parameters during the test period and we have found no negative observations. Physical inspections show that no fouling or clogging has occurred in separators or filters.

Mariehamn, Finland  
July 03, 2023

Johan Schrey  
Chief Engineer  
Rederi AB Fjärdvägen



22.10.2019  
Dnr: ÅLR2019/3676

Performance and usage of Nanol Technology Additive Power+ ML on the Ferries of the Government of Åland.

From June 2017 and until now the ferries M/S Skarven and M/S Alfågeln have been using Nanol Technology additive in the lube oil. The engines on board are Wärtsilä 2 x 9L20 and Wärtsilä 1 x 16V22.

We started with a test period on M/S Skarven from 12<sup>th</sup> June 2016 until 31<sup>st</sup> December 2016 where we used Nanol in one of the main engines to compare with the other one without the additive Nanol. During the test period in normal traffic conditions we observed a fuel oil saving of more than 3 % in the engine using Nanol.

M/S Alfågeln was drydocked in September 2019 including an overhaul of the main engine. We could clearly see less wear and tear in the main engine.

The results are to us remarkable and we have therefore expanded our agreement with Nanol technology for the next 2+2 years starting from 2019 and running on five (5) Different ferries in our archipelago traffic. This is part of our work helping to achieve our goals in minimizing the usage of fossil fuels for a sustainable future.

Mariehamn 2019-10-22

Sten Schauman

Procurement officer

Department of Infrastructure

Government of Åland



# Marine Trials and Testimonials

Customer	Engine	Test hours	Fuel savings
	Wärtsilä Vasa 16V46B	2,300h	2%
	-	-	4%
	Wärtsilä 8L46C	5,000h	4%
	-	-	4%
	Deutz TBD 645 L6	14,000h	4%
	2x Pielstick 8L	25,000h	4%
	4x Wärtsilä 8L46F 3x Wärtsilä 8L20	1,450h	5%

**Testimonials**

*'Fuel consumption was reduced by ~4% over the first 12 months of running with Nanol.'*



**Bore Ltd**



*'Fuel consumption was reduced by 4% in 2011 as compared to 2010.'*



**Rederi AB Lillgaard**



*\* All testimonials from customers using Nanol top treat solution.*

# Oil condition after test

No impact on oil condition after 6 months operating.

- Copper from Nanol: 200-250 ppm
- Copper content stable over 6 months
- No wear metals detected
- No increase in oxidation, nitration, sulfation or base number (TBN)

Engine: Wärtsilä 16V46B Lubricant: Chevron Taro 40 XL 40		Operating hours with Nanol						
WEAR		0 h	889 h	1203 h	1445 h	1776 h	2014 h	2272 h
Iron	mg/kg	20	20	20	19	18	20	19
Chrome	mg/kg	0	0	0	0	1	1	0
Tin	mg/kg	0	1	3	2	0	1	1
Aluminium	mg/kg	4	2	3	3	2	2	2
Nickel	mg/kg	30	27	27	26	25	28	27
Copper	mg/kg	2	205	227	222	205	226	220
Lead	mg/kg	0	0	1	0	0	0	0
Manganese	mg/kg		2	2	2	2	2	2
PQ index	-		<25	<25	<25	<25	<25	<25
CONTAMINATION								
Silicon	mg/kg	10	9	9	9	8	9	9
Potassium	mg/kg		3	2	2	2	2	1
Sodium	mg/kg		30	32	28	28	33	32
Vanadium	mg/kg	90	83	82	76	73	84	76
Water	%	negligible	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Diesel fuel	%		<0,3	<0,3	<0,3	<0,3	<0,3	<0,3
Soot content	%	0,14	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
OIL CONDITION								
Viscosity at +40C	mm2/s	136,05	130,52	132,37	132,31	134,6	136,14	135,22
Viscosity at +100C	mm2/s		14,06	14,19	14,11	14,29	14,37	14,21
Viscosity index	-		105	105	104	104	104	103
Oxidation	A/cm		1	1	1	1	1	1
Nitration	A/cm		4	4	4	4	5	4
Sulfation	A/cm		11	12	11	12	12	12
Dispersancy	%		89	92	88	94	94	92
ADDITIONAL TESTS								
BN	mgKOH/g	26,6	27,37	28,17	27,98	27,21	27,29	27,36





Thank you for your attention  
We will be looking forward to work together with you