Excessive foam in a gearbox can shut down a wind turbine, can we prevent it?

Problematic Foam Generation in Wind Turbine Gearboxes: Causes & Treatment

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How do we confront foam?

Do Nothing	Top Treat Defoamant	Flush & Fill
• Closely monitor the oil condition • Closely monitor the turbine performance • Cross your fingers	• Relatively easy to perform • Very effective against over-filtration • Does not fix Contamination	• Drain the system • Identify/correct any contamination sources • Flush (maybe more than once) • Verify the system is clean • Refill with new product

How much to flush?

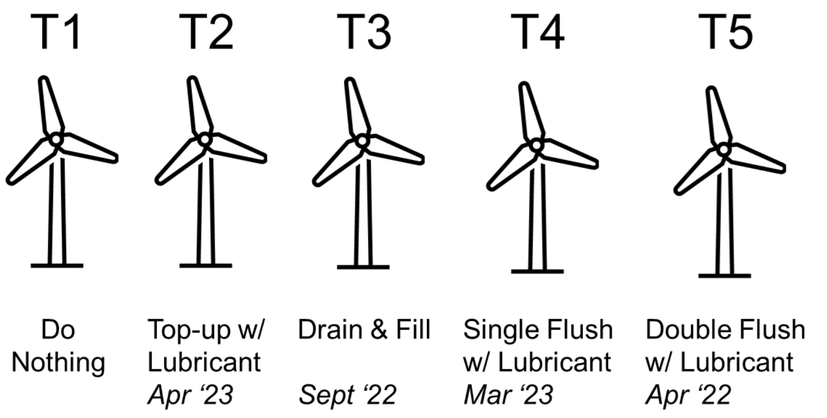
How to know when it's enough?

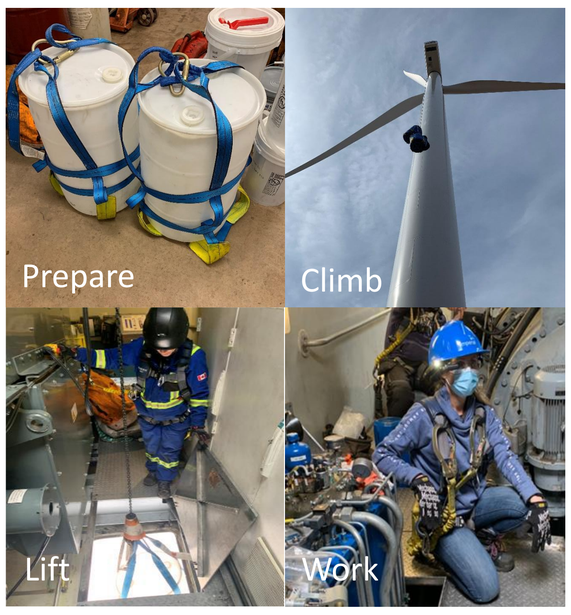
How to clean out deposits?

How soon will we know if it worked?

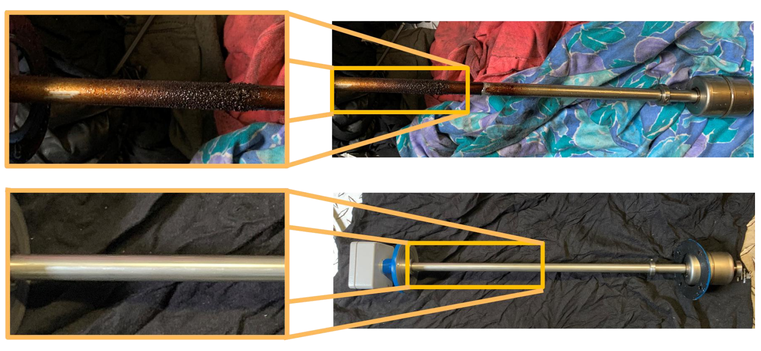
Like new or good enough?

Performing an Oil Change…260 feet up in the air

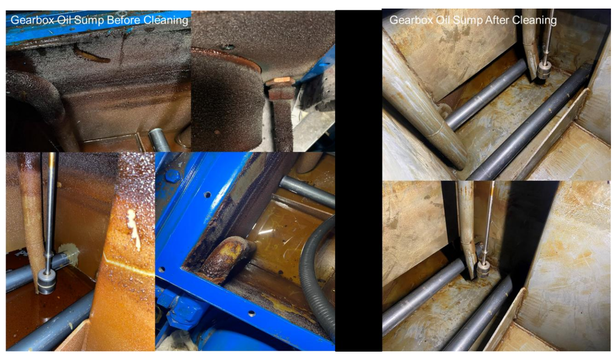




Dealing with deposits



T3 – Drain and fill – new oil is capable to solubilize deposits



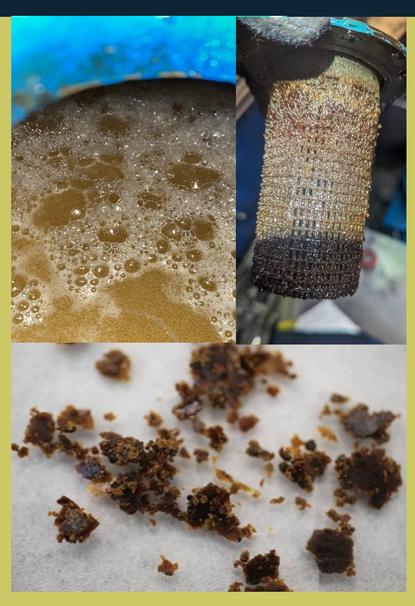
T1 – Oil Soluble cleaner to remove/ soften deposits followed by manual clean

Current Status

- Since conversion, all turbines are operating well with no signs of elevated foam.
- T5 (double flush and fill) 2nd stage gearbox is starting to show signs of zinc. Zinc content and oil appearance are being closely monitored in conjunction with foam to see if early indicators can predict when foaming becomes problematic.

Deposits & Foam

- At WEICan gearboxes with in-service foaming also suffered from zinc-based deposits
- Foam preceded by oil darkening and an increase in zinc concentration
- Zinc can be sourced from coated parts and or contamination with a zinc containing oil (less likely)

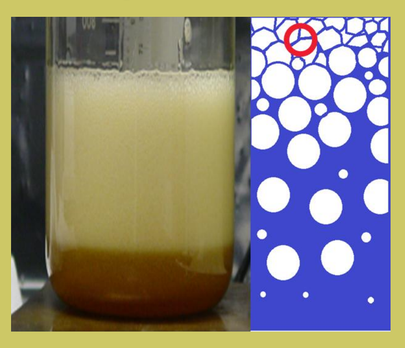


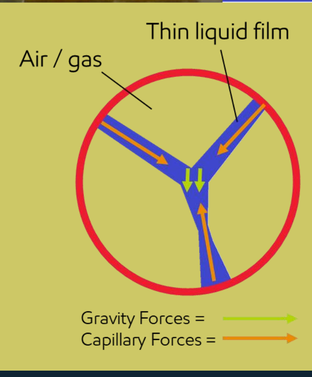
Note: The gear oils in use do not contain zinc in the formulation.

Foam Fundamentals

foams are thermodynamically unstable

- Foams ultimately separate into liquid and gas phases
- Foams collapse when the liquid film becomes unstable
- Anti-foam additives help destabilize the film
- Gravity and capillary forces cause the film to drain/thin
- Good lubricants accelerate film drainage and promote film rupture





More on foam

Causes:
- Contamination (dirt/dust/other)
- Water
- Other lubricants (incl. greases)
- Reduction in anti-foam additives
- Mechanical issues

Effects:
- Increases oil oxidation
- Leads to oil loss
- Prevents oil movement in circulation systems

Becomes a problem when:
- Oil level control becomes impossible
- Foam/Oil spills out causing safety hazards
- Causes air locks at high points

Acknowledgements: Wind Energy Institute of Canada, www.weican.ca

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Learn more about Wind Turbine Lubrication