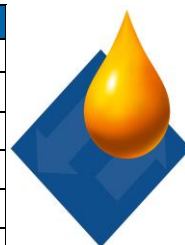


Sample Details	
Client Name:	Example Client
Contact details:	Email: Test@abc123.com Mobile: 07XXXXXXX123
Date	20/06/2018
Analyst	Mr Test
Sampling point	Offline filter cart
Lab No.	1182224



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How clean is your oil ?

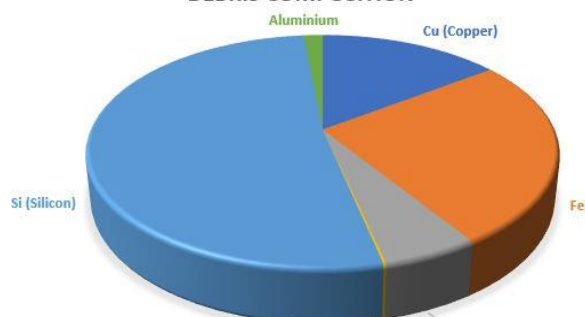
Objective of Analysis & Tests Performed	Debris material extracted on 1st filter wash
Filter submitted for analysis from a marine engine filtration system following a lube oil pump failure to determine the cause of failure. Client commented that engine had only recently been overhauled 3 weeks prior to failure and the lubricant was from a reputable supplier. An unused oil sample was provided from the IBC used to refill the system to establish if the oil in the filter was consistent with the oil in the machinery at time of failure. Analysis included a mixture of organic spectral chemistry, elemental analysis and wet chemistry techniques to determine the nature of the material and failure mode.	

Results Information

Microscopic Findings	

Each field view represents 1cm in size. The picture to the left shows significant ingress of sand particles, whilst the right picture shows a large long and curved cutting wear particle.

Particle Types				
	Trace	Few	Moderate	Heavy
Corrosion	Green			
Cutting Wear		Orange		
Dark Metal Oxides	Green			
Fatigue Chunks	Yellow			
Fibres	Green			
Laminar Particles	Green			
Non-ferrous (metallic)	Green			
non-metallic (amorphous)	Yellow			
Non-metallic (crystalline)	Red			
Normal Rubbing	Green			
Spheres	Green			
Sliding Striated	Yellow			

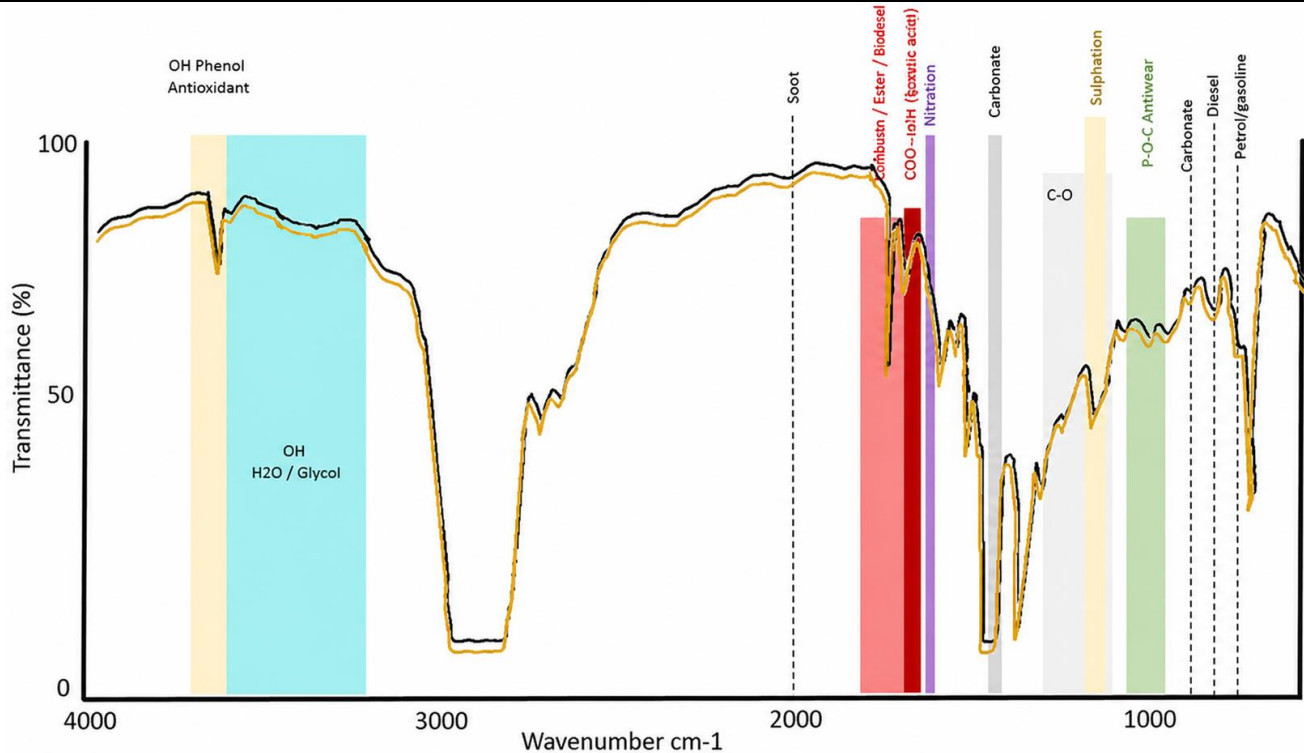
Elemental Composition	
DEBRIS COMPOSITION	
	
Si (Silicon)	Fe (Iron)
Cu (Copper)	Sn (Tin)
	Pb (Lead)

The particle composition shown on the left showed significant crystalline particles consistent with sand and the predominant wear type as cutting wear with sliding and fatigue particles. The elemental composition of the material was predominantly Silicon consistent with sand and copper, lead, tin and iron consistent with the pump material failure.

Comments are advisory only and data / comments are impaired by non-homogeneous samples and poor sampling techniques. On large systems where a small amount of material is submitted consider whether the sample is representative of the bulk of the system when determining the significance.

FTIR Findings

Comparison of new reference oil (yellow line) and used oil (black line) traces shows the two oils to be the same product. Both oils show significant remaining anti-oxidant suggesting the oil is in a near new condition.



Summary & Conclusion

The findings show the failure mode has severe cutting wear, which is likely linked to the abrasive silicon based crystalline material observed. The Silicon source is most likely sand rather than cat fines or dirt because of the low Aluminium content detected. The Copper, Lead and Tin are consistent with bearing material and the iron is most likely additional material from the failure.

The submitted reference oil for comparison shows by FTIR they are the same product, which suggests the clients fear the oil may not have been changed during the overhaul or the incorrect oil was used is unfounded. The IBC sample showed very little evidence of sand ingress, suggesting the contamination did not occur prior to arrival.

Advise to prevent failures such as this in future, inspect machine for sources of ingress such as storage tank breathers. Also review lubricant handling procedures from the point of transferring the lubricant from the IBC.

It is noted the client mentioned on the telephone that the offline filtration was only reconnected 10 days ago, which would support the filter companies argument the damage could have been prevented had the material been removed sooner. The client may wish to investigate why there was this delay in refitting the unit and review the procedures related to this going forward.

THIS IS AN EXAMPLE REPORT ONLY