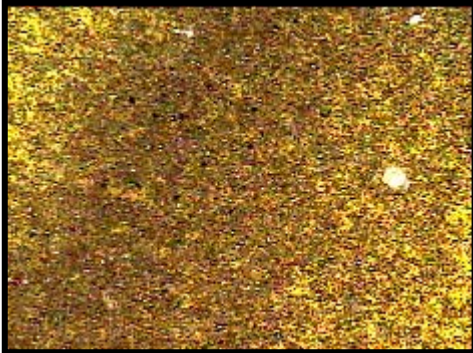


## Wear Debris Analysis No 124 ES1 SEDGB

### Example B

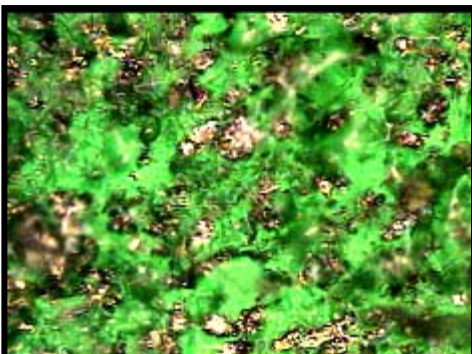
**Objective.** Check oil sample from Plant No. ES1 Sand Elevator Drive Gearbox for Wear Debris and any possible contamination. Mobil 630 3-4000 hrs. Sample Point Sump Bottom.  
Information found used to establish failure cause and future maintenance requirements.

**Method.** Sample approx 100 ml received, Sample preparation in accordance with Procedure No. 23. One sample processed 1 ml in volume, therefore the amount seen in the video pictures is the actual debris concentration per ml of oil.



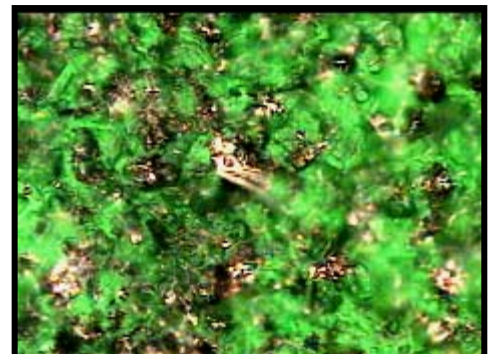
This image indicates the average wear debris level for sample @ 100X. One cc of the sample oil has been forced through a 13-mm diameter 0.3-micron membrane filter @ 150 P.S.I. trapping wear debris present. The bottom green/blue light shining up through the sample silhouettes any contaminating wear debris present indicating the amount of wear debris per cc.

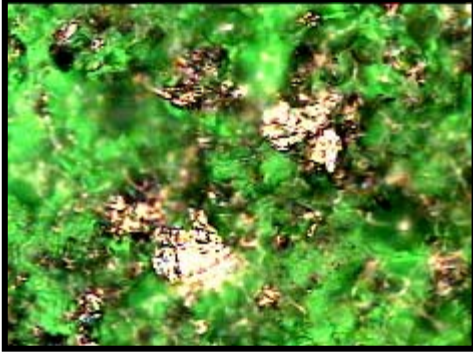
This image represents a 1-mm diameter circle from that filter.



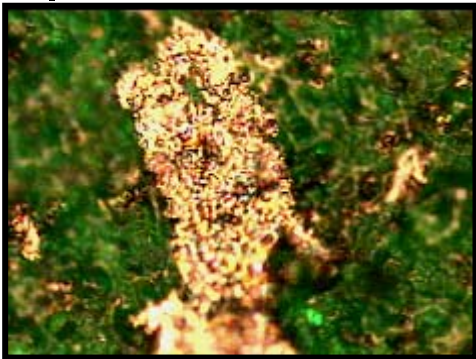
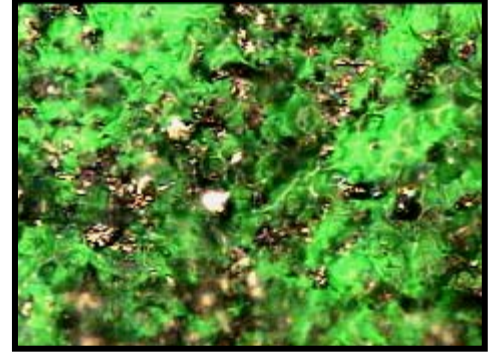
### **Steel Adhesive Wear Debris @ 1000X Sized 1-25 $\mu$ m,**

There is a moderate amount of Adhesive Wear debris contamination in this sample. There is mechanical damage been caused from this combination erosion, corrosion light fatigue abnormal wear mode catalysed by loss of EP additive package, build up of fine hard contamination and wear debris particles. Note the burnt wear debris particles and fine steel cutting wear debris.



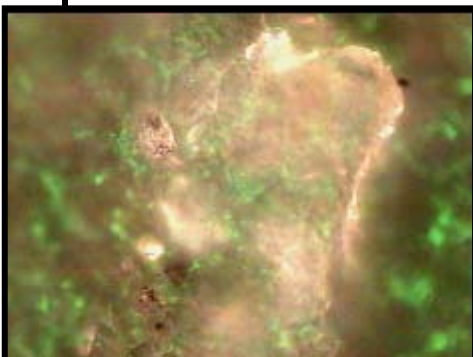


**Steel Adhesive Wear Debris @ 1000X  
Sized 1-35  $\mu\text{m}$ ,**



**Steel Fatigue Chunk Wear Particles @ 1000X Sized 1-130  $\mu\text{m}$ ,**

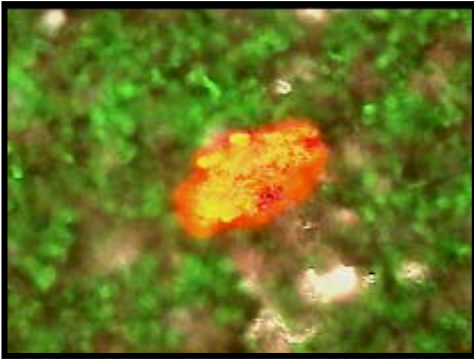
Fatigue Chunk Wear Particles are the result of material lost when a crack, pit or spall opens up on rolling bearing or gear teeth wear surfaces. Fatigue Chunk Wear Particles are initiated by repetitive denting and cracking caused by hard contamination been carried through the loaded bearings and gear sets by the lubricant flow.



**Organic Growth Debris @ 500X  
Sized 1-250  $\mu\text{m}$**

If organic debris gained access then it is likely that water and hard contaminants will have access as well. Water, organic matter and warmth can combine creating a mini environment enabling biological growths that are capable of forming colonies in lubricants. Service events and pressure equalisation via breather vents can offer access for this type of contamination.





### Red Iron Oxide Crystals @ 500X Sized 1-50 $\mu\text{m}$

Red Iron Oxide Crystals (Rust) are only found when water and steel wear particles are present in the system or have been in the system in the past. If free water and steel wear particles are combined in a lubrication systems the oxidation reaction to Red Iron Oxide Crystals will be rapid and completed in minutes. Normally if heavy amounts of large Red Iron Oxide Particles are found in the sample, there will be an abnormal wear mode prevalent and water present in the system.

### Results Conclusions and Recommendations

This drive has commenced into a moderate adhesive wear mode that is now causing wear damage to the drive requiring an oil change to enable the application to return to normal wear.

There are several reasons that have catalysed this abnormal moderate adhesive wear mode as follows.

We found evidence of fine hard contamination in the drive and the resulting small cutting wear debris.

We found red iron oxides and biological growths in the lubricant indicating the ingress of water into the lubricated area.

We found heat damaged lubricant residue, note the gelling on our filter indicating the lubricant has been exposed to heat/oxidation stress and is now commencing to polymerise the lubricant into dark oxide particles and this change we expect to increase the rate of wear several times.

We note the request to check if the lubricant has been cross contaminated with another type of lubricant but unfortunately without samples of the two suspected lubricants this will not be able to be established 100% and anyway it would not matter what type of lubricant was in use with the high level of environmental contaminants gaining access any lubricant would have been degraded in this manner.

We think change and replace the lubricant, seal the breather with a bladder bag breather or fit a  $< 3\mu\text{m}$  water repelling filter and once serviced future maintenance will be resample in 800 hours to ensure the wear mode returns to normal.

Signatory  
Testing Officer

***The analysis provided is indicative of conditions based upon sample information received and quality of sample processed. Recommendations are provided as a guide only. Any decisions relating to repair of components or changes to procedures are entirely at the discretion of the customer.'***