Assetivo

Case Studies

Case Study: Empty Keg Turner Bearing Failure.

Introduction

Assetivo were involved with preventative and predictive maintenance and condition monitoring services to a major brewery in the form of scheduled lubrication, lubricant sampling & analysis, vibration analysis, thermal monitoring, and visual inspections. The objective was to improve the long-term availability of critical equipment by way of reduced downtime and reliability improvement though RCA, defect elimination and continuous improvement activities

The Problem

Empty Keg Turner Oil Report

The Kegging department’s empty keg turners provide a simple but crucial role in the packaging line process. The keg turners simply rotate the incoming empty kegs by 180° before they reach the pre-wash area. They consist of a motor and belt driven central gearbox with twin output shafts driving two keg turner gearboxes via a series of couplings (see Figure 1). The keg turning gearboxes were added to the CBM database and were monitored solely via visual inspections and oil sampling. Vibration analysis was not carried out due to difficult access as well as the equipment being slow-moving with partial rotation and intermittent operation.

Figure 1: Empty Keg Turner KG-07

An oil sample taken (see Figure 2) revealed that the oil condition was poor with high viscosity for the stated grade of oil; 0.58% water content due to likely poor sealing; a high particle quantity (PQ) index; and a metallic appearance to the sample which indicated likely significant ferrous wear which would originate from the bearings, shafts or possible helical gears. Further to this, the oil sample report suggested high levels of copper and iron which again pointed towards bearing damage and/or bronze gear wear.

Results		Current Sample
Sample No		4935792
Status		
Sampled		26/01/15
Fluid Age		
Unit Age		
Fluid Condition		
Viscosity @ 40 °C	mm²/s	184.1
Water %	%	0.58
App	-	Metal
PQ index	-	532
TAN	mg KOH/g	0.46
Contamination		
Na (Sodium)	mg/kg	0.0
K (Potassium)	mg/kg	1.0
Si (Silicon)	mg/kg	5.7
Li (Lithium)	mg/kg	0.8
Wear Metals		
Al (Aluminium)	mg/kg	2.5
Sn (Tin)	mg/kg	5.4
Pb (Lead)	mg/kg	0.0
Cu (Copper)	mg/kg	22
Fe (Iron)	mg/kg	441
Cr (Chromium)	mg/kg	4.8
Mo (Molybdenum)	mg/kg	0.0
Ag (Silver)	mg/kg	0.8
Ni (Nickel)	mg/kg	1.0
Mn (Manganese)	mg/kg	2.0
Ti (Titanium)	mg/kg	0.0
V (Vanadium)	mg/kg	0.0
Cd (Cadmium)	mg/kg	0.0
Additives		
B (Boron)	mg/kg	1.4

Figure 2: Oil sample report

Upon receipt of the oil report the Assetivo engineer decided to refresh the gear oil but also carry out a borescope inspection to determine if any visible wear was present on the gear teeth or rolling element bearings. This took place on the first day of a week-long shutdown. Though outside the scope of the regular contract, the internal inspection was value added and was deemed necessary to determine the root causes of the high metallic content in the oil sample.

The Inspection: Visual and borescope

On removing the breather plug / oil fill hole and the drain plug to decant the used oil into a container, it was apparent that the oil was in a degraded condition. A simple visual inspection revealed that there appeared to be damage to the drive end bearing cage (see Figure 3) in the form of a fracture which suggested that it was highly likely that the rolling elements were no longer contained in the bearing's structure. The bronze gear wheel teeth appeared to be in reasonable condition with some signs of wear. The other worm gear and helical gears could not be inspected accurately to determine condition. A borescope inspection via the oil fill hole revealed several rolling elements strewn on the gearbox casing floor (see Figure 4). The rolling elements appeared to show some evidence of corrosion - likely from long-term ingress of water into the gearbox.

Figure 3: Damaged roller bearing cage

Figure 4: Rolling element on the gearbox floor

Conclusion

The oil sample and report revealed wear internal to the gearbox components and using a borescope inspection it was found that drive-end rolling element bearing was catastrophically failed. Though it is unknown how long the gearbox had been operating with a failed drive end bearing, the next logical failure due to the significant dynamic and geometric changes would have been the non-drive end bearing and or gear teeth. And if the bearing had failed and all load-bearing capacity lost, and structural integrity and geometry lost, then the gearbox would no longer have been functional. With respect to the findings, the brewery was informed immediately of the issue, and given that a direct replacement spare was not held for this obsolete gearbox, it was sent out for repair to a local supplier and was returned for use before the end of the shutdown week to ensure continued, reliable operation.

Savings

Given an approximate hourly production cost of £950.00, the Kegging process is a 24 hour operation, and the fact it took 4 full days to send out the gearbox to a supplier, have it repaired and returned, and finally reinstalled (where 4 days production = 96 hours). The lost production saving = £950.00 x 96 = **£91,200.00.** This does not take into account the potential for secondary damage to the motor, belts, shafts, and connected intermediate gearboxes in the event of the non-drive end bearing collapsing, or the costs of low manpower utilisation, or the potential for lost sales or loss of customer goodwill.

Predictive Maintenance

When applied as part of an integrated condition-based maintenance strategy, this case study has demonstrated the benefits of predictive maintenance in the form of lubricant analysis where oil condition, contaminants, wear metals and additives are tested for. Also, it highlights how in conjunction with the modern techniques and technologies of predictive maintenance, simple, visual inspections of internal rotating equipment components can highlight potential or actual failures which will impact on the brewery’s production uptime, overall maintenance costs, and equipment availability and life cycle costs.