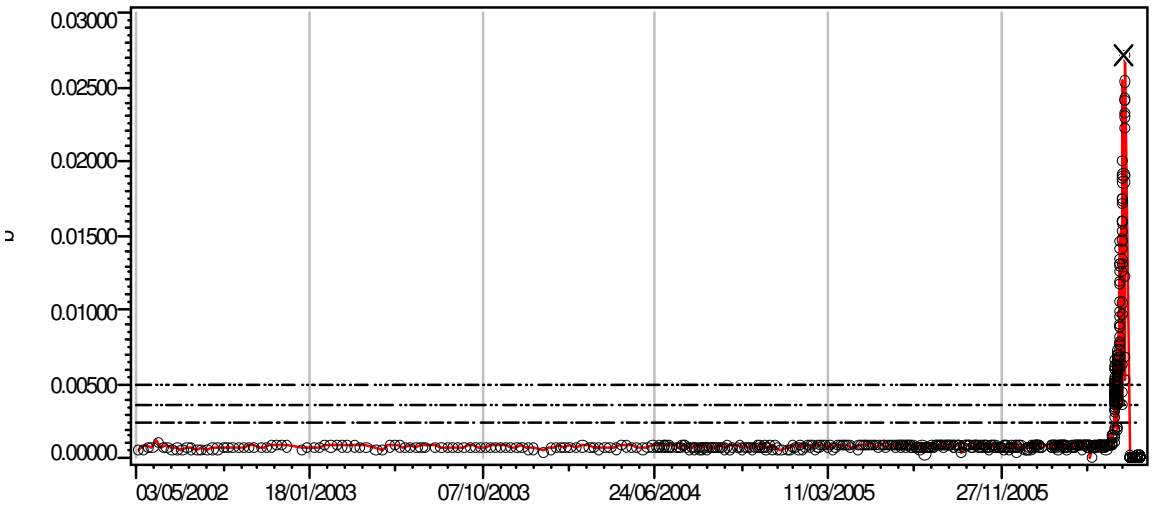
LAFARGE CEMENT
Dunbar Works
Maintenance

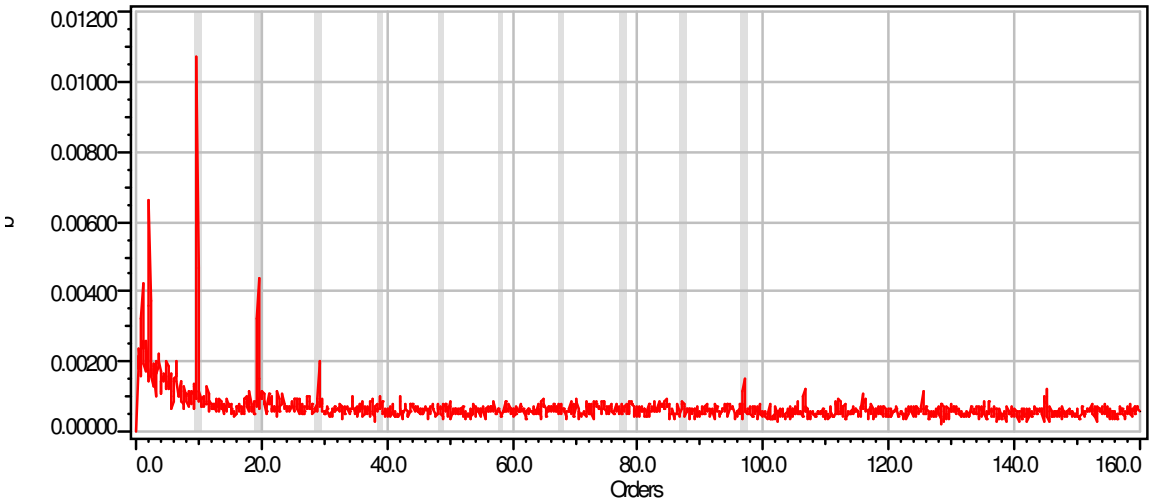
No 6 Cement Mill Gearbox Input Pinion Bearing.
Failure Analysis 2nd June 2006.

Due to constant Predictive Condition Monitoring via an online Vibration Analysis program(MTC), the Maintenance department were able to detect a rise in trend on the Drive End of the Gearbox. As shown in the Trend below the gearbox had been stable for whole duration of the monitoring system (since May 2002).
Also the gearbox has had Annual Inspections carried out by FL Smidth, and the last time any work was carried out on the Gearbox internals was in 1995 when the Input shaft bearings and the Layshaft bearings were renewed.
So this sudden increase in Trend was of great concern.



No 6 CEMENT MILL INPUT SHAFT Horizontal TREND.

After several Fault Frequency calculations it was decided that the problem was on Input shaft Drive End bearing (SKF 24148C). As can be seen below the Frequencies match perfectly. The amplitude of the problem had increased by 22X in HFE range.



BPFO – 24148 C HFE Spectrum 2000Hz.

It was agreed to call FL Smidth and arrange for a visit to give their view on the problem. After their engineers analysis it was agreed that the problem was the Input shaft DE bearing (24148 CC) this bearing is a Thrust bearing.
We held a meeting with all engineers to do a Root Cause Analysis.
The only work that was carried out in the 'Drive Area' was on the Drive Motor Bearings.
The Bearings had been leaking oil, so new sealing gland was fitted and the only gland packing available was Graphite based so this was used.
It was agreed to purchase new bearings for the Input Shaft (24148 C the problematic axial bearing and 23052 C the gear load bearing) and to arrange a window when David Brown Engineering were able to dedicate their workshop to check the shaft for damage and do the Bearing fitting. Once a date was fixed, Dunbar maintenance department would remove the input shaft assembly and it would be transported to DB Engineering.
This was going to be approx. 2 weeks before any work could be carried out so continual monitoring was being maintained and the problem was worsening faster than was expected.
It did not take long for the Vibration signal to go from HFE to Mid range (which in easier terms means it has gone from a bearing 'ringing noise' to a bearing 'knocking'). Amplitudes also reached Peaks of 28mm/sec.

When the Input assembly was stripped out it was found that the Bearing had undergone 'Electrical Washboard failure'. This meant that electrical current was tracking through from the motor via the coupling (which is a steel pin type coupling) to the first bearing in the Input housing which is a Thrust bearing.
The only damage was on the 'Thrusting' half of the bearing 'Outer race' and 'Rollers'.

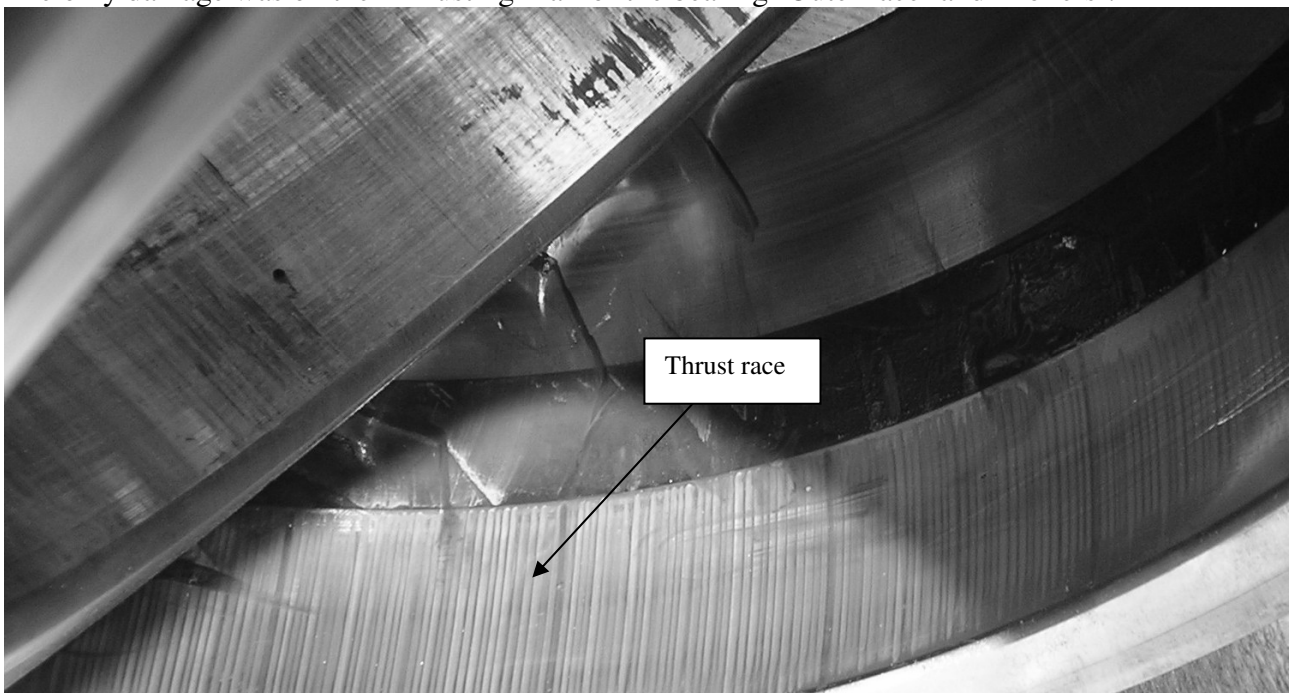
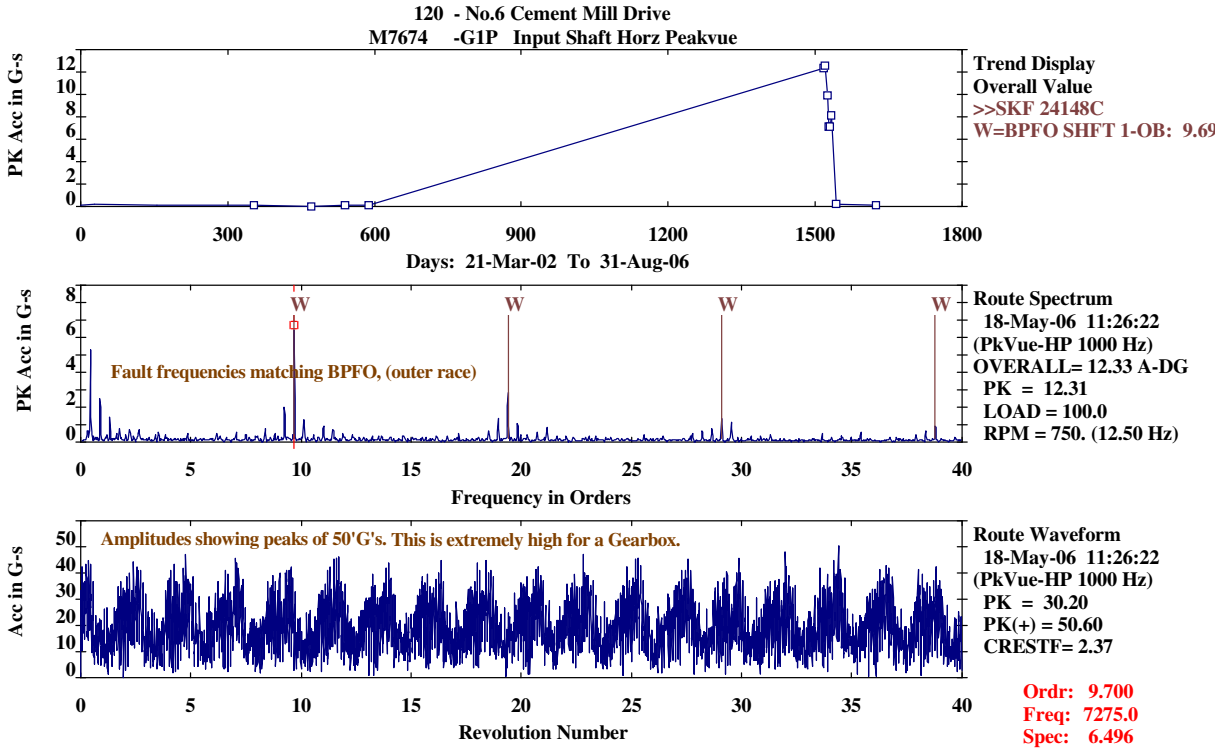


Photo showing the 'Washboard' effect due to Electrical current Tracking.

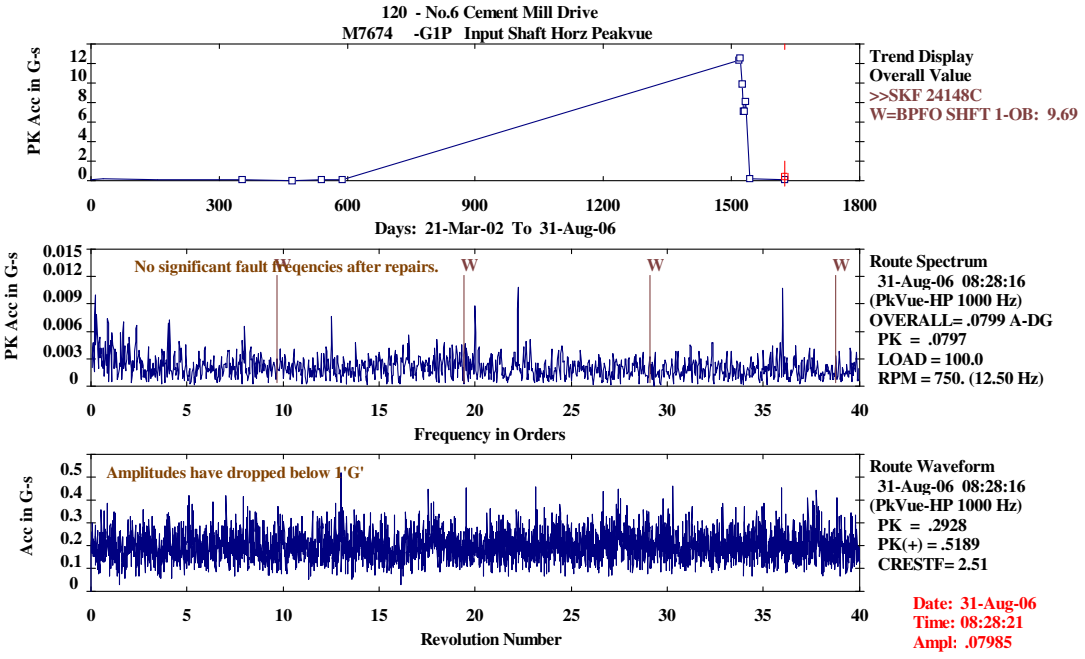
The FL Smidth engineer had witnessed this before and from a new bearing being fitted to Failure was approx. 16 days, this was because of an Earth strap problem.
The Root Cause Analysis of our problem was that the Gland seal Packing used on the Motor seals was Graphite based which is a good Electrical conductor and had created a 'By-pass' from the Earth straps and found its way through the shaft to the bearing in the Input shaft assembly.
We have now reverted back to the original type seals which are Non Conductive.

Photo showing the 'Washboard' effect on the Rollers (not all rollers).

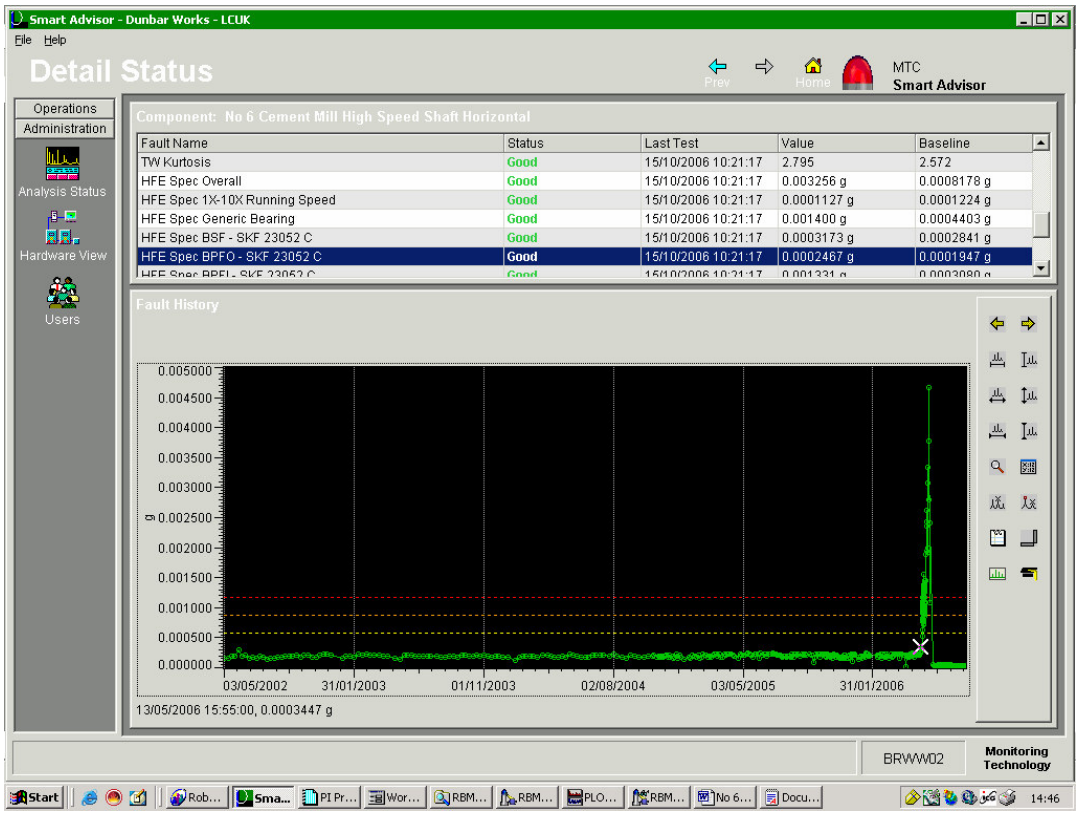
New bearings were fitted at David Brown Engineering and 'set up' to manufacturers recommendations, this saved a lot of time at site and was just a matter of fitting straight into the pre-dowelled position.
All oil was drained from the Gearbox and the sump was cleaned out with a cleaner and Lint free rags. Same cleaning method was carried out on the gearbox lid and all gears were checked and cleaned.
Once the reconditioned shaft was set-up and the gearbox lid was replaced, it was arranged with Fuchs Lubricants to pump new oil into the gearbox straight from the tanker (1750 ltrs).
Whilst the barring gear was removed it was also thoroughly cleaned, with old oil drained and new oil added.
Once the Barring gear was back in situ, the Couplings were checked for alignment by the FLS engineer and set to within their tolerances.



Readings taken above show severity of the bearing problem, very high impacting at BPFO and waveform severity readings of 50'G's. Readings this high could have been catastrophic if gone undetected.



These readings shown are after repairs. The drop in amplitude of waveform severity to below 1 'G' and there are no significant peaks in the spectrum.



This is the readings from the MTC online system today.
Without this system the problem may have gone undetected and may have been to late to react before catastrophic failure.
With the system we were able to Predict what the problem was, Plan spares to the minimum and most importantly Plan a window when to stop the Mill.