

INDUSTRY

Case Story



C.C.JENSEN

in close collaboration with

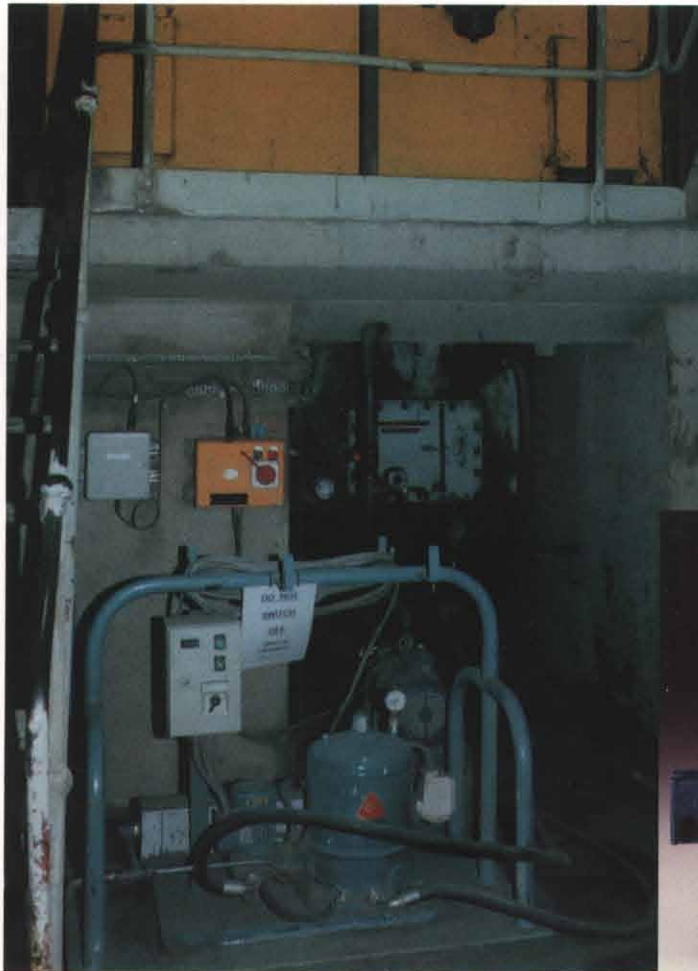
Mobil

and



**Blue Circle
Industries PLC**

FINE FILTRATION - INDUSTRIAL GEARBOXES
AEI 3000 HP DDDR Cement Mill Gearbox



This particular case is the result of joint efforts of Mobil Oil Company Ltd., their customer Blue Circle Cement and the C.C.JENSEN subsidiary in the UK, CJC Napier Ltd.

INTRODUCTION

In October 1992 CJC Napier were contacted by Mobil UK regarding the filtration of **Mobilgear 634** (ISO VG 460) at the Blue Circle Cement Works at Claydon (Nr Ipswich). The works were experiencing generation of excessive wear particles in a particular gearbox. One tooth set in the gearbox had started to pitting, resulting in tooth debris contaminating the whole box.

Subsequent discussions resulted in the installation of a CJC HDU type mobile filter unit on Blue Circle's No. 2 mill gearbox in February 1993. The filter was subsequently alternated to another gearbox and for both units Mobil's EM/PA dept. provided oil analysis reports that clearly quantified the effectiveness of the CJC filter unit.

To measure the rate of pitting degradation, and the speed of removal by filtration in the major gearbox, via particle counting and oil analysis, it was agreed between CJC Napier, and Blue Circle with the support of Mobil to conduct a case study. The results and conclusions from the study are presented in the following

CASE STORY

INDUSTRIAL
GEARBOXES

THE SYSTEM

Mill No. 2

Horizontal ball cement mill.

Gearbox

Electrically driven AEI 3000 HP double tandem spur helical reduction gearbox, 48:1 ratio.

Lube System

Dry sump, gravity drain to under lying oil tank. 125 micron wire wound filter with magnetic core installed after lube oil pump.

Oil

Approx. 1000 ltr of Mobilgear 634 held at approximately 35°C.

CJC Filter Unit

HDU 27/27 B-M85 off-line unit with P360 pump (360 ltr/h), 4 kW electrical preheater, and control box. Mounted on skid plate with protective brackets. Filter suction: see ill. 1.

Filter Element

One CJC B 27/27 element. Cellulose based, 3 micron absolute filtration. Dirt capacity: 4 ltr.

Sample Point

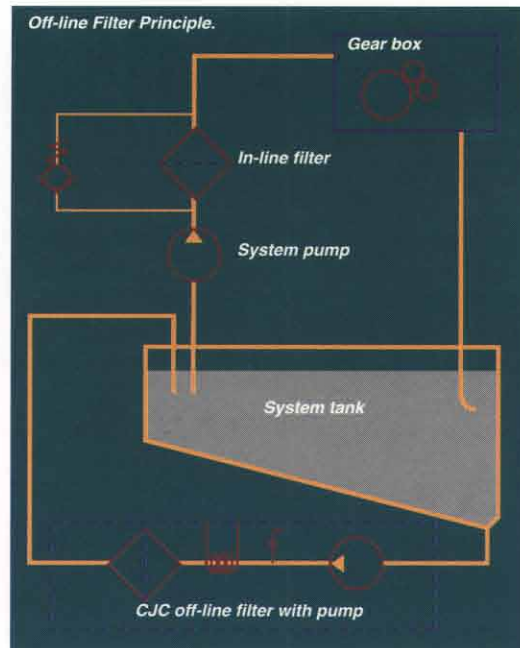
Sample cock installed in the filter supply line between filter pump and preheater.

this period samples were taken each morning by Blue Circle personel. After one week of filtration the unit was switched off for the purpose of establishing the contamination increase rate. A further three samples were taken at one weekly intervals.

The samples were submitted to Mobil's EM/PA dept. for spectrographic oil analysis and automatic particle count (ills. 2 & 5). To verify the Mobil reports three comparison samples were taken during the testing period and submitted to Filtrex Services of Holland for independant analysis - manual particle count and millipore test (ills. 3, 4 & 6).

RESULTS

The results from the Mobil EM/PA analysis reports are presented in ill. 2, using the ISO 4406 contamination classification system. The Y-axis states the ISO class (a change of one range number is a doubling or halving of the contamination, i.e. 15 is twice as dirty as 14). The first red column represents a typical prefiltration value. The first 'filter on' sample was taken immediately after the reconnection of the filter unit. The 'filter off' samples were taken at intervals after the week of continuous (round-the-clock) filtration.



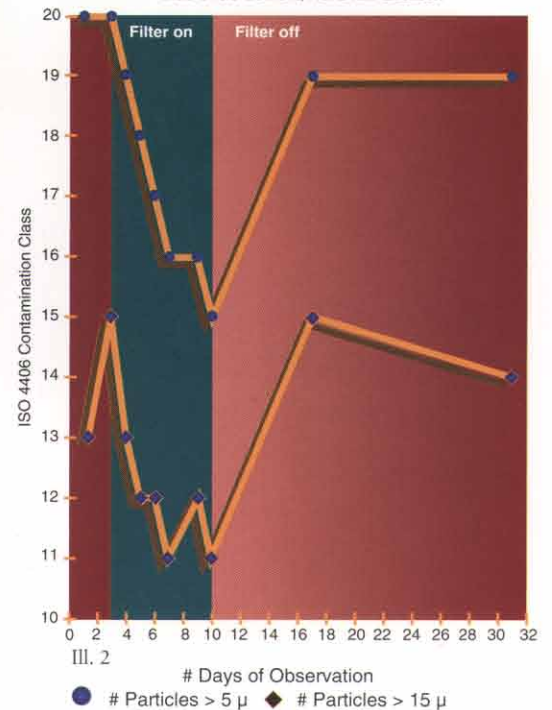
Ill. 1

THE TEST

Prior to test start the CJC filter was disconnected for a period of one month to allow contamination to build up to prefiltration level. The filter was reconnected and operated for **one week**, 24 hours a day, commencing Mon 8th Nov and finishing Mon 15th Nov. During

Changes in Contamination Level

Blue Circle Cement, No. 2 Mill Gearbox



Ill. 2



Mobil



Blue Circle
Industries PLC

COMMENTS

The analysis results clearly proves that a **dramatic reduction in particulated contamination** occurred during the week of filtration (from ISO 20/15 to 15/12, samples of Nov 8th and Nov 15th).

In just one week without filtration (Nov 15th to Nov 22nd) the contamination increased to a high level of 19/15 and plateaued at this level for the remainder of the study.

The Filtrex results (ill. 3) states the actual number of particles/100 ml oil that corresponds to the given ISO Class Codes. Note the significant drop and following rise in water content.

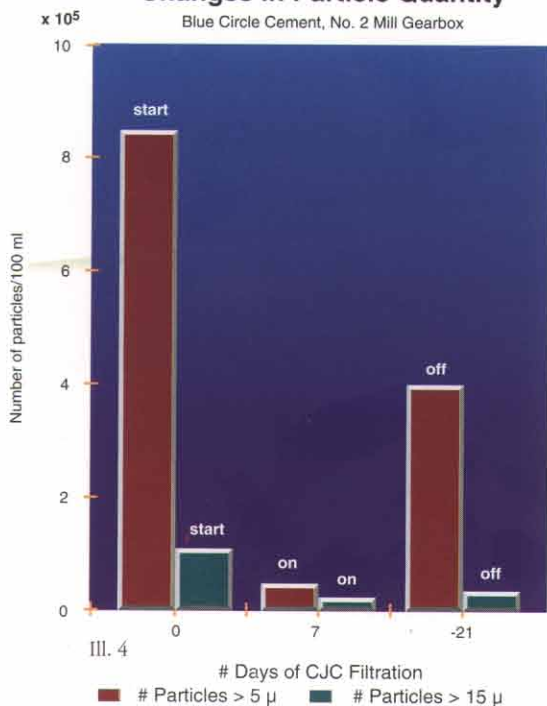
The Mobil reports also proved that a significant part of the contaminants removed was in fact large iron particles. The iron particles dropped from 117 ppm to an average of 14 ppm.

Ill. 3

Filtrex Services, Particle Analysis			
Sample date:	08.11	15.11	06.12
ISO Class >5 µ:	20	15	19
ISO Class >15 µ:	17	12	15
# particles >5 µ:	869,648	31,798	408,657
# particles >15 µ:	92,352	3,848	16,391
Water, ppm:	123,6	17,2	344,2

Changes in Particle Quantity

Blue Circle Cement, No. 2 Mill Gearbox



CONCLUSION

It is evident from these results that the CJC Offline Fine Filter has proved beyond doubt its ability to effectively remove high levels of contamination from an industrial gearbox in an extremely hostile environment.

The presence of high levels of contaminant particles - solids as well as water - leads to excessive wear on all lubricated mechanical parts **and** dramatic reduction of the oil lifetime.

The CJC combination of very fine filtration with the off-line principle enables the application of filter elements with very high dirt holding capacity (In 10 months of operation on two gearboxes only one filter element was replaced) That, in turn, enables a **cost effective** maintenance of industrial lubricants to an "as new" condition or better.

The fact that when the filter was switched off the contamination level rose to an almost prefiltration value of ISO 19/15 **serves to prove the value of continuous off-line filtration.** Especially in such hostile environments with large ingress and production of wear particles.

Since first noting the pitting damage in late '92, the AEI gearbox had the benefit of the CJC unit on alternate weeks for a period of six months. The next gear inspection identified additional benefits of removing the debris. Extracts from G.E.C. ALSTHOM GEARS Ltd. service report, dated Dec 12th 1993:

(...) the gearbox was found to be in a much cleaner condition generally. The condition of the gear teeth shows a marked improvement in the year of running. (...) smoother polished load surfaces than when previously inspected (...) pitting appears to have been arrested.



Mobil



Blue Circle Industries PLC

THE MOBIL EM/PA ANALYSIS REPORT.

Also for this particular case study Mobils EM/PA Department provided comprehensive progressive analysis reports (Ill. 5). The analysis states values for various parameters important to the general oil condition, giving also the nature and quantity of any particulate contaminants in the oil.

MILLIPORE ANALYSIS

For those not familiar with the ISO 4406 Contamination Classes, the ISO Codes may appear some-what theoretical. The millipore analysis (made by Filtrex Services) presented below gives an immediate and visible indication of the oil condition. In the millipore analysis 100 ml of oil is vacuumed through a fine filter membrane - in this case with a pore size of 0.8 μ . The two photos below show - in x20 enlargement - the membranes from No. 2 mill samples dated Nov 8th and Nov 15th.

Mobil EM/PA Progressive Analysis for Industrial Equipment

Customer Name Blue Circle Ind. PLC
 Address Masons Works, Claydon Ipswich Suffolk
 Post Code IP6 6JX
 Vehicle or Machine Cement Mill
 Identification No 08D1007
 Customer Machine Reference R2847
 Date of Sample 12-11-93
 Attention of R Parsons
 System Type No 2 Mill G/B AET
 Oil Grade Mobilgear 634

ANALYSIS RESULTS						Current result
Sample no	23	24	25	26	27	28
Analysis Date	18-10-93	22-11-93	22-11-93	22-11-93	22-11-93	22-11-93
Unit Life (hrs)	-	-	-	-	-	-
Oil Life (hrs)	-	-	-	-	-	-
Oil Added (ltr)	-	-	-	-	-	-
Filter Changed (hrs)	-	-	-	-	-	-
Viscosity (cST 40C)	378	381	379	378	378	378
Flash (deg c)	180+	180+	180+	180+	180+	180+
Insols (% wt Su)	0.05	0.01	0.02	0.04	0.01	0.01
TAN	0.85	0.88	0.87	0.78	0.80	0.84
Water	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Silicon	2	7	5	5	5	6
Oxidation	<1	1	1	<1	<1	<1
Appearance	Clear	Dark	Dark	Clear	Clear	Clear
Colour	7.5	3.0d11	3.5d11	2.5d11	3.0d11	3.5d11
Particle count	18/12	20/15	19/13	18/12	17/12	16/11
Metals (ppm)						
Iron	12	24	14	14	13	14
Aluminium	2	4	1	<1	2	<1
Chromium	<1	<1	<1	1	<1	<1
Molybdenum	<1	<1	<1	<1	<1	<1
Copper	3	3	3	3	3	3
Lead	11	12	13	14	15	14
Tin	<1	<1	<1	<1	<1	<1
Nickel	<1	<1	<1	<1	<1	<1
Titanium	<1	<1	<1	<1	<1	<1
Silver	<1	<1	<1	<1	<1	<1
Manganese	2	2	2	2	2	2

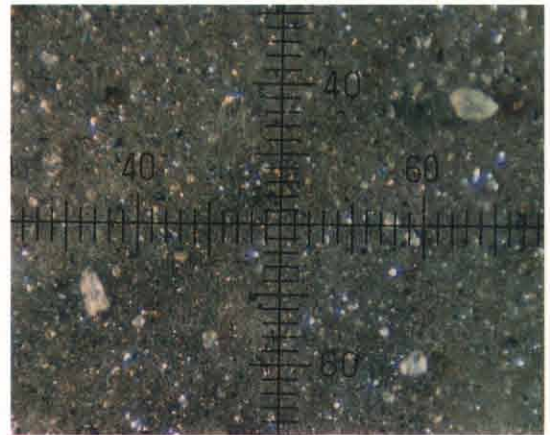
The sample was in good condition and no action is required.
 PARTICLE COUNT ANALYSIS RESULTS BS 5540 (ISO 4406) CONTAMINATION CODE 16/11

Report Date 22-11-93
 Report Reference MA40089

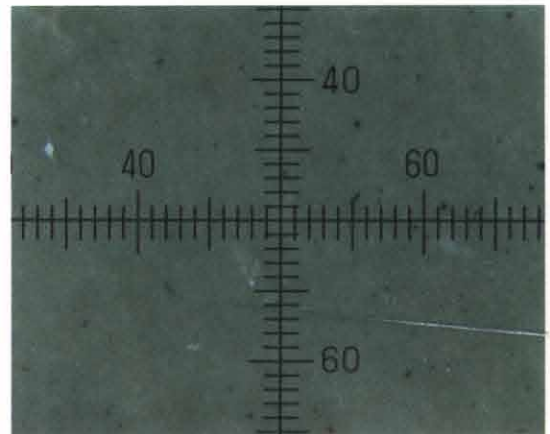
THIS SAMPLE GAVE
 A NORMAL RESULT

In the event of a query please contact EM/PA Department Tel 0276 855460

Ill. 6



Before sample, Nov 8th, before filtering. ISO 20/17.



After sample, Nov 15th, after one week of filtration. ISO 15/12.



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