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Three thousand horsepower turbo-centrifugal fans rotate at extremely high speeds to maintain pressures in pipelines and other critical applications.

MAG Purifier Improves Lubrication on Turbo-centrifugal Compressor

Provides Optimal Performance

Careful analysis of the lubricants in a wide range of installed units convinced the manufacturer's engineering group that the removal of fine particulate was essential to continuous long-term high reliability operation. The proactive approach described below was evaluated as a strategy to eliminate potential problems before an unplanned outage occurred.

. . . despite the clear state of the oil, varnish deposits continued to appear at a less than desirable state - both on rotating and stationary components

by
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The Problem

Upgrading of the oil filtration system provided reliable ISO 15/11 service. Nevertheless, despite the clear state of the oil, varnish deposits continued to appear at a less than desirable state - both on rotating and stationary components throughout the assembly. Experimental increasing of the filtration parameters achieved little effect.

The Trial

MAG Systems was selected to participate in a side-by-side test program using twin compressors of like design installed several years ago. The oil analysis indicated a buildup of fine material in both machines. Varnish was shown to be an ongoing process in both machines.

The Procedure

The test began in March 2001. The lubricant was ISO Viscosity Grade 32, Turbine Lube oil. The purification system was a MAG Systems' model ISOPur-101 connected in a kidney loop on the 150-gallon oil tank. Initially only the mechanical filters of the ISOPur-101 were used for the first four weeks. The electronic filters were not connected. This provided a reference base line using filters only.

MAG Systems was selected to participate in a side-by-side test program using twin compressors of like design

In mid April the electronic filters were energized, beginning the Balanced Charge Agglomeration process. Oil cleaning began immediately as can be seen on Figure 1.

After cleaning the oil for several weeks, the Balanced Charge process started to remove contaminants from the walls, lines, bearings and gears of the system. The system scouring began vigorously on 14 May 2001. The ISO code went up and down as the system removed material from the walls and the oil more rapidly. Variations in temperature influenced the up and down variability in the process during this period. (Material was removed at a faster rate at higher temperatures.)

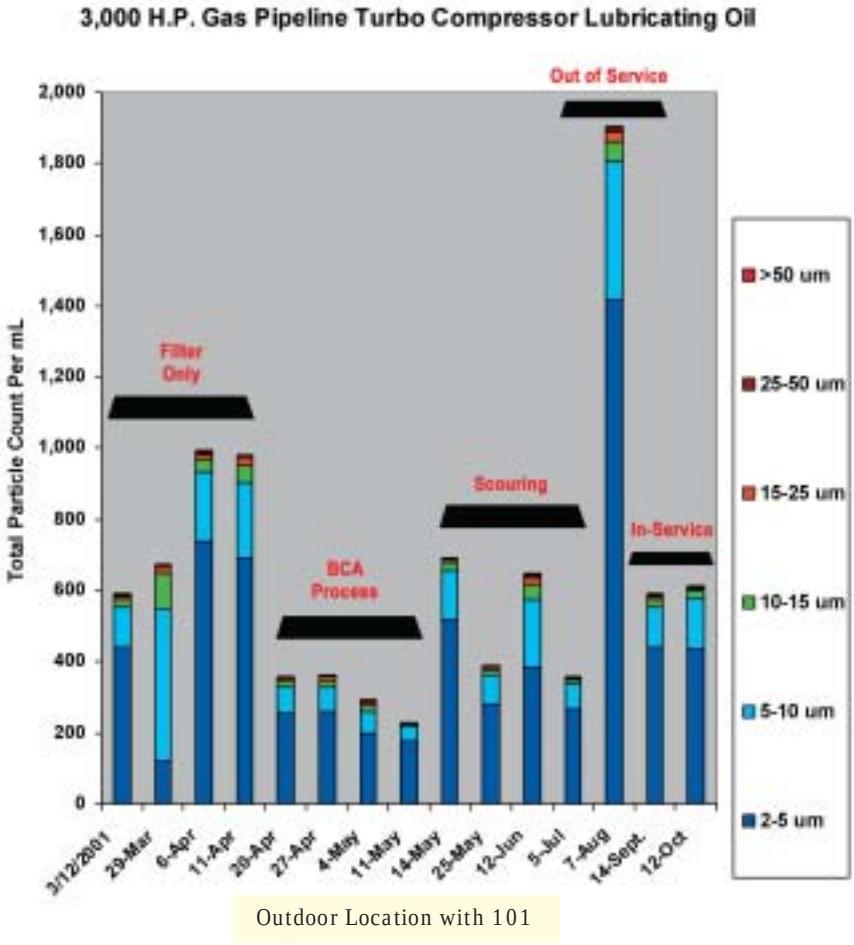

Fig 1 - Particle Counts

The system was out of service from 01 August to 15 August. (See Figure 1 and Table 1.) The 07 August sample shows the scouring process was continuing in the absence of the ISOPur technology, as the balanced charge in the fluid continued to pull fine material from the system. Since the system was not removing the accumulated particulate from the fluid during that time, it resulted in the spike shown on the graph. The September sample clearly shows that the oil and system cleaning process had resumed at a normal level after the MAG system had resumed operation.

In mid April the technology was energized, beginning the Balanced Charge Agglomeration process.

Table 1.

Particle Counts given are particles within the indicated range for one (1) ml of oil. Blue Shading indicates MAG Filter Energized.

Particles	3/12/2001 Filter	29-Mar	6-Apr	11-Apr	20-Apr	27-Apr	4-May	11-May	14-May	25-May	12-Jun	5-Jul	7-Aug	14-Sep	12-Oct
1-2 um	129	122	194	152	86	62	57	55	168	97	88	86	394	116	129
2-5 um	442	122	740	693	256	260	199	176	517	280	386	267	1415	440	436
5-10 um	110	426	195	209	72	70	61	41	138	81	187	69	390	115	142
10-15 um	21	100	31	48	17	17	15	6	22	15	45	12	58	18	19
15-25 um	10	18	15	23	8	10	11	3	9	8	15	6	25	10	7.6
25-50 um	6	9	10	8	4	7	7	2	3	3	10	4	13	6	4.5
>50 um	0.6	3	1	0.6	0.7	1	1	0.2	0.5	1.3	5.4	0.6	2	1	0.9
ISO Code	16/14/11	17/15/12	17/15/13	17/15/12	16/14/11	16/14/11	15/14/11	15/13/10	17/15/11	16/14/11	17/15/12	16/14/11	18/16/13	16/14/11	16/15/11
TAN Mg KOH	0.11	0.03	0.24	0.17	0.15	0.22	0.05	0.21	0.05	0.19	0.41	0.18	0.27	0.18	0.12
Water (KF) PPM	63	29	32	23	35	25	44	21	52	21	116	45	47	69	35
Viscosity @ 40 C	31	31.7	31.7	31.4	31.9	34.5	31.4	32.4	28.4	30.3	31.8	31.67	31.76	31.81	31.67

Tear Down and Inspection

In late November 2001, the gear casing and bearings were disassembled to inspect and determine the amount of varnish either building up or being removed from the compressor. The case was removed with the assistance of the overhead crane, and the first inspection revealed the internals to be much cleaner than normal. The bearing caps and blocks were removed to permit the analysis of the shaft and journals.

Shafts that were previously covered with brown varnish were completely bright. Journals that had segments of black varnish were either greatly reduced in varnish content or totally clean. Obviously, the Balanced Charge Agglomeration process has steadily removed contaminants from all of the internal surfaces of the equipment.

Filter Cartridge Analysis

On 12 October, the Pre-Filter and the Collection Cartridges were removed and sent to the laboratory for analysis to determine the amount and type of material the MAG system was removing.

The residue from the Pre Filter Cartridge was determined to be 98% organic, 1% metallic and 1% other. This is very encouraging since the varnish was either organic or carbonaceous in nature, and the optical microscope was unable to distinguish between the two. The extremely low level of metallic components demonstrates that the existing level of oil filtration producing an ISO code of 15/11 is sufficient for this application. The total estimated weight of this debris was 3.2 grams demonstrating that less than 10 % of the capacity of the Pre-Filter cartridge was used during this period of operation.

The residue from the Collection Cartridge was determined to be ~78% Organic and ~16% metallic, with the balance being other.

Fig 2 - Brown varnish on journals and shaft

Fig 3 - Clean and bright

Shafts that were previously covered with brown varnish were completely bright

This is consistent with the previous x-ray studies that revealed a low metallic nature of some of the heavy deposits in the system. The predominance of organic material is a further confirmation of the carbonaceous nature of the varnish deposits within the system. The total gravimetric weight in this filter was determined to be 0.25 Grams. This is

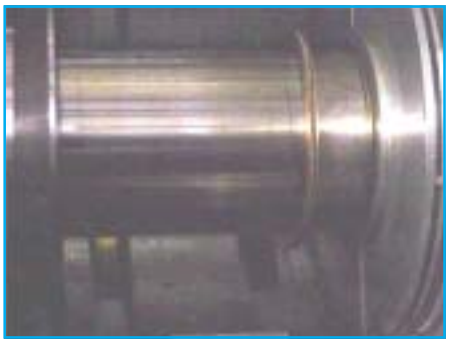

Fig 4 - Clean journal

Fig 5 - Varnish on bearing pads

Fig 7 - Clean pads

Fig 6- Clean pads

Journals that had segments of black varnish were either greatly reduced in varnish content or totally clean

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. . . collection cartridge, ~78% organic and ~16% metallic

probably less than 1% of the actual weight of the sludge in the cartridge due to the fact that a 0.80 um filter disc was used for the analysis, while the majority of the particles were significantly less than 0.50 microns in size.

Fig 8 - Ferrogram

Conclusion

The MAG process cleaned an enormous range of organic and metallic components from the compressor system, eliminating and reversing the varnish deposition problem in this critical equipment. The end result will be reduced vibration, extended inspection and maintenance periods, and increased productivity. ❖❖

For more information on the MAG Purifier call toll free at 1-866-921-1200; or email maginfo@isopurfluid.com

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