Fuels & Lubricants Centre

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It was established that the product analysed (Magnom 2” PumpMate core assembly) , was previously fitted to hydraulic system of a product manufactured by a major UK 'Off Highway' OEM.
The test unit run for a total of 1250 hrs of normal equipment use.

Analysis of Contaminated *Magnom PumpMate* product Core

All cores were cleaned in an ultrasonic bath using petroleum spirit with the resulting wash millipored on to an 8 µm filter paper to give a ‘non-magnetic’ patch.
Remaining debris was then placed in a millipore holder.
Samples were examined by Scanning Electron Microscope (SEM) with *in-situ* quantitative Energy Dispersive X-Ray Microanalysis (EDX). The findings of this examination were as follows
The Magnpm PumpMate is constructed of 3 stacked magnetic cores, for the purpose of the analysis, these individual cores are identified as 'A' 'B' & 'C'.

Size Ranges / Composition – Core A

Majority Debris (85.0 %) – Very fine (< 20 µm) to very large flat flakes, cutting wear, chunky particles and spheres, the largest measuring ≈ 1.6 x 1.4 mm. Analysis indicated a composition consistent with chromium/ nickel low alloy steel. See Figure 1.
Small Amount (10.0 %) – Very fine to very large flat platelets, chunky nodulated particles and spheres, the largest measuring ≈ 1.6 x 0.9 mm. Analysis indicated a composition consistent with carbon/ manganese steel.
Small Amount (5.0 %) – Very fine to very large chunky nodulated particles and spheres, the largest measuring ≈ 4.2 x 1.1 mm. Analysis indicated a composition consistent with a plain carbon steel. See Figure 2.

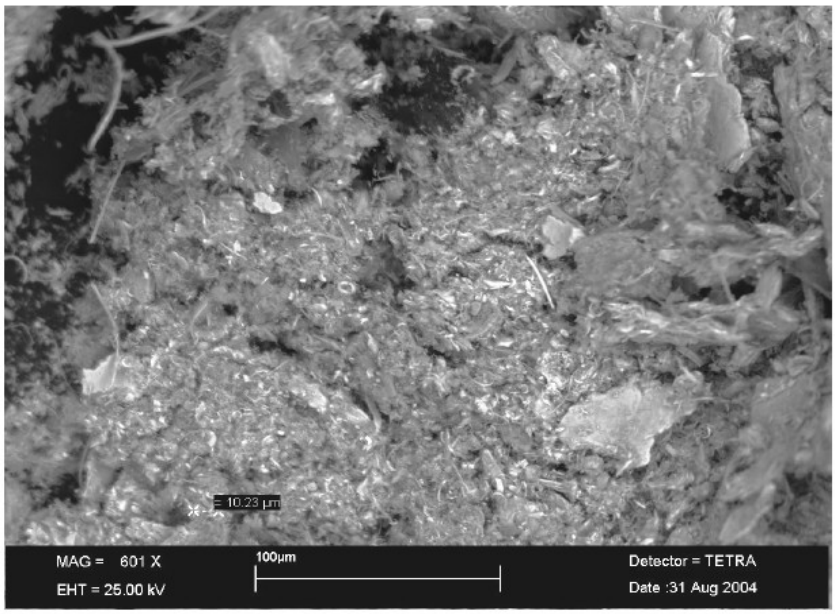

Figure 1. SEM micrograph illustrating typical size distribution of debris ex-Core A.

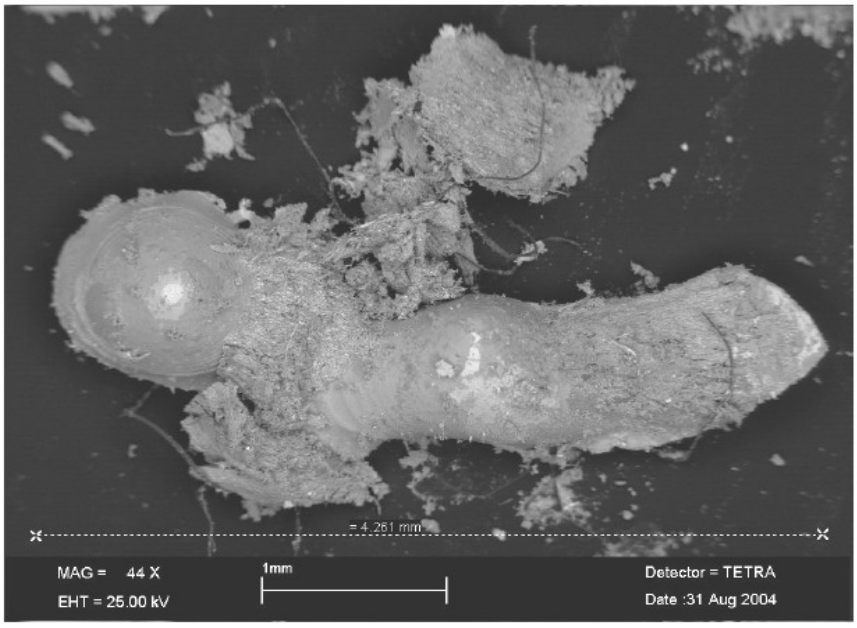

Figure 2. Typical example of nodular particles found in sample ex-Core A.

0-10µm = 50%
Mainly a chromium/ nickel low alloy steel.
11-30µm = 30%
Mainly a chromium/ nickel low alloy steel.
31-50µm = 10%
Mixture of a chromium/ nickel low alloy steel and a carbon/ manganese steel.
51-100µm = 5%
Mixture of a chromium/ nickel low alloy steel and a carbon/ manganese steel.
>100µm = 5%
Mixture of a carbon/manganese Steel and a plain carbon steel.

Size Ranges / Composition – Core B

Majority Debris (85.0 %) – Very fine (< 20 µm) to very large flat flakes, cutting wear, chunky particles and spheres, the largest measuring ≈ 0.6 x 0.4 mm. Analysis indicated a composition consistent with a chromium/ nickel low alloy steel. See Figure 3.

Small Amount (10.0 %) – Very fine to very large flat platelets, chunky nodulated particles and spheres, the largest measuring ≈ 0.9 mm. Analysis indicated a composition consistent with a carbon/ manganese steel.

Small Amount (5.0 %) – Very fine to very large chunky nodulated particles and spheres, the largest measuring ≈ 1.2 mm. Analysis indicated a composition consistent with plain carbon steel. See Figure 4.

0-10µm = 50%
Mainly a chromium/ nickel low alloy steel.
11-30µm = 30%
Mainly a chromium/ nickel low alloy steel.
31-50µm = 10%
Mixture of a chromium/ nickel low alloy steel and a carbon/ manganese steel.
51-100µm = 5%
Mixture of a chromium/ nickel low alloy steel and a carbon/ manganese steel.
>100µm = 5%

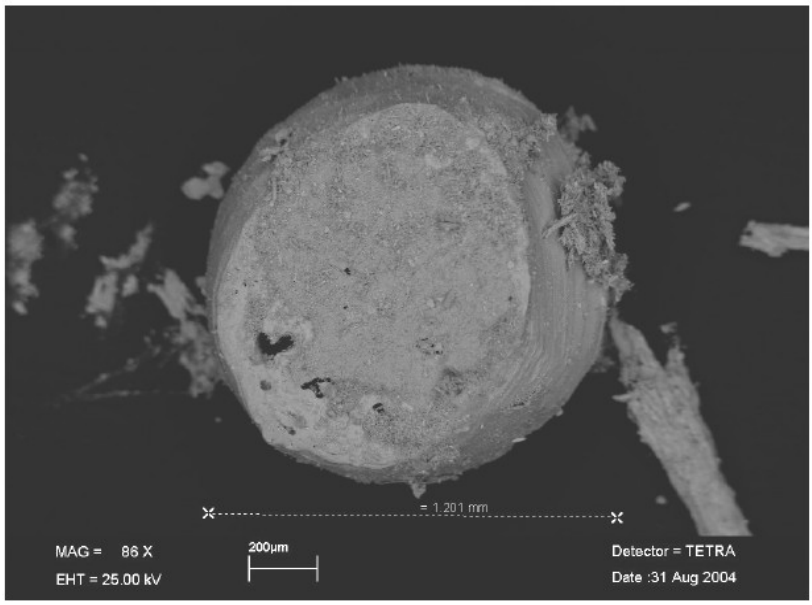

Figure 4. Typical example of a spherical particle found in sample ex-Core B.

Size Ranges / Composition – Core C

Majority Debris (95.0 %) – Very fine (< 20 µm) to very large flat flakes, cutting wear, chunky particles and spheres, the largest measuring ≈ 0.8 x 0.6 mm. Analysis indicated a composition consistent with a chromium/ nickel low alloy steel. See Figure 5.

Small Amount (5.0 %) – Very fine to very large chunky nodulated particles and spheres, the largest measuring ≈ 0.8 mm. Analysis indicated a composition consistent with plain carbon steel. See Figure 6.

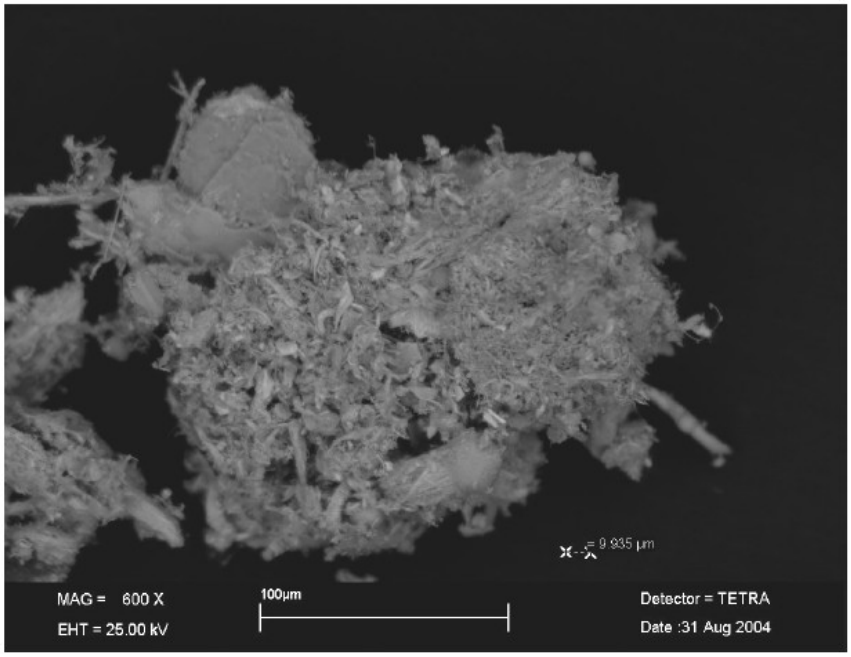

Figure 5. SEM micrograph illustrating typical size distribution of debris ex-Core C.

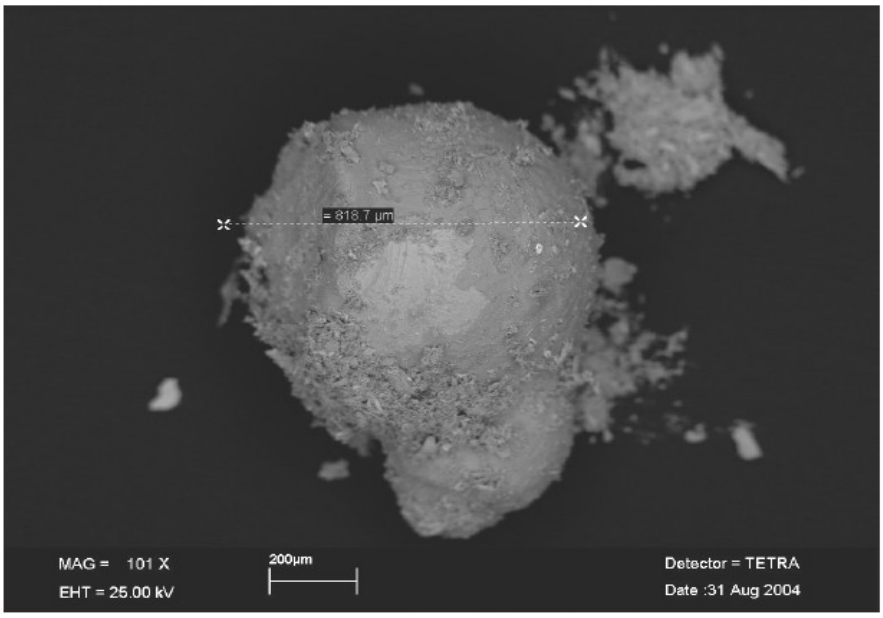

Figure 6. Typical example of a spherical particle found in sample ex-Core C.

0-10µm = 50%
Mainly a chromium/ nickel low alloy steel.
11-30µm = 30%
Mainly a chromium/ nickel low alloy steel.
31-50µm = 10%
Mixture of a chromium/ nickel low alloy steel and a plain carbon steel.
51-100µm = 5%
Mixture of a chromium/ nickel low alloy steel and a plain carbon steel.
>100µm = 5%
Mixture of a chromium/ nickel low alloy steel and a plain carbon steel.

Comments

Due to the large amount of debris collected the sizing of particulate was made difficult due to their packing together in deep layers that obscured many of them.

The presence of large amounts of metallic particulate within an oil wetted system may cause extensive secondary damage.

Rob Chapman
Laboratory Manager