

TECHNICAL BULLETIN

MILITEC-1 IN A CATERPILLAR 988B LOADER

February 26, 1992

The **Amoco Oil Refinery** in Texas City, Texas began testing MILITEC-1 in July/August of 1991. For their testing, they selected the Caterpillar 988B Loader which works in the coke pits at the refinery. The coke pits are the final by-product of the refining process where pure carbon dust (coke) is ejected into pits with depths varying from a few feet to 15 or 20 feet. The Cats operate in these pits loading the coke into containers for shipment to Japan where the carbon is glued together to form pencil lead. The pit environment in which these pieces of equipment operate is highly contaminated and any rain may create large pools of very acidic water. Normal yearly maintenance and handling on Amoco's six 988Bs may cost upwards of one million dollars, mostly due to overhauls and downtime. This environment provided the best opportunity to test MILITEC-1 under extreme conditions.

Two loaders, #103 and #105, were selected for the main test program. They were treated with MILITEC-1 at a ratio of four ounces per quart of existing lubricant. This is double the normal treatment level and was chosen because of the extreme operating environment. The primary engines were treated first. Also because of the extreme conditions, an oil analysis was scheduled to be performed after each 250 hours of operation, less than the regular oil change and analysis intervals (300-500 hours), to monitor the wear occurring in the engines in hopes of averting major damage.

One loader, #105, was also selected to test MILITEC-1 in the transmission. The MILITEC-1 was added to the transmission in #105 at the same time that it was added to the engine. The treatment ratio for the transmission was 2 ounces of MILITEC-1 per quart of transmission fluid.

The test results are on the following pages. Due to the positive findings, the head of maintenance has expanded the use of MILITEC-1 and welcomes maintenance supervisors using heavy Caterpillar equipment to call.

Thanks go to the garage maintenance staff at the Texas City Refinery for their diligent work testing MILITEC-1 and sharing their findings.

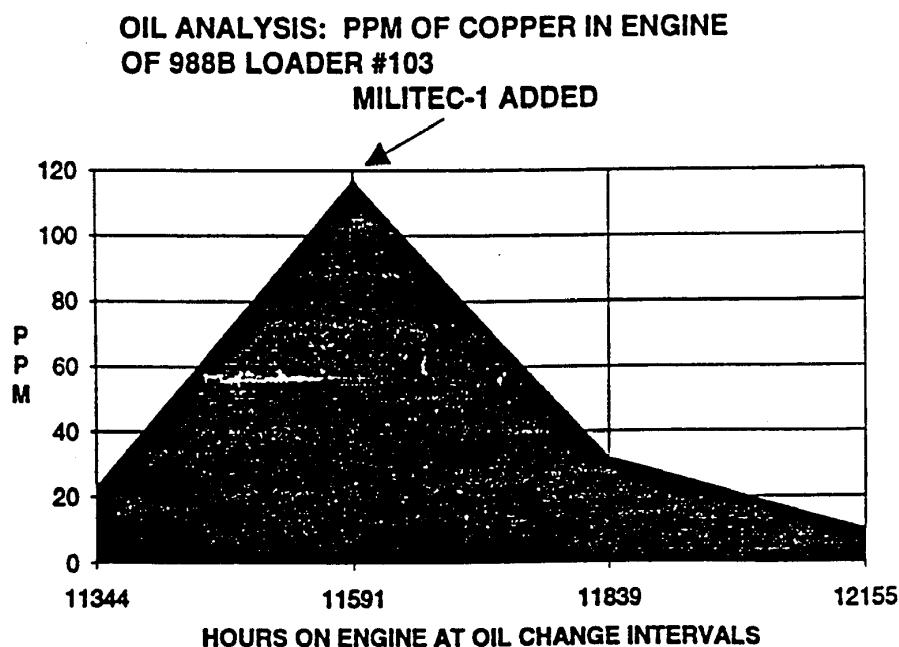
Results from Caterpillar #103, Primary Engine:

Cat #103 was treated with MILITEC-1 at 11591 hours on the engine. At this time, the oil analysis was indicating Copper levels at the extremely high level of 117 parts per million (PPM). Copper is monitored as an indicator of abnormal wear of engine thrust washers, bushings, and bearings. This provides an excellent indicator of damage occurring to the load-bearing areas of the engine. According to the head of fleet maintenance, extremely high copper levels sound the loudest alarm of all the metals monitored for wear and will result in immediate action. At this time, it was decided to treat the engine with MILITEC-1 to see if the levels could be brought down. After treatment, the engine started up noticeably easier and ran smoother.

The equipment normally operates 24 hours per day, 7 days a week. It was returned to normal operation in the coke pit for a

period of 248 engine hours after which it was returned to the garage where the oil was changed and resampled. The oil analysis at 11839 hours indicated the Copper level was at 32 PPM, a drop of 85 PPM in one oil interval, but still in the high range. The drop of 85 PPM was outstanding according to the head of fleet maintenance.

The Cat was returned to operation for an additional period of 250 hours, **without any additional treatment of MILITEC-1**. Following this period, #103 was again sampled and the Copper level had fallen to 10 PPM. According to the head of fleet maintenance, this total drop of 107 PPM over two oil intervals clearly demonstrated the ability of MILITEC-1 to dramatically reduce wear in the most extreme of environments.



Results from Caterpillar #105, Primary Engine:

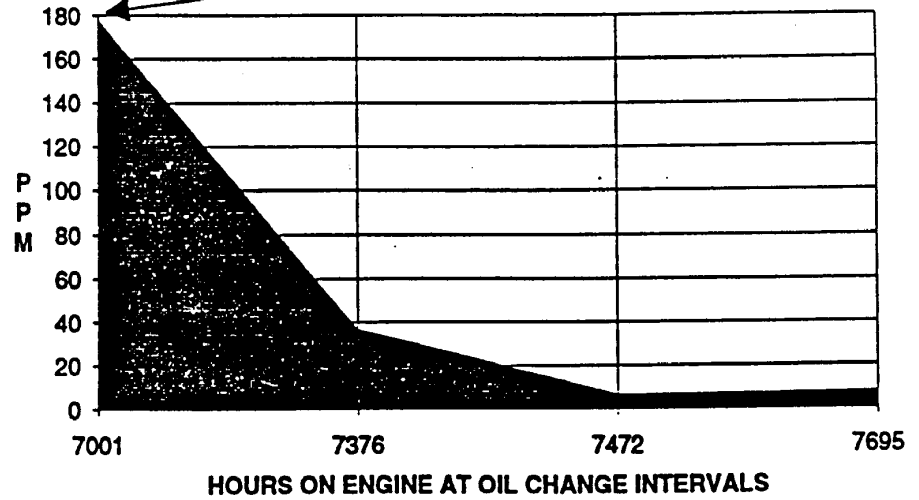
At 7001 hours on the primary engine, Cat #105 was showing a Copper level of 178 PPM, in the extremely high range. This indicated abnormal wear of the thrust washers, bushings and bearings in the engine and dictated a resampling after 250 hours to determine if extreme measures were called for including an engine overhaul. It was decided to treat the engine with MILITEC-1 at this time to see if any wear reduction could be recorded.

Following 375 hours, the engine oil was resampled. The period was longer than initially planned due to demand and another loader breaking down. At 7376 hours, the Copper levels had fallen to 37 PPM, a drop of 141 PPM in one oil change. According to the head of fleet maintenance, this was unexpected as they felt MILITEC-1 might have a chance of saving the engine, but that it would probably break down from the existing wear. The equipment was serviced and returned to the coke pits.

Following an additional 96 hours of operation, the engine was resampled. At 7424 hours, the Copper levels had fallen to 7 PPM, a total decline of 171 PPM (96%) over 469 hours of operation with MILITEC-1.

Since these results, an additional 223 hours have been put on the engine with the most recent analysis occurring at 7695 hours. The Copper level in this sample was 8 PPM, well inside the comfortable range.

OIL ANALYSIS: PPM OF COPPER IN ENGINE OF 988B LOADER #105 MILITEC-1 ADDED



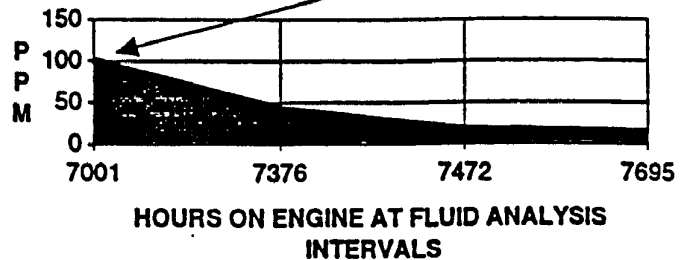
Results from Caterpillar #105, Transmission:

This transmission had a history of ruining hot and had unusually high Copper levels since the day it was installed. The Copper level is monitored to gauge the wear occurring on bearings, discs, gear bushings and sleeves, all of which may sustain periods of high load.

At 7001 hours, when MILITEC-1 was added, the Copper level was 104 PPM, in the extremely high range for such a transmission. Also, the Iron level was 26 PPM, in the slightly high range. The elevated iron readings indicated wear on the shaft and gears which foretold premature transmission failure.

Following 375 hours of operation, the transmission fluid was resampled. At 7376 hours, the Copper level had fallen to 46 PPM, still in the high range but nonetheless a dramatic decline. The

TRANSMISSION FLUID ANALYSIS: PPM OF COPPER IN ENGINE OF 988B LOADER #105 MILITEC-1 ADDED



Iron level had dropped to 11 PPM which was in the average range.

Following another 96 hours of operation, the transmission fluid was again sampled. At 7424 hours, the Copper level had fallen to 22 PPM, in the slightly high range. The iron had dropped to 9 PPM, slightly below average.

After another 223 hours of operation, the transmission fluid was again sampled. At 7695 hours, the Copper level had fallen to 19 PPM, in the slightly high range but extremely low for this transmission, given its historically high levels. This was well enough in the comfort range that drastic action was no longer contemplated to save the transmission. The Iron level had remained at 9 PPM, indicating no significant wear was occurring.

TRANSMISSION FLUID ANALYSIS: PPM OF IRON IN ENGINE OF 988B LOADER #105 MILITEC-1 ADDED

