
GLOBAL TIRE MANUFACTURER MANAGED RELIABILITY PROGRAM

OIL ANALYSIS AND SIDE STREAM FILTRATION

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Case Study

SYNOPSIS

RIG developed and implemented a turnkey ISO cleanliness program that increased the reliability of critical hydraulic systems for a global tire manufacturer.

RIG's ISO cleanliness program reduced maintenance, oil and filter costs, as well as prolonged the life of critical hydraulic equipment by exceeding the target cleanliness level on all 63 hydraulic systems.

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An inline laser particle counter provided real-time oil analysis

PROJECT OVERVIEW

RIG developed and implemented a turnkey ISO cleanliness program that increased the reliability of critical hydraulic systems for a global tire manufacturer. The program managed 63 recirculation hydraulic systems located in a single department of the manufacturing plant. These systems actuated sensitive valves and cylinders with proportional directional valves being the most critical components. Operating pressures of the valves were below 3000 psi. The target ISO 4406:99 cleanliness code for these systems was 17/15/11. 's ISO cleanliness program reduced maintenance, oil, and filter costs as well as prolonged the life of critical hydraulic equipment by exceeding the target cleanliness level on all 63 hydraulic systems.

OIL CONTAMINATION

The process controlled by the hydraulic systems inherently caused a sizable portion of the hydraulic oil to be expelled into a containment trench below the equipment. Once in the trench, the oil was washed into a separation pit. This collection process introduced heavy particulate and water contamination into the oil. The customer had previously purchased new oil to continuously replace this leaked oil. RIG developed a custom ISO cleanliness program to reclaim the oil for reuse, virtually eliminating the need to purchase new oil.

OIL RECLAMATION

Once in the separation pit, a skimmer rope pulled the oil from the top of the water and pumped it into a decant tank in preparation for oil reconditioning by RIG. The first step of the reclamation process was running the oil in a vacuum dehydration unit to remove the

emulsified and dissolved water. It was then filtered to remove particulates in order to exceed the target ISO code of 17-15-11. An inline laser particle counter and a moisture reader verified the oil health and ISO cleanliness level as the it was pumped into the clean oil holding tanks for reuse. The holding tank was spot checked every month to ensure fluid cleanliness from a 3rd party laboratory.

OIL ANALYSIS PROGRAM

RIG implemented a quarterly oil analysis program to monitor oil health. This program included incorporated a sampling and laboratory testing schedule for each oil reservoir. The samples were sent to a 3rd party laboratory for spectroscopy, particle count, viscosity, total acid number, and Karl Fisher water analysis. The test results were then analyzed by RIG’s MLA certified technicians for any potential issues. The technicians provided recommendations to prevent and remedy any issues highlighted in the laboratory analysis. The oil analysis results were entered in a database in order to establish trending data that was used to accurately predict and prevent issues before they occurred. The oil testing data and recommendations were presented to the customer at quarterly oil analysis meetings.

17-15-11	MOBIL/DTE 26	Marginal/Critical	HIGH COPPER/HIGH IRON/HIGH WATER CONTENT	FILTER CART/WATER REMOVING FILTER OR DRAIN & REFILL
18-16-13	RANDO HD 46	MARGINAL	HIGH ISO COUNT	FILTER CART
18-17-13	RANDO HD 46	MARGINAL	HIGH ISO COUNT	FILTER CART
18-16-12	RANDO HD 46	MARGINAL	HIGH ISO COUNT	FILTER CART
20-18-15	MOBIL/DTE	MARGINAL	HIGH ISO COUNT	FILTER CART
19-17-14	RANDO HD 46	MARGINAL	HIGH ISO COUNT	FILTER CART
18-16-13	MOBIL/DTE	MARGINAL	HIGH ISO COUNT	FILTER CART
18-17-13	MOBIL/DTE	MARGINAL	HIGH ISO COUNT	FILTER CART
18-16-13	MOBIL/DTE	MARGINAL	HIGH ISO COUNT	FILTER CART
19-17-13	MOBIL/DTE	MARGINAL	HIGH ISO COUNT	FILTER CART

Table 1. Oil health log with ISO particle count analysis and recommendations

PORTABLE FILTRATION CARTS

The ISO cleanliness program also incorporated auxiliary filtration at the oil reservoirs for each of the 63 hydraulic systems. The filtration was provided by 3 filtration carts custom built by RIG to fit in the limited space around the oil reservoirs. The carts were outfitted with 1-micron beta 1000 filter elements to effectively remove particulates from the oil. The filter elements were replaced with water removing elements when an increase in the water content was indicated in an oil analysis report.

Each reservoir was outfitted with a RIG BSF (Breath/Sampler/Filler) to prevent moisture accumulation while allowing the system to breath as well as provide a consistent sample and connection point for the filter cart. The BSF kits also provided the added benefit reducing opportunities for contamination by eliminating the need to open the reservoir for sampling or filtering.



Figure 1. BSF kit installed on a hydraulic oil reservoir

The carts provided fast filtration rates to facilitate quick rotation of carts between the 63 hydraulic systems. RIG personnel moved carts every four hours to ensure that each oil reservoir was filtered according to a specific rotation schedule. Deviations from the rotation schedule were made in the event of excessive particle count results in order to immediately target the contaminated hydraulic system. Detailed weekly logs were provided to the customer to document the filter cart rotation.



Job Log: 2016-04-#2411
 Company: Customer Location
 Plant/Location: State
 Team Location: City
 Job Number: 3190
 Account Type:
 Start Date: 4/18/2016
 End Date: 4/24/2016

Production Lines	System ID	Filter Service Type	Filter Cart Number	Hour Meter - Start Time	Hour Meter - End Time	Total Hours of Circulation	Sample	Parts	Sign Off
Tire	ATLPH-Z	FC	71	4/18/16 8:45 AM	4/18/16 4:30 PM	7.75	YES	N/A	JO
Tire	ATLPH-Z	FC	28	4/18/16 8:40 AM	4/18/16 12:30 PM	3.63	NO	N/A	JO
Tire	ATLPH-Z	FC	29	4/18/16 8:35 AM	4/18/16 12:25 PM	3.83	NO	N/A	JO
Tire	ATLPH-Z	FC	29	4/18/16 12:30 PM	4/18/16 4:20 PM	3.83	NO	N/A	JO
Tire	ATLPH-Z	FC	28	4/18/16 12:35 PM	4/18/16 4:25 PM	3.83	NO	N/A	JO

Table 2. Example of the data documented in the weekly auxiliary filtration log

RESERVOIR CLEANING

The final component of the ISO cleanliness program was annual cleanings of each hydraulic reservoir. To ensure that each system was free of any dirt and debris RIG would clean each systems reservoir every year. During a shutdown period RIG's confined space certified personnel would drain the reservoir, clean the reservoir, inspect/replace suction strainer, replace all filter, and inspect/replace reservoir access gasket. By cleaning the reservoirs every year we were able to ensure that any of the build up on the tank walls and bottom of the tank were not transferred into the hydraulic system.



Figure 2. Oil reservoir prior to annual cleaning



Figure 3. Clean oil reservoir after annual cleaning

RESULTS

Oil analysis data compiled over a one year period was compared to the initial analysis to determine the effectiveness of the ISO cleanliness program. The comparison indicated a drastic improvement in the oil health from the ISO cleanliness program. The table below compares the condition of the oil in the 63 hydraulic before the program and after one year of implementation.

Oil Condition	Number of Hydraulic Systems	
	Before ISO Cleanliness Program	After 1 year
Normal	11	54
Marginal	49	6
Critical	3	3*

**Immediate analysis revealed excessive silicon contamination cause by a mechanical issue with the hydraulic equipment*

Table 3. Number of Hydraulic Systems

In the period of 1 year, the oil in 54 systems was at normal conditions compared to only 11 before implementing the ISO cleanliness program. The average particle count was reduced from 19/18/16 to 17/16/11 which doubled the life of each component within the department. Further investigation was performed on the 3 systems in critical condition after one year and revealed an excessive amount of silicon in the oil. This was due to a mechanical issue with the equipment that allowed the tire mold release agent to enter into the hydraulic system during the pressing process. The issue was immediately communicated to and remedied by the tire manufacturer.

CONCLUSION

RIG's ISO cleanliness program provided an incredible 400% reduction in new lubricant costs. It also greatly improved the health of the hydraulic oil which substantially extended the life of critical valves and components. The cost of RIG's service was more than offset by the drastic reduction in the oil, maintenance, and down time costs.



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