GLOBAL PLASTIC INJECTION MOLDING 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 plastic mold injection company. The program managed 28 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. The plant was experiencing issues with several electrically operated valves sticking in the closed position ever year requiring them to be rebuilt. Operating pressures of the valves were below 3000 psi. The target ISO 4406:99 cleanliness code for these systems was 17/15/11. RIG 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 28 hydraulic systems.

RIG ISO Cleanliness Program

OIL ANALYSIS PROGRAM

RIG implemented a quarterly oil analysis program to monitor oil health on the 28 recirculation hydraulic systems. This program incorporated a routine sample and laboratory testing of each reservoir at an ISO/IEC 17025:2005 accredited laboratory. The samples were analyzed for spectroscopy, particle count, viscosity, total acid number, and Karl Fisher water analysis. The test results were analyzed by RIG's MLA I and MLA II certified technicians. The technicians provided recommendations to increase reliability based on 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.

	Date Sampled	NEW OIL	4/14/2017	1/17/2017	12/5/2016	9/6/2016	6/3/2016
	Lab No	1052888	1928346	1860805	1833236	1769561	1705779
	Machine / Lube Cond.		N / N	N / N	N / N	N / N	N / N
	ELEMENTAL SPECTROSCOPY (ppm) ASTM D5185 Mod (-) indicates below detection limit						
Wear Metals	Iron	-	3	4	4	3	4
	Copper	-	3	3	3	3	2
	Lead	-	-	-	-	-	-
	Aluminum	-	-	-	-	-	-
	Tin	-	-	-	-	-	-
	Nickel	-	-	-	-	-	-
	Chromium	-	-	-	-	-	-
	Titanium	-	-	-	-	-	-
	Vanadium	-	-	-	-	-	-
	Silver	-	-	-	-	-	-
Additives	Calcium	41	48	45	49	51	49
	Magnesium	-	2	2	2	-	3
	Phosphorus	273	303	337	339	323	337
	Zinc	420	416	391	424	413	399
	Barium	-	-	-	-	-	-
	Molybdenum	-	-	-	-	-	-
Contaminants	Silicon	-	12	11	11	10	9
	Boron	-	-	-	-	-	-
	Lithium		-	-	-	-	-
	Sodium	-	-	-	-	-	-
	Potassium	-	-	-	-	-	-
	PARTICLE COUNT (particles per ml) ISO 4406:99						
	ISO Code	17/16/12	14/13/9	15/14/10	17/15/12	16/14/11	18/16/13
	>4 Micron	1116	151	241	737	413	1578
	>6 Micron	434	58	93	286	160	613
	>14 Micron	33	4	7	21	12	46
	>50 Micron	1	0	0	0	0	2
	>100 Micron	0	0	0	0	0	0
	VISCOSITY (centistokes) ASTM D445						
	Viscosity@40°C	43.9	46.2	46.5	46.6	46.3	46.5
	ACID NUMBER (mg KOH/g) ASTM D974						
	Acid Number	0.50	0.51	0.55	0.66	0.50	0.56
	WATER (PPM) a-ASTM D6304C b-IWI-134* c-Crackle d-IWI-135* e-IWI-370*						
	Water		99 (a)	58 (a)	83 (a)	218 (a)	163 (a)

Figure 1. Right: Oil Analysis Report Highlighting the Substantial Reduction of the ISO Code Particle Count.

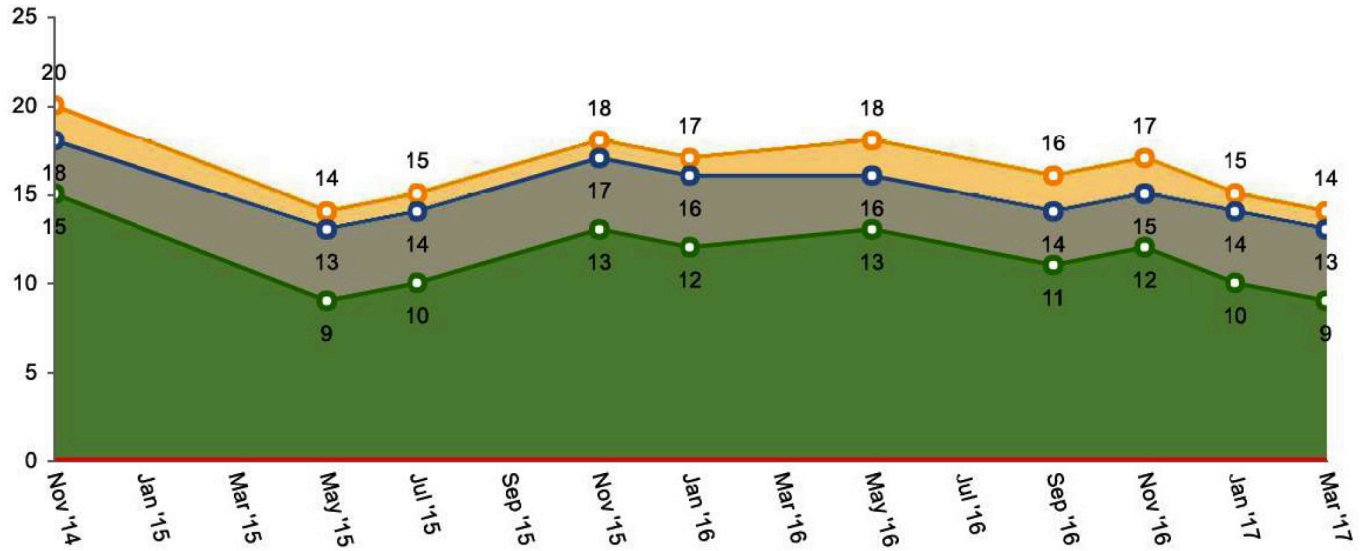

Figure 2. Thirty-Month Particle Count Analysis

PORTABLE FILTER CARTS

The ISO cleanliness program also incorporated auxiliary filtration at the oil reservoirs for each of the 28 recirculation hydraulic systems. The filtration was provided by 2 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. RIG personnel moved carts every two weeks 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.

Auxiliary Filtration Job Log

Job Log: 2017-03-#3412
Company:
Plant/Location:
Team Location:
Job Number: 3970
Account Type: Service Solution
Start Date: 3/23/2017 8:00 AM
End Date: 4/13/2017 3:44 PM

Production Line	System ID	Filter Service Type	Filter Cart Number	Hour Meter - Start Time	Hour Meter - End Time	Total Hours of Circulation	Sample	Parts	Sign Off
	2069879	FC	77	3/23/2017 8:15 AM	4/13/2017 11:00 AM	506.75	No		JO
	13026	FC	57	3/23/2017 8:25 AM	4/13/2017 11:10 AM	506.75	No		JO
	2919505	FC	77	12/23/2016 11:15 AM	1/9/2017 3:00 PM	411.75	No		JO
	2613982	FC	57	12/23/2016 11:25 AM	1/9/2017 3:10 PM	411.75	No		JO

Figure 3. Example of the Data Documented in the Weekly Auxiliary Filtration Log

PORTABLE WATER REMOVING CART

RIG incorporated a stand alone water removing filtration cart to target systems that were found to have high water content based on the quarterly oil analysis program. The elevated water content was noticed during summer months, when the weather was hot and humid. Condensation would build on the inside of the reservoirs causing a spike in water content on the oil analysis reports.

RIG presented two options: 1) install desiccant breathers on each reservoir to pull the moisture out of the reservoirs and also particulates, or 2) rotate one of RIG portable water removing filter carts. The customer selected options 2, which RIG supported. The results were undeniable, an immediate decrease in the ppm water on the oil analysis report. This solution was strictly for preventative maintenance purposes, to avoid larger issues in the future. RIG portable water removing carts, ran side stream on the reservoirs, at eight (8) gallons per minute. All 21 system were back to spec (>50ppm water) within 65 days.

PARTICLE COUNT (particles per ml) ISO 4406:99						
ISO Code	17/16/12	15/13/9	16/14/10	14/12/8	16/14/11	17/16/12
>4 Micron	1116	165	344	96	372	875
>6 Micron	434	64	134	37	144	340
>14 Micron	33	4	10	2	11	25
>50 Micron	1	0	0	0	0	1
>100 Micron	0	0	0	0	0	0
VISCOSITY (centistokes) ASTM D445						
Viscosity@40°C	43.9	45.3	45.5	45.9	45.6	45.3
ACID NUMBER (mg KOH/g) ASTM D974						
Acid Number	0.50	0.52	0.50	0.49	0.42	0.54
WATER (PPM) a-ASTM D6304A b-IWI-133 c-ASTM D6304C d-IWI-134[a] e-IWI-135[a] f-IWI-136[a] g-Crackle h-IWI-370[a]						
Water		42 (c)	321 (c)	55 (c)	25 (c)	10 (c)

Figure 4. Before and After Reports For Portable Water Removal Cart

Auxiliary Filtration Job Log

Job Log: 2016-12-#3109
Company: Polylainer, Inc, Lee's Summit, MO
Plant/Location: Lees Summit, MO
Team Location:
Job Number: 3758
Account Type: One Time
Start Date: 12th/2016 12:00 AM
End Date: 1/9/2017 5:22 PM

System ID:	Location:	Date started:	Time started:	Date finished:	Time finished:	Total hours:	Water content before: (PPM)	Total water content (Gal)	Water content after: (PPM)	Total water content (Gal)
2613986	104	1/9/2017	3:30 PM	1/11/2017	3:00 PM	59.67	228	0.11	22	0.01
2692761	213	11/11/2016	11:30 AM	11/14/2016	1:00 PM	73.5	270	0.14	86	0.04
14441	107	12/1/2016	1:15 PM	12/9/2016	10:30 AM	189.25	479	0.24	17	0.01
2613982	103	11/4/2016	12:40 PM	11/7/2016	1:10 PM	72.5	236	0.12	102	0.05
11143	102	11/2/2016	10:30 AM	11/4/2016	12:30 PM	46	133	0.07	29	0.01
11142	214	11/14/2016	1:05 PM	11/17/2016	2:00 PM	75	168	0.08	100	0.05

Figure 5. Portable Water Removing Cart 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.

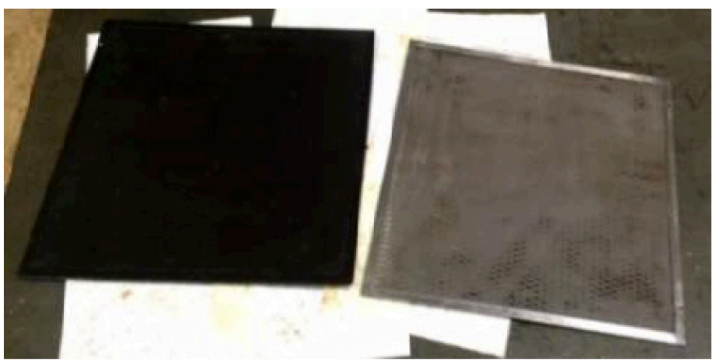

Figure 6. Screen Baffles Before and After

Figure 7. Reservoir Before and After

RESULTS

Oil analysis data compiled over a 30 month period was compared to the initial analysis to determine the effectiveness of RIG ISO cleanliness program for plastic injection molding manufactures. The analysis shows improvement consistent improvement in the in the oil health from the managed RIG ISO cleanliness program. The table below compares the condition of the oil in the 28 hydraulic before the program and after 30 months of implementation.

Prior to the program 71% of the systems were marginal or critical. This was leading to increased maintenance cost and unscheduled downtime on the systems. After RIG implemented and managed the ISO cleanliness program only one (1) system (>1%) was in the marginal classification. The average particle count was reduced from 20/18/15 to 14/13/9 which doubled the life of each component within the department.

	Number of Hydraulic Systems	
Oil Condition	Pre ISO Cleanliness Program	Post Cleanliness Program
Normal	8	27
Marginal	18	1
Critical	2	0

Figure 8. RIG ISO Cleanliness Program Oil Analysis Data

THE AVERAGE PARTICLE COUNT WAS REDUCED FROM 20/18/15 TO 14/13/9 WHICH DOUBLED THE LIFE OF EACH COMPONENT WITHIN THE DEPARTMENT.

CONCLUSION

RIG partnered with this customer to develop a customized ISO cleanliness program that would allow the departments maintenance staff to focus on critical issues while RIG MLA I and MLA II trained and certified technicians ensure the desired fluid cleanliness.

RIG RELIABLE INDUSTRIAL GROUP

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