Paper Mill Lubrication

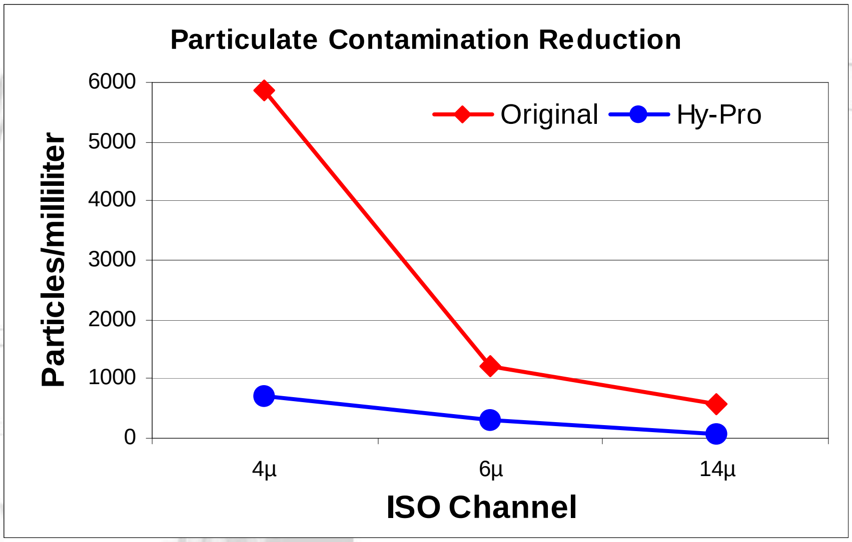
Paper Machine Filter Element Upgrade

Large paper mills rely on continuous production to be profitable, thus unplanned down time is a huge financial burden. When unplanned downtime does occur and equipment must also be either repaired or replaced, the damages can feel exponential. In this case, contaminated lubricants were fouling important components that kept the mill rolling and an upgrade was sought to reduce these expenses. Hy-Pro was chosen to replace the existing filter elements in the search for better bottom-line profitability.

Test Protocol - Fluid cleanliness was analyzed before and after the fluid passed through the filter housings with an on-line particle counter calibrated to ISO11171 (ISO codes per ISO4406:1999). No bottle samples were used and on-line samples were continuously taken until at least three consecutive identical samples were yielded to ensure that the sample ports were properly flushed ensuring no false counts due to dirty sample ports.

Filter Element Upgrade - The original glass media element was rated $\beta 7_{[c]} > 1000$ and was replaced by a Hy-Pro HP8314L39-6MB ($\beta 7_{[c]} > 1000$). It was anticipated that the Hy-Pro element would provide lower ISO fluid cleanliness codes and yield longer element life once the Hy-Pro elements achieved a greater cleanliness equilibrium.

The Results - On-line particle counting was used to quantify the fluid cleanliness after the Hy-Pro upgrade. The Hy-Pro elements yielded substantial improvement in ISO fluid cleanliness codes visible in the tables and graph below. With the Hy-Pro elements there was a **90.8% reduction in particles $4\mu_{[c]}$ and larger, a 98% reduction in particles $6\mu_{[c]}$ and larger and a 99.5% reduction in particles $14\mu_{[c]}$ and larger**.



Original Elements	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	20	17	16
Actual Particles per Milliliter	5865	1202	561

Hy-Pro Upgrade	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	16	12	9
Actual Particles per Milliliter	538	23	5

98% reduction in particles $6\mu_{[c]}$ and larger.

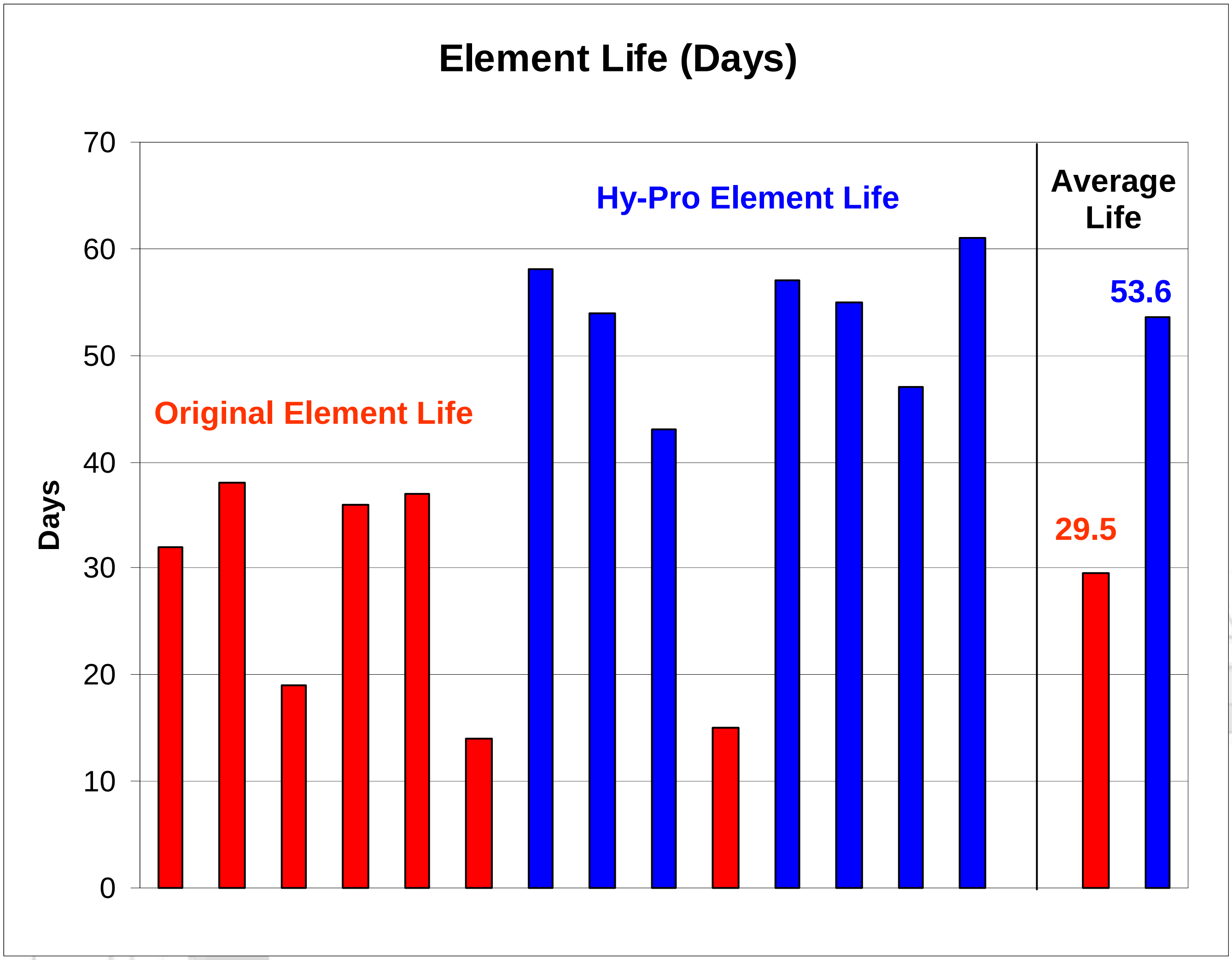
ISO fluid cleanliness ratings can sometimes be deceiving because what appears to be only a one or two number decrease in any channel is actually a significant improvement. Take as an example the 6µ channel in the two tables above: the original $6\mu_{[c]}$ code was17 while the same $6\mu_{[c]}$ code after upgrade was 12. This should seem like a big improvement and a closer look at the actual data reveals the magnitude of the improvement:

- The actual number of particles $6\mu_{[c]}$ and larger reduced by a multiple of 52 from 1202 to 23 particles / ml.
- There were 98% fewer particles $6\mu_{[c]}$ in the fluid causing additive depletion and generating wear particles.

A table and further explanation of the ISO cleanliness codes is included on the last page.

Hy-Pro . . . Longer Element Life!

Element change intervals were documented and are expressed in the graph below. The Hy-Pro elements lasted on average 53.6 days where the original element in the system was lasting on average 29.5 days. The Hy-Pro elements yielded a 81% improvement in element life. Element & Oil purchases would decrease as the average element life in this application has been nearly doubled, and the oil is cleaner which will extend the useful life of the oil making this element upgrade a substantial money-saver.



A reduction in the number of particles per milliliter translates to longer useable life-spans for the oil, the filter elements and all the components in the lubrication system. The increase in lifespan also means reduced maintenance and down time, fewer bearing replacements, and operating cost savings. The end result is that the roller bearings that are so critical to the paper manufacturing process are then less likely to fail prematurely. Peace-of-mind in this case comes from both enhanced reliability and better bottom-line profitability.

Cleaner Fluid, Longer Component & Fluid Life, More Uptime!

Roller Contact Bearing

Current ISO Code	Target ISO Code	Target ISO Code	Target ISO Code	Target ISO Code
	2 x Life	3 x Life	4 x Life	5 x Life
28/26/23	25/22/19	22/20/17	20/18/15	19/17/14
27/25/22	23/21/18	21/19/16	19/17/14	18/16/13
26/24/21	22/20/17	20/18/15	19/17/14	17/15/12
25/23/20	21/19/16	19/17/14	17/15/12	16/14/11
25/22/19	20/18/15	18/16/13	16/14/11	15/13/10
23/21/18	19/17/14	17/15/12	15/13/10	14/12/9
22/20/17	18/16/13	16/14/11	15/13/10	13/11/8
21/19/16	17/15/12	15/13/10	13/11/8	-
20/18/15	16/14/11	14/12/9	-	-
19/17/14	15/13/10	13/11/8	-	
18/16/13	14/12/9	-	-	
17/15/12	13/11/8	-	-	
16/14/11	13/11/8	-	-	
15/13/10	13/11/8	-	-	
14/12/9	13/11/8	-	-	

Laboratory and field tests prove time and again that Hy-Pro filters consistently deliver lower ISO fluid cleanliness codes.

Improving fluid cleanliness means reduced downtime, more reliable equipment, longer fluid life, fewer maintenance hours, and reduces costly component replacement or repair expenses.

Hydraulic Component

Current ISO Code	Target ISO Code	Target ISO Code	Target ISO Code	Target ISO Code
	2 x Life	3 x Life	4 x Life	5 x Life
28/26/23	25/23/21	25/22/19	23/21/18	22/20/17
27/25/22	25/23/19	23/21/18	22/20/17	21/19/16
26/24/21	23/21/18	22/20/17	21/19/16	21/19/15
25/23/20	22/20/17	21/19/16	20/18/15	19/17/14
25/22/19	21/19/16	20/18/15	19/17/14	18/16/13
23/21/18	20/18/15	19/17/14	18/16/13	17/15/12
22/20/17	19/17/14	18/16/13	17/15/12	16/14/11
21/19/16	18/16/13	17/15/12	16/14/11	15/13/10
20/18/15	17/15/12	16/14/11	15/13/10	14/12/9
19/17/14	16/14/11	15/13/10	14/12/9	14/12/8
18/16/13	15/13/10	14/12/9	13/11/8	-
17/15/12	14/12/9	13/11/8	-	-
16/14/11	13/11/8	-	-	-
15/13/10	13/11/8	-	-	-
14/12/9	13/11/8	-	-	-

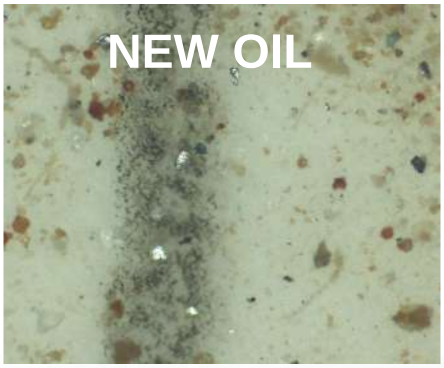
Develop a Fluid Cleanliness Target

Hy-Pro will help you develop a plan to achieve and maintain target fluid cleanliness. Arm yourself with the support, training, tools and practices to operate more efficiently, maximize uptime and save money.

New Oil is Typically Dirty Oil . .

New oil can be one of the worst sources of particulate and water contamination.

25/22/19 is a common ISO code for new oil which is not suitable for hydraulic or lubrication systems. A good target for new oil cleanliness is 16/14/11.



HY-PRO FILTRATION

Understanding ISO Codes - The ISO cleanliness code (per ISO4406-1999) is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes $4\mu_{[c]}$, $6\mu_{[c]}$ and $14\mu_{[c]}$. The ISO code is expressed in 3 numbers (example: 19/17/14). Each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger. It is important to note that each time a code increases the quantity range of particles is doubling and inversely as a code decreases by one the contaminant level is cut in half.

ISO 4406:1999 Code Chart

Range Code	Particles per milliliter	
	More than	Up to/including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

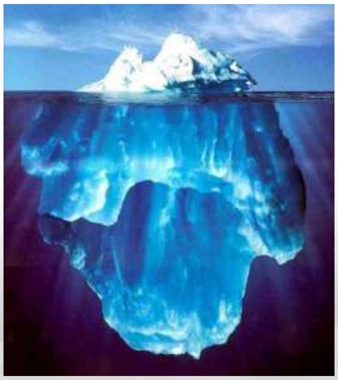
Particle Size	Particles per milliliter	ISO 4406 Code range	ISO Code
$4\mu m_{[c]}$	**151773**	**80000~160000**	**24**
$6\mu m_{[c]}$	**38363**	**20000~40000**	**22**
$10\mu m_{[c]}$	8229		
$14\mu m_{[c]}$	**3339**	**2500~5000**	**19**
$21\mu m_{[c]}$	1048		
$38\mu m_{[c]}$	112		

Particle Size	Particles per milliliter	ISO 4406 Code range	ISO Code
$4\mu m_{[c]}$	**492**	**320 ~ 640**	**16**
$6\mu m_{[c]}$	**149**	**80 ~ 160**	**14**
$10\mu m_{[c]}$	41		
$14\mu m_{[c]}$	**15**	**10 ~ 20**	**11**
$21\mu m_{[c]}$	5		
$38\mu m_{[c]}$	1		

Succeed with a Total Systems Cleanliness Approach

Developing a Total System Cleanliness approach to control contamination and care for fluids from arrival to disposal will ultimately result in more reliable plant operation and save money. Several steps to achieve Total Systems Cleanliness include: evaluate and survey all hydraulic and lubrication systems, establish an oil analysis program and schedule, insist on specific fluid cleanliness levels for all new fluids, establish a baseline and target fluid cleanliness for each system, filter all new fluids upon arrival and during transfer, seal all reservoirs and bulk tanks, install high quality particulate and desiccant breathers, enhance air and liquid filtration on existing systems wherever suitable, use portable or permanent off-line filtration to enhance existing filtration, improve bulk oil storage and handling during transfer, remove water and make a commitment to fluid cleanliness.

The visible cost of proper contamination control and total systems cleanliness is less than 3% of the total cost of contamination when not kept under control. Keep your head above the surface and avoid the resource draining costs associated with fluid contamination issues including:



- Downtime and lost production
- Component repair/replacement
- Reduced useful fluid life
- Wasted materials and supplies ($)
- Root cause analysis meetings
- Maintenance labor costs
- Unreliable machine performance
- Wasted time and energy ($)

HY-PRO FILTRATION