Steel Mill High Pressure Hydraulics

Hydraulic Oscillator System Element Upgrade

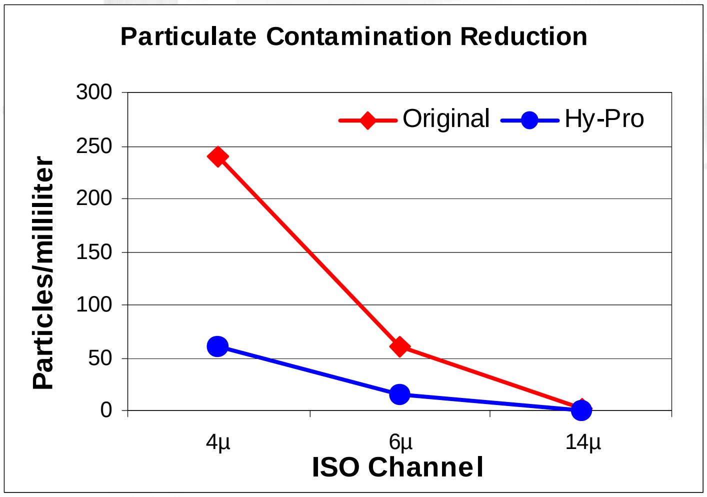
The hydraulic oscillator delivering molten steel into casting molds in this application was operating at a sub-standard level. The hydraulic system, which oscillated the pour of steel from an electric arc furnace into the molds, consisted of 250cc pumps driving a large servo valve which oscillated the pouring steel 6mm per stroke. Frequent filter replacements and hydraulic fouling lead to the assumption that improving fluid cleanliness would improve reliability. It was predicted that upgrading from the original elements to Hy-Pro elements would be a solution. Elements were located at pump discharge, servo pilot pressure filter, offline loop, and return line.

Standard System Information

Operating Temperature	**~110℉**
Fluid Type	**EcoSafe FR46**

Filter Element Upgrade - Original elements with 003 glass media were fitted on the pump discharge filter, servo pressure filter, and the return line filter housings. In the upgrade these were replaced by Hy-Pro 3M media code elements. Hy-Pro 1M media was used to upgrade the $\beta 2.5_{[c]} > 1000$ rated glass media element installed in the offline loop filter housing.

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 **75% reduction in particles $4\mu_{[c]}$ and larger, a 75% reduction in particles $6\mu_{[c]}$ and larger and a 74.7% reduction in particles $14\mu_{[c]}$ and larger**.



Original Elements	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	15	13	8
Actual Particles per Milliliter	~240	~60	~1.9

Hy-Pro Upgrade	$4\mu_{[c]}$	$6\mu_{[c]}$	$14\mu_{[c]}$
ISO Code (per 4406:1999)	13	11	6
Actual Particles per Milliliter	~60	~15	~.48

75% reduction in particles $6\mu_{[c]}$ and larger.

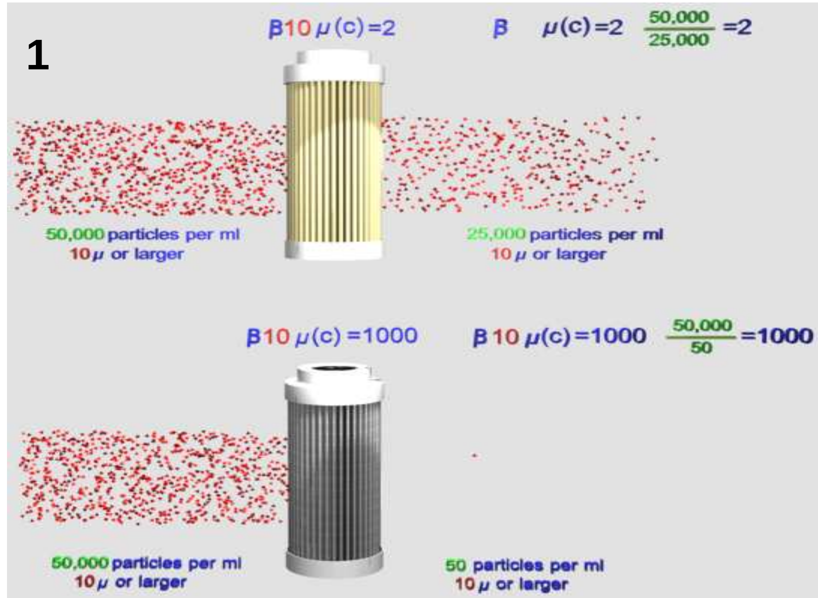
ISO fluid cleanliness codes can sometimes be deceiving because what appears to be only a one or two number decrease in any channel is actually a significant improvement. Take as an example the 4µ channel in the two tables above: the original cleanliness code was 15 while the 4µ channel code after upgrade was 13. This may seem like a minor improvement but a closer look at the actual data reveals the magnitude of the improvement:

- The actual number of particles was reduced by a multiple of 4 decreasing from 240 to 60 particles / ml.
- There were 75% fewer particles $4\mu_{[c]}$ and larger causing additive depletion and generating wear particles.

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

Hy-Pro G8 Dualglass Upgrade from Cellulose Media

Glass media has superior fluid compatibility versus cellulose with hydraulic fluids, synthetics, solvents, and high water based fluids. Glass media also has a significant filtration efficiency advantage over cellulose, and is classified as “absolute” where cellulose media efficiency is classified as “nominal”.



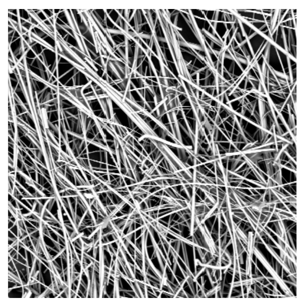
Elements of different media with the same “micron rating” can have substantially different filtration efficiency. Figure 1 provides a visual representation of the difference between absolute and nominal filter efficiency.

The illustrated glass element would typically deliver an ISO Fluid Cleanliness Code of 18/15/8 to 15/13/9 or better depending upon the system conditions and ingression rate. The cellulose element would typically achieve a code no better than 22/20/17.

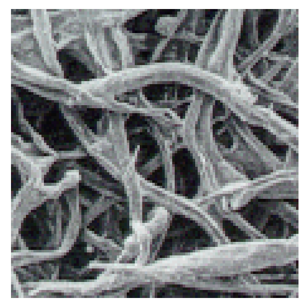
Runaway contamination levels at $4\mu_{[c]}$ and $6\mu_{[c]}$ are very common when cellulose media is applied where a high population of fine particles exponentially generate more particles in a chain reaction of internally generated contaminate.

Inorganic glass fibers are much more uniform in diameter and are smaller than cellulose fibers. Organic cellulose fibers can be unpredictable in size and effective useful life. Smaller fiber size means more fibers and more void volume space to capture and retain contaminate.

Glass Fiber

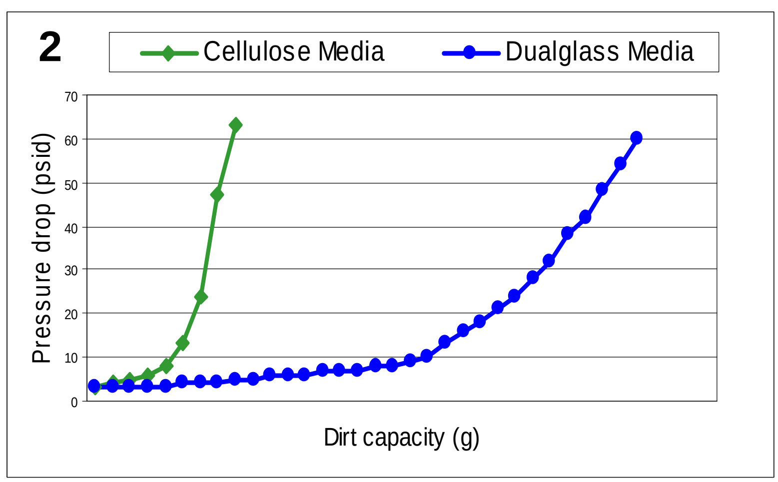


Cellulose



Upgrading to Hy-Pro G8 Dualglass

Glass media has much better dirt holding capacity than cellulose. When upgrading to an absolute efficiency glass media element the system cleanliness must be stabilized. During this clean-up period the glass element halts the runaway contamination as the ISO cleanliness codes are brought into the target cleanliness range. As the glass element removes years of accumulated fine particles the element life might be temporarily short.



Once the system is clean the glass element can last up to 4~5 times longer than the cellulose element that was upgraded as shown in figure 2.

HY-PRO
FILTRATION

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	-	-	-

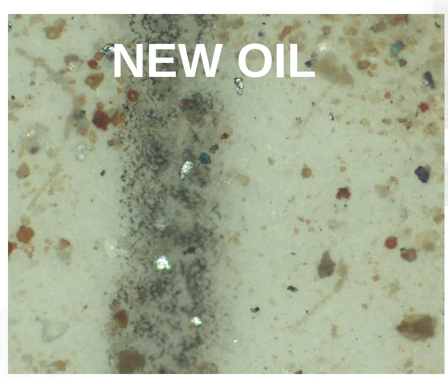
Develop a Fluid Cleanliness Target

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

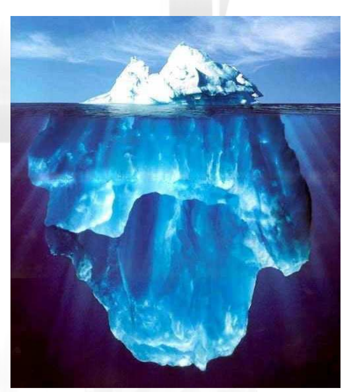
Particle Size	Particles per milliliter	ISO 4406 Code range	ISO Code
$4\mu m_{[c]}$	**151773**	**80000~160000**	**24**
$6\mu m_{[c]}$	**38363**	**20000~40000**	**22**
$10\mu m_{[c]}$	8229		
$14\mu m_{[c]}$	**3339**	**2500~5000**	**19**
$21\mu m_{[c]}$	1048		
$38\mu m_{[c]}$	112		

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 ($)
- Root cause analysis meetings
- Maintenance labor costs
- Unreliable machine performance
- Wasted time and energy ($)