CJC™ Diesel Fuel Filtration

Diesel filtration systems for removal of particles, water, bacteria/sludge and oil degradation products from diesel fuels

Clean Diesel Fuel Delivered

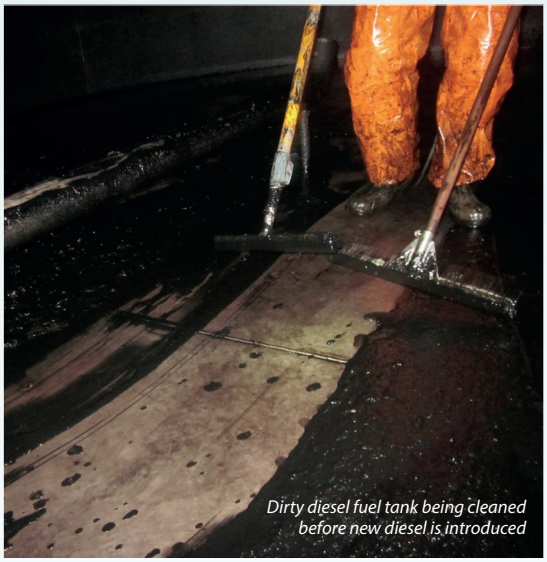
Why diesel fuel tanks and engines **need fine filtration and water removal**

Modern engines & equipment - under constant development

In an attempt to reduce emissions and improve fuel efficiency, equipment manufacturers continuously develop new solutions for modern engines. The High Pressure Common Rail (HPCR) fuel injection system is one of these landmarks which have now become standard in engines.
Because a HPCR system operates under extremely high pressure with very small tolerances, it requires different fuel cleanliness standards. Under such circumstances the smallest particles have the biggest negative impact on the diesel fuel systems.

Ultra-low-sulfur diesel

In certain territories ultra-low-sulfur diesel (ULSD) has become a standard. Due to the refining process the ULSD has less lubricity efficiency and lubricity is essential in diesel fuel to reduce friction in components such as pumps, injectors and valves. This means even higher requirements for clean diesel fuel.



Dirty diesel fuel tank being cleaned before new diesel is introduced

Diesel contamination

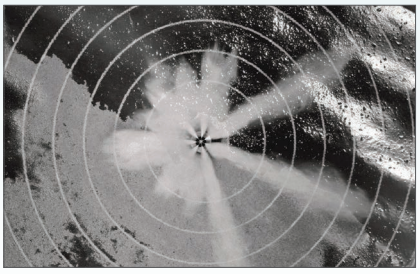
Water & Particles
Water and particles/dirt cause the main problems in diesel systems. While both will have a direct negative impact on the engine; water found during storage will also lead to bacteria growth which will quickly clog fuel valves, injectors and in-line pressure filters cau-sing engine stop. Common problems caused by water and particles in the diesel are: rust/corrosion, cavitation, microbial contamination and abrasive wear. There is a direct correlation between the water and particle level in diesel and the lifetime of critical components such as injectors, fuel pumps and filters.

Asphaltenes, Paraffins & Resin
As a by-product of the refining process and a natural consequence of fuel degradation processes modern diesel contain asphaltenes, paraffins and resin. These are commonly known as organic debris, but in daily language referred to as tar/asphalt, wax, sludge and diesel bugs. Most of the organic debris are acidic and will cause corrosion of injectors, pumps and tanks. It will plug your injectors affect combustion and eventually clog in-line filters. In short it will ruin your engine.

Injector and fuel pump lifetime - high cleanliness is needed

While the HPCR has become a standard, the diesel cleanliness requirements for these systems have not yet become industry standards, which has an impact on wear and tear. While most OEMs recommend a diesel cleanliness of ISO 18/16/13, the reality is that ISO 14/12/9 or even lower is needed to provide the expected component lifetime. In a HPCR system operating under 2,000 - 3,000 bar pressure and needle valves with a clearance of 2-4 microns, the difference between ISO code 18/16/13 and 14/12/9 translates into several thousand extra operating hours on injectors and fuel pumps. The high pressure through the injectors creates “blasting” with water droplets and particles; and it causes water implosions (cavitation) resulting in high wear rates on injectors. Furthermore, particles will generate wear on the entire injector system and lead to poor spray patterns. This results in incomplete combustions and reduced engine component and oil lifetime. This is exacerbated by rust and corrosion.
Today it has become common to see as low as 2,000 hours lifetime of injectors and frequent fuel pump failures, where industry standard should in fact be significantly higher. Recommended injector lifetime of most engines is 9,000 hours. With ultra clean diesel fuel this can in fact be extended even longer.

This is why modern technology requires very clean diesel, and this is where CJC™ Oil Filters perform.



Poor injector spray pattern, from worn injector (photo taken with a microscope at nozzle point)

A fuel pump worn out by cavitation

CJC™ Diesel Fuel Filtration
- the industry highest dirt holding capacity!

Millipore membrane - sample taken ***before*** installation of offline filtration

Millipore membrane - sample taken ***after*** installation of offline filtration

Filtration efficiency with optimum cleanliness levels

Compared to a normal in-line filter, a CJC™ Diesel Filter is significantly different. The main differences are the dirt-holding capacity, the fine filtration capabilities and the removal of particles, water and sludge - with one and the same filter insert.

CJC™ Oil Filters have the highest dirt holding capacity compared to in-line filters with a dirt holding capacity of up to 500 g. Each CJC™ Filter Insert provides a dirt holding capacity up to 4-8 kg and 2 liters of water, as a CJC™ Filter Insert also absorbs water. For systems with continuously water ingress, a CJC™ Filter Separator with coalescer element continuously separate large amounts of water on top of the particle removal.

The CJC™ Filter Insert is like a maze where the oil passes through several layers of cellulose called depth filtration. The large particles are retained at the surface, and the smaller particles will enter the "maze" and are retained within the filter material.

CJC™ Filter Inserts have a 3 µm absolute rating. This means that 98.7% of particles 3 µm and larger are removed in a single pass. Furthermore, they also have a 0.8 µm nominal rating. This means that 50% of particles from 0.8 µm to 3 µm in size are removed in a single pass.

Financial savings

Reference:
An iron ore miner in Western Australia operates a fleet of haul trucks with 16 cylinder motors. The OEM has set the injector life at 9,000 hours (half engine life). Due to the high levels of contamination in the diesel fuel, most of the injectors are failing before 2,000 hours. One injector costs $ 1,600 which means over $ 25,000 per set. Multiplied by the number of vehicles in the fleet this adds up to well over $ 3 mio.

This cost is only on replacing the actual injectors, it does not take into account the man hours required to perform the change, the extra downtime on the vehicle, nor the cost of the increased fuel consumption due to over-fuelling, and possible further engine damage due to fuel dilution of the engine lube oil.

Today more than ever, the miners are forced to be very cautious on reducing and controlling their cost per tonne produced. This type of premature failure dramatically adds to the operations overall cost per tonne, but can be avoided by keeping the fuel at acceptable cleanliness levels.

Reference:
Mine Site: Sadiola
Anglogold Ashanti - Gold mine

Financial benefits
Based on incoming diesel cleanliness level ISO 23/21/14 which equals 75 mg dirt/litre diesel and a request from customer that outgoing diesel cleanliness must be ISO 17/15/11. With an annual consumption of 52 million liters diesel this translates into approx. 3,900 kilo dirt/year.

Using CJC™ Filter Inserts:
with a dirt holding capacity of 4 kilo dirt and 2 liters water per insert, this equals *975 inserts per year.*
▶ Insert change every 23 days!

Using standard in-line filters:
with dirt holding capacity of 0,5 kilo dirt per insert, this equals 7,800 inserts per year.
▶ Insert change every 2-3 days!

In this specific case, the difference in costs are several million dollars

Do your own math
- what will this look like in your case?

CJC™ Solution
- with oil cleanliness levels down to ISO 13/11/8 - or even better

Installation of a CJC™ Diesel Filters will clean the diesel in the tanks to the cleanliness level required by the manufacturers. Most manufactures recommended ISO cleanliness level is 18/16/13, which enhances the performance of the machinery immediately.

However, the reality is that in modern engines it is advisable to go well below the manufacturers' recommended cleanliness levels, and the impact this has on a diesel engine, is significant. E.g. providing diesel ISO cleanliness level 13/11/8 rather than ISO cleanliness level 18/16/13, will extend the lifetime of your engine components such as fuel pumps, injectors, valves etc. by a factor of 4 *(source: Noria Corporation)*

Your key to reliable machinery
& effective production is clean diesel!

CJC™ Diesel Filter HDU 2x27-108 GP

CJC™ Diesel Filter PTU3 4x27/108 GP

CJC™ Diesel Filter HDU 427-81 P

CJC™ Oil Contamination Monitor, OCM15 Continuous online particle and moisture monitoring can be installed as an option

Your Benefits
- introducing a CJC™ Filter:

- reliable machinery
- effective production
- high combustion efficiency

- high dirt holding capacity
- removal of contaminants in one and the same filter
- reduced component costs
- limited consumption of filter inserts

Understanding the correlation between **diesel cleanliness and equipment lifetime**

Oil cleanliness level is measured and categorized in ISO codes, where dirt is counted as particles. Water in oil is measured in PPM (Parts Per Million): 0.1% = 1000 PPM

The ISO 4406/1999 is a method for classifying the level of contamination by solid particles. Number of particles per 100 ml fluid after their size ranges: Particles are counted in size 4/6/14 µm.

Hence classifying diesel according to ISO codes tells you how many particles of a given size are present in the diesel.

Example: diesel ISO code 19/17/14 means the diesel contains: 250,000 – 500,000 particles size 4 micron or bigger; 64,000 – 130,000 particles size 6 micron and bigger, 8,000 – 16,000 particles size 14 micron or bigger.

Life Extension Table - Cleanliness Level, ISO Codes

	21/19/16		20/18/15		19/17/14		18/16/13		17/15/12		16/14/11		15/13/10		14/12/9		13/11/8		12/10/7	
24/22/19	2	1.6	3	2	4	2.5	6	3	7	3.5	8	4	>10	5	>10	6	>10	7	>10	>10
	1.8	1.3	2.3	1.7	3	2	3.5	2.5	4.5	3	5.5	3.5	7	4	8	5	10	5.5	>10	8.5
23/21/18	1.5	1.5	2	1.7	3	2	4	2.5	5	3	7	3.5	9	4	>10	5	>10	7	>10	10
	1.5	1.3	1.8	1.4	2.2	1.6	3	2	3.5	2.5	4.5	3	5	3.5	7	4	9	5.5	10	8
22/20/17	1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	5	>10	7	>10	9
	1.2	1.05	1.5	1.3	1.8	1.4	2.3	1.7	3	2	3.5	2.5	5	3	6	4	8	5.5	10	7
21/19/16			1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4	9	6	>10	8
			1.2	1.1	1.5	1.3	1.8	1.5	2.2	1.7	3	2	3.5	2.5	5	3.5	7	4.5	9	6
20/18/15					1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	5	3	7	4.6	>10	6
					1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	3.5	2.5	5.5	3.7	8	5
19/17/14							1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5	6	3	8	5
							1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.7	3	2	4	2.5	6	3.5
18/16/13									1.3	1.2	1.6	1.5	2	1.7	3	2	4	3.5	6	4
									1.2	1.1	1.5	1.3	1.8	1.5	2.3	1.8	3.7	3	4.5	3.5
17/15/12											1.3	1.2	1.6	1.5	2	1.7	3	2	4	2.5
											1.2	1.1	1.5	1.4	1.8	1.5	2.3	1.8	3	2.2
16/14/11													1.3	1.3	1.6	1.6	2	1.8	3	2
													1.3	1.2	1.6	1.4	1.9	1.5	2.3	1.8
15/13/10															1.4	1.2	1.8	1.5	2.5	1.8
															1.2	1.1	1.6	1.3	2	1.6

Hydraulics and Diesel Engines | Rolling Element Bearings | Journal Bearings and Turbo Machinery | Gearboxes and others

Source: www. noria.com

LET - Table

Evaluation of particle count and moisture level compared to machine lifetime.

The table describes the expected increase in lifetime when oil cleanliness is improved.

Each quadrant represents a machine type:

- Top left quadrant is for hydraulic components and diesel engines.

Example:
If the current diesel cleanliness level in an engine is found to be ISO 18/16/13 and the diesel is cleaned to a level of 13/11/8 the *lifetime of critical components in the diesel engine is prolonged by a factor of* 4

According to studies by Noria Corporation there is a direct link/correlation between water and particle level in diesel fuel and the lifetime of critical components e.g. injectors, fuel pumps and filters.
www.noria.com

LEM - Moisture Level

Current moisture level, ppm	Life Extension Factor								
	2	3	4	5	6	7	8	9	10
50,000	12,500	6,500	4,500	3,125	2,500	2,000	1,500	1,000	782
25,000	6,250	3,250	2,250	1,563	1,250	1,000	750	500	391
10,000	2,500	1,300	900	625	500	400	300	200	156
5,000	1,250	650	450	313	250	200	150	100	78
2,500	625	325	225	**156**	125	100	75	50	39
1,000	250	130	90	63	50	40	30	20	16
500	125	65	45	31	25	20	15	10	8
260	63	33	23	16	13	10	8	5	4
100	25	13	9	6	5	4	3	2	2

1% water = 10,000 ppm.
Estimated life extension for mechanical systems utilizing mineral-based fluids

Source: www. noria.com

Example: By reducing average diesel moisture level from 2,500 ppm to 156 ppm, component life (MTBF) is *extended by a factor of* 5

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