

Slash Costs, Eliminate Downtime, and Go Green with Precision Filtration

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Hydraulic oil is used in a plethora of applications across virtually every industry. Whether providing power to a machine, lubricating its crucial components, or acting as a pre-production washing agent, hydraulic oil's pivotal role underscores the importance of maintaining pristine hydraulic fluids—a fact that is all too often underestimated or ignored. In this paper, we will explore how fluid cleanliness is not merely a technical consideration but a strategic imperative for businesses seeking optimal performance, cost-effectiveness, and environmental responsibility.

Types of Contaminants

Hydraulic systems are vulnerable to various types of contaminants. Understanding these contaminants and how they make their way into the machine is essential for developing effective filtration strategies.

Solid Contaminants

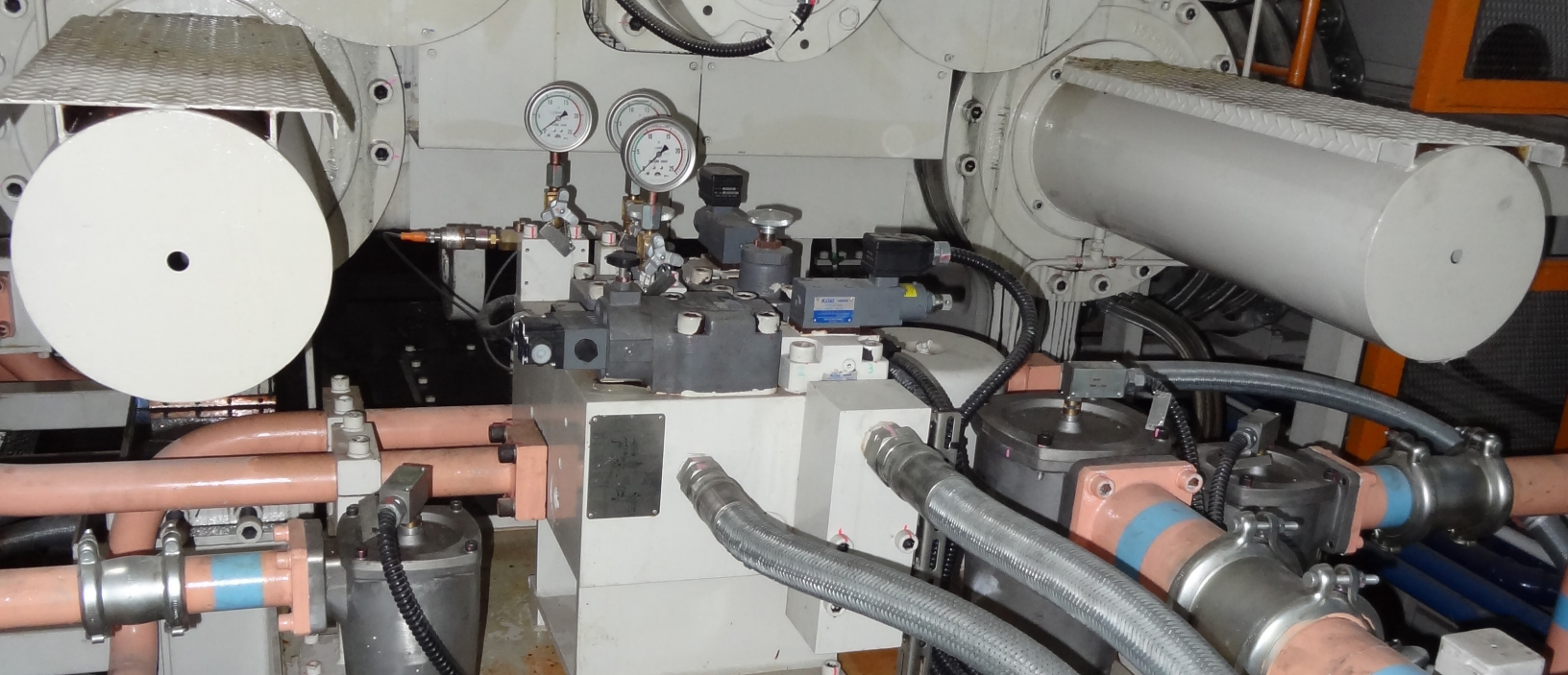
Particulate Matter: Particulate matter, comprising tiny solid particles, can gain entry from the surrounding environment through openings or leaks.

Wear Particles: Wear particles are generated as a natural consequence of the friction and abrasion within the hydraulic system. These particles, originating from components like gears and valves, can significantly impact system performance when not properly managed.

Liquid Contaminants

Water: Water contamination can occur through environmental ingress or as a byproduct of system operation. The presence of water in hydraulic fluid can lead to issues such as reduced lubricity, accelerated component wear, and increased susceptibility to oxidation.

Varnish: Varnish formation is a complex issue arising from the degradation of the hydraulic fluid. As the fluid degrades, it can create sticky residues that adhere to system surfaces, impairing the smooth operation of components.



Coolants: Some systems take advantage of liquid cooling systems. Depending on how these systems are implemented, leaks can occur and will lead to failure due to how cooling fluids react with hydrocarbon molecules.

Gaseous Contaminants

Air and Entrained Gases: Entrapped air and gases in hydraulic fluid can lead to aeration and cavitation, reducing the fluid's ability to transmit power effectively. The presence of air can also contribute to foaming, causing further complications within the system.

Foam: Foam in hydraulic systems can result from aeration or other factors. Excessive foam can lead to reduced fluid density and, consequently, compromised hydraulic system performance.

Addressing both external and internal sources of contamination requires a comprehensive approach that goes beyond mere symptom management, necessitating the adoption of precision filtration systems to proactively tackle contamination at its root.

Effects of Contamination on Hydraulic Systems

Contamination within hydraulic systems can have far-reaching consequences, affecting not only the immediate performance but also the longevity and sustainability of the entire system. Some consequences of failing to maintain fluid cleanliness include:



Reduced System Efficiency and Performance

Contamination, especially in the form of solid particles and varnish, disrupts the precise and delicate balance that hydraulic systems rely on for optimal performance. Oxidation, often accelerated by contaminants, breaks down the oil's film strength, rendering it ineffective for lubrication. This compromise in lubrication adversely impacts the overall efficiency and performance of the system, leading to issues such as reduced power output, slower response times, and increased energy consumption. Furthermore, it can result in overheating, which further degrades the hydraulic fluid and exacerbates the problem.

Increased Wear and Tear on Components

Solid contaminants, such as particulate matter and wear particles, can infiltrate and wreak havoc within the hydraulic system. They can wear out seals, score or erode internal parts, and clog vital components, leading to increased wear and tear. This not only escalates maintenance and repair costs but also shortens the service life of crucial components, resulting in frequent replacements.

System Downtime and Maintenance Costs

The compromised performance and increased wear brought about by contamination inevitably lead to unplanned system downtime. Downtime, in turn, disrupts operations, delays projects, and results in financial losses due to halted production. The costs associated with emergency maintenance, repairs, and replacement of damaged components can be substantial. Additionally, frequent fluid changes and system flushes to address contamination issues further increase operational costs.

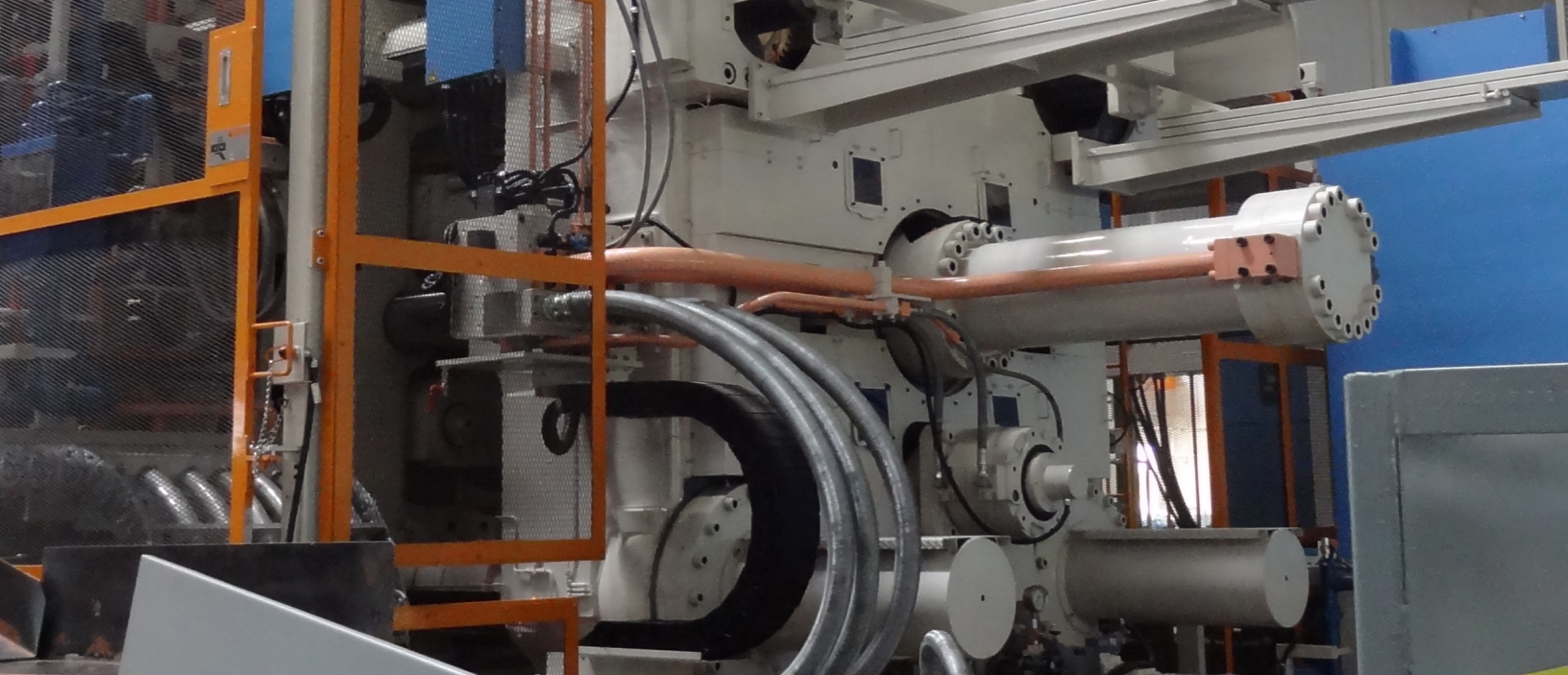


Environmental Impact

Contaminated hydraulic fluids, if not managed properly, can have environmental repercussions. Disposing of contaminated fluids can be problematic, as they may contain hazardous materials. Moreover, the need for frequent fluid changes contributes to excess waste and poses challenges in adhering to environmental regulations and sustainability standards. This aspect of environmental responsibility is increasingly significant in today's world, where businesses are expected to operate with a greater emphasis on sustainability and compliance.

Additionally, burning waste oil, including contaminated hydraulic fluids, is a practice that some entities resort to for waste management or energy recovery. However, it's crucial to recognize that burning waste oil can result in carbon dioxide (CO₂) emissions, contributing to environmental concerns such as air pollution and climate change. The severity of environmental impact depends on various factors, including the composition of the waste oil, combustion efficiency, and the type of combustion equipment used. Waste oil may contain impurities, contaminants, and additives that, when burned, can contribute to the emission of pollutants, including CO₂. Incomplete combustion can result in the release of not only CO₂ but also other pollutants, including carbon monoxide (CO) and particulate matter.

Understanding the wide-ranging effects of contamination underscores the urgency of adopting proactive measures to safeguard hydraulic systems. Precision filtration emerges as a crucial solution, mitigating these effects and ensuring the efficient, cost-effective, and environmentally responsible operation of hydraulic systems over the long term.



Maintaining Clean Hydraulic Fluid with Precision Filtration

Precision filtration systems use a combination of advanced filters, separators, and monitoring tools to ensure that hydraulic fluids remain within strict purity parameters. They work by removing particles from the oil, eliminating moisture, and maintaining the fluid's acid value, all while the system operates. This process ensures that the hydraulic fluid consistently meets the required standards, thus prolonging the life of the fluid and the components it serves.

Benefits of Precision Filtration

The precision filtration process can remove contaminants down to sub-micron levels, providing a higher level of cleanliness and reliability, which is essential for precision machinery and critical applications. Precision filtration offers several distinct advantages:

Minimized Wear and Tear on Components: By consistently removing contaminants, precision filtration significantly reduces the wear and tear experienced by system components, thereby extending their service life and reducing maintenance costs.

Extended Fluid Life: The ability to maintain hydraulic fluids at their optimal cleanliness level ensures that the fluids last longer, reducing the frequency of fluid changes and, in some cases, eliminating them altogether.

Improved System Reliability: Precision filtration contributes to enhanced system reliability, resulting in reduced downtime, increased operational efficiency, and a more sustainable and responsible approach to hydraulic system maintenance.

Long-term Cost Savings and Environmental Advantages: One of the most compelling aspects of precision filtration is its potential for long-term cost savings and environmental benefits. By extending the life of hydraulic fluids, reducing wear on components, and minimizing waste, businesses can achieve substantial cost reductions. Furthermore, the responsible handling of hydraulic fluids and reduced waste contribute to environmental sustainability, aligning with corporate social responsibility and regulatory compliance objectives.

Incorporating precision filtration systems into hydraulic setups is a strategic move that enhances system performance, optimizes maintenance costs, and aligns with modern business values of environmental responsibility and sustainability. This technology represents a significant step forward in ensuring that hydraulic systems operate at peak efficiency while minimizing their environmental footprint.

Introducing Meiji's Precision Filtration System: Miracle Boy

In response to the challenges posed by hydraulic fluid contamination, the introduction of a precision filtration system from Meiji offers an innovative and effective solution. It has emerged as a game-changer in the battle against contamination, addressing the intricacies of hydraulic fluid purity in a systematic and efficient manner.

The result of this is significant cost savings. Depending on quality, hydraulic fluid can cost anywhere from \$10 to \$30 per gallon (\$2.65 to \$7.95 per liter). The cost to dispose of this oil ranges from \$0.50 to \$3.00 per gallon (\$0.13 to \$0.79 per liter). The Miracle Boy filtration system is so precise that oil can last indefinitely, nearly eliminating the need for oil changes.



Example:

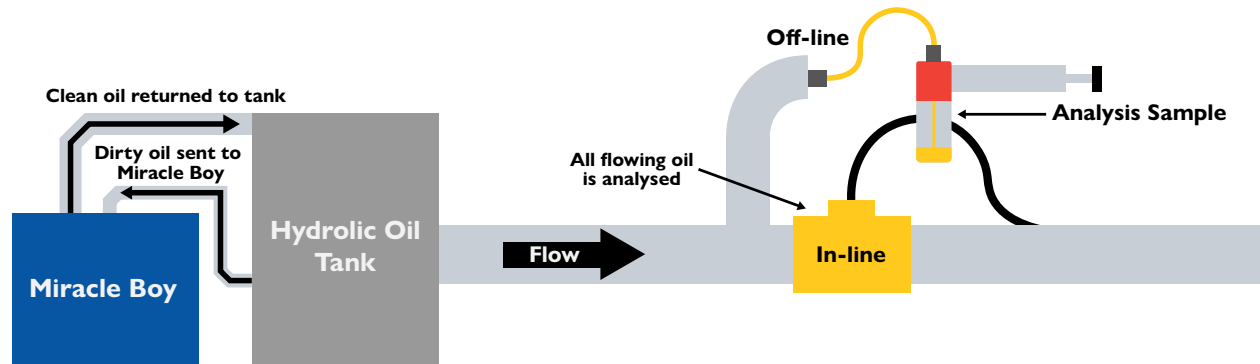
Cost of oil: 500 gallons X \$20/Gal Hydraulic Fluid = \$10,000

Cost of disposal: 500 gallons X \$0.80 = \$400

Total savings: \$10,400/year

How the Miracle Boy System Works

Miracle Boy is unique because it's neither inline nor offline filtration. Inline filtering describes any element or process that resides within the hydraulic circuit for the purpose of trying to keep the oil clean. Offline filtering describes a process wherein the oil is removed from the machine, taken elsewhere, and filtered. The oil is either put back into the machine or fresh oil is put in place. Miracle Boy typically uses near-line filtering, where a second circuit is deployed for filtering, typically hooked directly to the oil tank or reservoir.



Near-line

- Oil filtered continuously to like-new standards or better
- Filters can be changed without taking the machine offline
- Filtration system failure doesn't take the machine offline
- Machine stays on-line continuously
- Machine does not suffer production quality issues
- Machine does not suffer any damage
- Disposal of used oil is eliminated (good for the environment!)

In-line

- Oil filtered continuously but degrades continuously
- Top-ups and changes needed regularly. Failing to change or top-up at the right time can cause serious damage and production flaws.
- Changing filters forces the machine offline
- Filtration system failure forces machine offline and causes serious damage and production flaws
- Used oil must be properly disposed and causes environmental harm

Off-line

- Oil Removed and taken away for filtering. Full replacement is required. Failing to remove an off-line filter at the right time causes serious damage and production quality issues
- Oil analysis is costly
- Changing filters forces the machine offline
- Filtration system failure forces machine offline and causes serious damage and production flaws
- Process causes environmental harm

The benefits of near-line vs inline or offline are:

1. Compared to inline filtering, near-line filters can be replaced WITHOUT needing to take the machine out of service, while inline requires the machine to be taken out of service. This provides a big boost in productivity. Additionally, inline systems cannot filter fine particulates as doing so would slow the oil circulation to the point where the circuit would cease to function and cause major damage. This is why all machines using inline filters must have their oil topped up and eventually changed altogether on a regular cadence. And for the 30 to 60 days prior to changing the oil, the machine is in jeopardy of sustaining serious damage as well as producing output with quality issues.

2. While near-line systems maintain the oil without taking the machine down, offline filtering requires the machine to be taken out of service to drain and eventually replace the oil. It also typically means scrubbing the inside of the oil tank or reservoir to remove harmful deposits. Again, this causes a loss of productivity. Plus, just as with inline filtering, for the 30 to 60 days prior to changing the oil, the machine is in jeopardy of sustaining serious damage as well as producing output with quality issues.

Case Study: Precision Filtration Improves Reliability in Aluminum Die Casting Machine

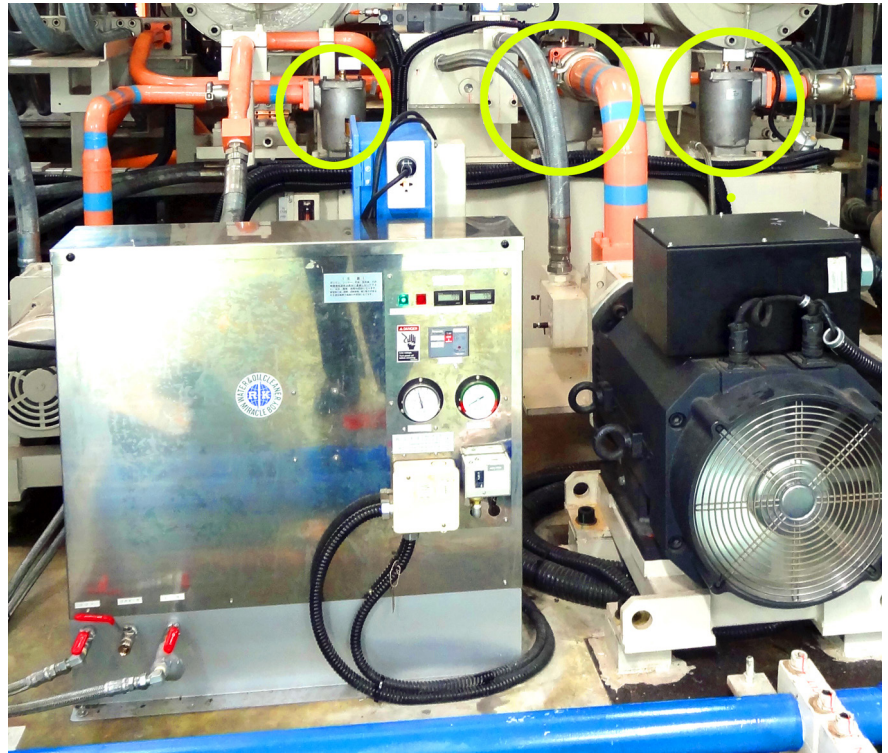
An aluminum die casting machine required frequent oil changes due to high levels of contamination. The contamination also caused wear and tear on the machine, increasing maintenance costs, and causing quality issues in the finished product. Making repairs meant halting production, making it difficult to meet output goals.



Previous Environment	Equipment: Ube Machinery 1600t Aluminum die casting machine Oil Type: Ester Flame-Retardant Hydraulic Oil, 800 Gallon Tank Filtration unit: Built in Bypass Filter
Issues	<ul style="list-style-type: none"> • Cost of disposing and replacing oil was expensive (≈ \$5,000/tankful) • Contaminated oil regularly damaged die casting machine • Equipment failure required suspending the entire automobile production line • Murky oil made meter readings difficult
Solution	Installed Miracle Boy to the hydraulic tank of die casting machine. Model: SRC-813-10V, Filter Element: GE-41-MR1
Result	Hydraulic oil is now cleaner than when it was new. Oxides (rust) and moisture levels are maintained as new. Viscosity does not change. Pump and valves remain undamaged. The production line is undisturbed, and the casting quality remains high.
Customer Feedback	“The rising cost of [hydraulic] oil meant we had to go longer between changes, putting undue stress on the die caster. Now we don’t worry about that, and instead of changing oil yearly, all we do is change the Miracle Boy filters. That’s 90% savings. And not having to worry about the electromagnet valve or hydraulic pump failing is the best thing of all because we don’t ever want to get blamed for stopping the entire line.”

Conclusion

Maintaining clean hydraulic fluids is imperative for efficient system operation, reduced downtime, and cost savings. Precision filtration emerges as a key solution to address contamination challenges, providing a pathway towards enhanced system performance and environmental sustainability. As industries strive for operational excellence, adopting precision filtration practices becomes a critical step in ensuring the longevity and reliability of hydraulic systems.



Miracle Boy system installed.

About Meiji

Meiji is a global distributor of factory and process automation solutions. One of the lines it represents is that of Nihon Roka, a leading innovator in hydraulic and fluid management solutions that has spent over 50 years at the forefront of advancing precision filtration technologies. With a rich history of excellence and a commitment to solving complex challenges, Meiji and Nihon Roka have become trusted partners for industries relying on hydraulic systems. Leveraging cutting-edge research and development, Meiji and Nihon Roka have developed state-of-the-art filtration systems that offer unparalleled precision and efficiency, safeguarding hydraulic systems against the adverse effects of contamination.



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