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What is Clean?

Understanding the fluid purification process can result in meeting exact manufacturing standards.

How important is filtration in any manufacturing process? The increased demands for higher surface finish and closer part tolerance has placed a greater emphasis on numerous fluid parameters, including delivery pressures, chemical stability, and fluid cleanliness.

Fluids are a key production in the manufacture of metal parts, from relatively simple items such as coins and wire to more complex objects including medical devices and engines for aerospace applications.

Along with exacting standards set forth by customers, manufacturers need to determine how to best purify fluids that cycle, constantly, through precision machinery. What constitutes a clean fluid, free of weak and fine particulates? The answers to fluid filtration, usually based on the following parameters, are:

- What particles need require removal from the liquid?
- Particle sizes and concentration
- Particle chemistry and configurations
- Will it be easy or difficult to remove the particles from the fluid?
- Are the particles valuable, recyclable, or hazardous?
- What are the volumes and scope of the filtration application?
- Is the project short or long term?

The definition of filtration, generally, is as the mechanical or physical operation used for the separation of solids from fluids (liquids or gases) by interposing a medium through which only the fluid can pass. Removal of solids from the fluid stream is by permanent media, disposable media, or a combination of the two.

Permanent media includes mesh screens, wedge wire, micro-screen, nylon and polyester fabrics, baskets, strainers, filter tubes, discs, and membranes. The types of disposable media used are cartridges, bags, socks, rolled paper and cloth, powdered cellulose, Diatomaceous Earth, Perlite, sand and Zeolite.

Fluid filtration technology can help companies operating machine tools to achieve extended tool life, improved component quality, reduced maintenance and spare parts costs. Higher productivity and lower environmental impact are other key reasons to monitor fluid cleanliness.

Benefits of Clean Fluid

All metal removal processes generate a tremendous amount of heat. Reduction of this is required to achieve productivity and part quality. The cooling effect provided by a fluid gives the cutting tool or grinding wheel a longer life and helps prevent burning and smoking.

At the point where the tool is in contact with the part, lubrication is necessary to reduce friction between the tool and the part, resulting in improved tool life and better finishes on the metal cut.

How clean must coolants be for most types of manufacturing? For most applications, five microns is acceptable in both size and quantity. By comparison, anything visible to the human eye is greater than 45µm (human hair measures 50µm to 130µm; common table salt is 70µm to 90µm, for example). On the opposite extreme, tobacco smoke measures 0.012µm to 1µm, while viruses measure 0.01µm to 1µm.

When choosing a filter aid, there are many factors to consider, including:

• Clarity – It is important to provide consistent fluid clarity to achieve the goals of the manufacturing processes. Fluid clarity achieved and costs are directly related; the most cost effective filter aid balances the needs of the manufacturing processes while providing the right clarity levels to meet or exceed production parameters.

• Cycle Life – The goal of effective filtration is to ensure that you are able to meet all metalworking production requirements at the lowest overall costs. The goal is to improve and optimize productivity by using the most efficient type and grades of filter media, and only as necessary.

• Filtration Rate – This factor determines everything: the size of the equipment and the cost of operation. It is therefore critical that the correct filtration rate is utilized with the right permanent or disposable media to achieve the lowest cost operation.

•Environmental Disposal – Most industries have become responsible leaders in protecting our environment. There is greater and greater emphasis today on recycling and metal recovery. Where fluid recovery is required, choosing the right filtration equipment, and permanent and disposable media is critical to long term savings.

▲Eriez Hydroflow Coolant Recycling System

Fluid Cleanliness Issues

The design of machinery filtration systems is to handle four types of fluids:

- Water soluble coolants – used for general machining, grinding, forming
- Straight cutting oils – used for general machining, grinding, screw machines
- Water based parts washing fluids (no solvent type fluids)
- EDM fluids, stamping fluids, rolling fluids, water based rust preventatives

No matter the fluid, each has its own particular set of issues that determine how long the fluid is effectively usable, and how clean it can remain.

For example, water-soluble coolants – used in a large percentage of manufacturing operations – have issues with odors and solids, causing operators to dump their coolant and recharge with new coolant. There are other problems as well if coolant is not kept clean: corrosion, residues, and dermatitis.

Coolant odors can get worse over time as the coolant gets old and new coolant concentrate added in, increasing the

▲Eriez Hydroflow Portable Coalescer

▲Eriez Hydroflow Sump Cleaner

COMMON PRACTICES

The manufacture of components for jet and turbine engines such as vanes, blades, buckets, etc. requires several different processes. The most common processes are creep feed grinding on water soluble coolants, CBN grinding on oil, and even EDM machining using dielectric oils. Each of these processes produces different particulate and requires varying degrees of cleanliness.

For a major supplier of aircraft engines, Eriez Hydroflow invested hundreds of hours of development time before developing a system able to handle multiple machines. It consisted of

- A 10,000 gallon/1,500gpm Star Filter in Building A
- A heat exchange package for each Star Filter
- A clean-coolant satellite tank with clean spindle coolant pumps, heat exchanger and integral pump back station located at each guide on the system
- A gravity return header system in each building to receive dirty coolant from each grinder and deliver it to the Central Booster Pump
- A solids handling booster pump to return dirty coolant through a trench back to Building A.

The ultimate result in this application was five micron filtration throughout the manufacturing complex that stretched from building to building. According to the customer, Eriez Hydroflow delivered a trouble-free, smart coolant filtration system.

concentration. Bacteria, always present in coolants, will also cause bad smells. Soluble oil coolants are more prone to bacteria smells while synthetics have the least smell. The newest generation of coolants is prone to less bacteria smell.

Solids also play a role in frequent coolant changes. When the coolant is dirty, it affects the tool life and the finish of the end product. Small particles circulating in the fluid will cause many problems, including decreased tool life, poor finish on parts, and more wear and tear on machine tools.

Machine tools usually have a chip conveyor or drag out to remove most of the big chips, but there are always many very small particles left behind in the sump. Solids settling in the sump combine with tramp oils and other materials to form sludge in the bottom of the machine. This becomes a breeding ground for anaerobic bacteria in water-soluble coolants.

This sludge requires removal, physically, from the bottom of the tank on a regular basis or machine operators will face high bacteria problems with water-soluble coolants. Solids will build up over time in the sump until there is little room for the fluids. This is true of coolants and straight oils.

Fluid purification also means the timely removal of tramp oil that leaks into the coolant. This residue can include way lube, hydraulic oil, spindle oil, and gearbox oils. Older machines leak oil naturally while newer CNC machines leak on purpose – at least a quart of way lube a day and often much more.

Categorization of tramp oils is in two main ways:

- Free tramp oils – they will float to the surface of the fluid
- Emulsified tramp oils – they become chemically emulsified to the coolant or cleaner, not floating to the surface

Each type of coolant reacts with tramp oils differently. Synthetic coolants typically reject the tramp oils…they float out of solution to the surface. Semi-synthetic coolants reject some of the oils, but over time will chemically emulsify the oils. Soluble oil coolants will chemically emulsify the tramp oils sooner or later.

Removing tramp oil from the manufacturing process is critical because the removal improves fluid performance and longevity, air quality, bacterial resistance, corrosion resistance, and tool life.

By initiating ongoing fluid purification methods and using the right equipment, manufacturers see a 40% to 80% reduction in fluid purchases and a corresponding decrease in disposal costs, according to figures compiled by Eriez Hydroflow.

The solutions and accompanying equipment to keep fluids clean are numerous and depend upon the complexity of machinery and the manufacturing process. Eriez Hydroflow offers vacuum filters, coolant recycling systems, coalescers, oil skimmers, sump cleaners, magnetic chip conveyors, refractometers, and other types of fluid filtration equipment. **A**

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