How Oil Mist Collector Technologies Impact Efficiency

Among the reasons young people give for not choosing a career in manufacturing is the perception that factories are dirty, unhealthy places to work. In truth the majority of today's CNC machine shop owners take pride in providing a clean, safe workplace for their employees and make significant investments in health and safety related equipment. One of the most challenging issues is oil mist and smoke created by the oil-based, synthetic or emulsion type coolants used by modern CNC machine tools.

If left unabated, oil mist hangs in the air and eventually settles on all surfaces including machines, floors and people. Breathing these vapors can cause serious respiratory problems, aggravate existing breathing conditions, irritate the eyes, nose and throat and cause skin irritation. These can lead to employee health problems and related absenteeism. Slick, oil-covered floors present the risk of injuries from falls. All of which creates potential liabilities for the shop owners and problems with OSHA.

Even high-efficiency factory HVAC systems typically can't keep the workplace free of these contaminants, which is why many shops invest in oil mist collection devices. It's important to note that not all oil mist collectors work the same way. The technologies behind the three most common types of oil mist collectors are: electrostatic, centrifugal and multi-stage. Each has unique characteristics that sometimes impact its efficiency and reliability.

Electrostatic Oil Mist Collectors

The electrostatic technology used in some oil mist collectors was originally designed to eliminate dust and other particulates in air handling systems, and to remove dry smoke. The technology is very effective for these purposes. Unfortunately, when exposed to oil mist the system's cells quickly become coated by layers of liquid, and efficiency drops off dramatically. This means that users must regularly clean the cells, usually on a monthly basis. Not unlike a nickel-cadmium (NICad) battery, every time the cells are cleaned they lose some of their ability to remove oil mist. The result is reduced efficiency and increasingly shorter time between cleanings. Additionally the costly tungsten ionizer wires on the bottom of the electrostatic cells must be periodically replaced, usually about every two years.

Another drawback is that electrostatic cells typically operate at a lower voltage setting for applications involving water-based coolants. This is due to the difference in the polarity of water and oil that, if not adjusted for, can cause annoying popping and crackling noises. Operating at this lower input voltage further decreases overall efficiency. Electrostatic units also emit ozone that can reach substantial levels in multi-unit installations.

Centrifugal Oil Mist Collectors

As the name implies, oil mist collectors employing this technology depend on centrifugal force to thrust impurities outward from the center of the device. When used to collect oil mist, the unit's filtering pads quickly become saturated, thus reducing airflow and the amount of impurities it can process, and so efficiency drops off. Because the centrifugal cage impeller is not a true fan, it's impossible to measure the air curve to know exactly how much air is actually flowing through the unit, so there is no way to effectively monitor the efficiency of the system. Other disadvantages are the high amount of energy required to turn the heavy centrifugal components and the resultant loud noise when operating.

Multi-Stage Oil Mist Collectors

LNS WS Series oil mist collectors, on the other hand, use a three-stage system that consists of an initial pre-filtration cartridge, a cyclonic separation chamber and a final stage filter to achieve 99% filtration and residual oil mist concentration of only 0.2 mg/m^3 (milligrams per cubic meter). This level of efficiency is guaranteed to be consistent throughout the oil mist collector's life. LNS oil mist collectors accommodate all machine types and processes using water-soluble, synthetic or neat oil coolants.

The unique multi-stage design eliminates the maintenance requirements of electrostatic oil mist collectors, the noise and vibration problems associated with centrifugal type units, reduces energy consumption and provides verifiable, continuous filtration efficiency.

How Each Stage Works

As oil mist is drawn into the collector, it passes through the proprietary, multi-layered pre-filtration cartridge. This cartridge consists of three filtering layers that remove solid particulates and entrain bulk liquids. At the same time it agglomerates finer mist particles into larger ones. Overall efficiency at this stage is 92%.

In the second stage the oil mist droplets accumulated in stage one are further reduced by means of inertial impaction, whereby small dust particles and liquid droplets impact a deflecting surface, in this case a special impeller that creates a cyclonic effect. The particles are forced to a cylinder wall where they coalesce and are then captured.

The third stage uses a proprietary high surface area cartridge media filter to remove any remaining oil mist. This filter removes 99% of oil mist to exceed OSHA and NIOSH standards. Users can also add an optional 4th stage HEPA filter that removes 99.97% of cutting oil smoke particles.

An integrated pressure gauge monitors the condition of the stage three filter by measuring airflow. Routine maintenance consists of replacing the long-life filters that typically maintain efficiency for 3,000 – 4,000 hours. Average time to replace a filter is five minutes.

Using a laser particle counter, users can instantly read the overall efficiency of LNS multi-stage oil mist collectors as expressed in milligrams per cubic meter (mg/m^3). A shop fully equipped with these oil mist collectors typically achieves a reading of 0.2 mg/m^3.

One Size Does Not Fit All

CNC shops can have a wide variety of machine tools, so it's important to match the machine with the appropriate oil mist collector. The WS Series has five models with 170 to 1250 CFM airflow rates. They can be mounted directly on the machine tool or secured to a stand.

Tony Staub, owner of Staub Machine Company in Hamburg, New York learned the differences in oil mist collector technologies through personal experience:

"We consider ourselves an environmentally conscious company, but beyond that we spend a lot of time in the shop and I want to protect the health of my 34 employees. Over the years we've tried a variety of approaches starting with a unit that had a spinning filter. Unfortunately, it produced an annoying, droning noise that was hard to listen to all day. So we tried other technologies that solved the noise problem, but all had other drawbacks including some serious maintenance issues such as repeated bearing and shaft failures, plus the need to frequently change filters. Next we tried electrostatic, collection cell and ionizer wire-based units, but they did not keep the air quality consistently good unless we constantly performed cleaning and maintenance on the units, which became a drain on our time. Our data suggests that the LNS oil mist collectors more consistently maintain our air quality standard than the other units."

Along with the important benefits of safeguarding the health and wellness of the workforce while reducing employee absenteeism, there are other significant advantages to installing multi-stage oil mist collectors. Because the units release filtered air back into the shop there is no direct venting to the outside. This saves energy by reducing the load on the factory's HVAC systems, as you aren't removing air you've already paid to heat or cool.

You'll also reduce the mean time between planned maintenance and associated labor costs because of the minimal time it takes to change the long-life filters. Additionally, because these systems exceed both OSHA and NIOSH standards you won't encounter any regulatory problems regarding oil mist in your shop.