Fluid Application - Spray Mist

Spray mist application of water soluble cutting and grinding fluid almost always is done as an alternative to flood or high pressure coolant delivery when the machine or operation doesn't allow for the free flow and return of fluid in volume. Though some spray mist fluids provide slight lubricity, they primarily serve to take heat from the process yet do little to move chips or reduce friction between the tool and work piece.

In typical spray mist applications, a small amount of pre-mixed fluid is taken from a holding tank, delivered to a spray head, then mixed with a stream of rapidly moving air. The air stream divides the fluid into small droplets and delivers it to the point of cut. The size and number of these fluid droplets are critical. They need to be big enough to get where they are needed without "fogging out," but small enough to evaporate easily. The reason that spray misting is such an efficient heat removal technique is that it takes advantage of the high "heat of vaporization of water."

While all spray mist equipment is quite similar in function, its set-up and maintenance are critical. Smaller droplets are better than larger ones because they tend to evaporate more rapidly, but larger droplets are less likely to create fog problems and carry a longer distance. Each time a set-up is made or changed, it is necessary to confirm the set-up of the spray mist unit(s). To do this, machinists typically direct the nozzle at the point of cut to spray on their hand then adjust the fluid/air mixture until it just begins to run after 3 to 5 seconds. The amount of air used is also critical, as too much air can "blow a hole" in the spray mist pattern and result in some areas not getting enough fluid to function properly. Another way of looking at this is when you are finished working, the part is about room temperature and there is just a little liquid coolant left on the part. If the part is warm to the touch, you are not getting enough fluid to the work zone. If the part is wet, you are wasting product and creating a mess.

While it is possible to spray mist any fluid, including straight cutting oils, it typically is done with water-soluble products. Spray mist fluids characteristically have:

1. Little or no oil content – Oil does not evaporate well and when it does it has a much lower heat rate of evaporation than water.
2. Very rapid and complete wetting – For a fluid to transfer heat effectively from a surface to a fluid, it is necessary for it to come in contact with the heated surface. The faster this happens, the better the fluid works to transfer heat.
3. Low misting – It is critical that the product is separated into small, similar-sized droplets rather than a mix of many different sized droplets.
4. Low product odor – Spray mist is most often used in open machines where there is greater operator exposure. Low product odor is critical to the success of the process.
5. Very good H&S profile for eye and nasal inhalation irritation – Spray mist should not irritate the operator or other people in the area of the spray mister.
6. Superior corrosion protection – As spray mist fluids are inherently "clean" and leave very little film, it is critical that the fluids do a great job of controlling corrosion.
7. Maximum cleanliness/very low residue – As there is very little possibility of spray mist fluid washing off built-up residue, it is crucial that fluids leave as little residue as possible to prevent location and chucking problems with parts.

When looking at fluid delivery systems, it is important to recognize the difference between spray misting and MQL. Spray misting almost always controls the temperature in a tool or work piece without the mess of flood or high-pressure coolant. MQL has the ability to deliver lubricity to the cutting zone without a conventional coolant system.

Notes:

1. The heat of vaporization for water is 966.6 BTUs per pound. It takes 966.6 BTUs to evaporate one pound of water, yet it takes 142 BTUs to raise that same pound of water from 70°F to 212°F.
2. One BTU is the amount of energy necessary to raise the temperature of one pound of water one degree Fahrenheit or 0.25198 Kg. Calories.
3. One horsepower is equal to 56.88 BTUs per minute.

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