Technical Bulletin

Master Fluid SOLUTIONS

Fluid Application - MQL (Minimum Quantity Lubrication)

Minimum quantity lubrication (MQL) is micro lubrication near dry machining, or “spatter” lubrication; it could be considered the latest method of delivering metalworking fluids to the point of cut, or just the logical continuation of the age old technique of “brushing on” a lubricant where it is needed. In any case, this technology recognizes that sometimes just a little fluid, when properly selected and applied, can make a substantial difference in how effectively a tool performs.

The basic “cutting functions” (why the product is purchased) of metalworking fluids are that they:

1. Promote tool life – MQL performs very well here, particularly when the tool failure mechanism is thermal shocking or with excessive heat or abrasion from flank drag. It does not do very well when multiple tools are in play, either at the same time (as with a screw machine) or sequentially (as in a vertical machining center), as tool nozzle alignment is difficult to impossible.

2. Promote and improve surface integrity of the workpiece – In situations of very high tool pressures, MQL can help reduce them; however, in processes that generate large amounts of heat, MQL is not particularly effective.

3. Flush chips and swarf from the cutting zone – MQL totally fails here. If you are going to use Fluid Application - MQL (Minimum Quantity Lubrication) MQL in a production environment you need an alternative method of chip removal.

4. In-process corrosion protection – This is sometimes included with the other more traditional “cutting functions.” Many additives used in MQL fluids can be very reactive both under pressure and in the presence of moisture. MQL fluid left on parts, chips, or machine tools can cause mild to moderate corrosion or staining.

Advantages of MQL:

1. Provides some lubrication on machines not set up for flood or high-pressure, high-volume coolant delivery and recovery

2. Reduces mist and spray, therefore offering an attractive alternative on unenclosed machines like a typical tool room mill or lathe.

3. Reduces or eliminates problems associated with “thermal shocking” of the cutting tool. (This is when the tool runs hot then is abruptly cooled by the coolant and it shatters.)

4. Particularly well suited for tools and operations where either generated heat or abrasion to the flank of the tool are major “players” to tool failure.

5. Produces a cleaner, drier work piece than a flood or highpressure coolant.

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6. Reduces both the cost of buying and disposing of conventional cutting fluid if all operations can be run with MQL.

7. When used in conjunction with either high-pressure or flood coolant, MQL facilitates the application of high lubricity fluid on an as-needed basis.

Disadvantages of MQL:

1. MQL does not take heat out of the tool, the work piece or the whole machining system; it will reduce only the amount of heat produced by the chip moving up the face of the tool and parasitic “flank drag.”

2. It will not move chips from the cutting zone.

3. It will not prevent corrosion on either chips or parts.

4. The nozzle must be located not more than 1 to 2 inches from the tool as it enters the cutting zone, so more often than not, the applicator nozzle must be adjusted for each different tool.

5. The nozzle is susceptible to both damage and being moved (pointed improperly) when either heavy chips or stringers are produced.

6. After the tool enters the work piece no additional fluid can reach the tool work piece interface.

Like so many other tools, MQL provides an answer to some manufacturing problems and at the same time generates others. To achieve most of the “noncutting” benefits of MQL, it needs to replace all the metal removal fluids in your shop. In addition, you need to equip your machines with other systems to address chip removal and corrosion protection.

NOTES:

1. “Flank Drag” is the energy used to slide the cutting tool over a freshly cut work surface. Flank drag is a “parasitic” (nonproductive) force.
2. Surface integrity involves all aspects of the surface and near surface regions of the work piece that may ultimately affect the functional behavior of the work piece. It includes, but is not limited to, things like: micro-geometry, hardness, microstructure, residual stress, and “surface texture” or finish.