Cutting Oil Recovery: Are You in the 1%?

By Daniel Chang

How much can you recover from recycling cutting oil? The answer: about 99%. The Minnesota Technical Assistance Program (MnTAP) is a free, confidential, non-regulatory, industry-tailored technical assistance program that works with businesses to reduce waste and increase efficiency. Recently, MnTAP has been leading a project focused on supporting precision manufacturing and metal fabrication companies with funding from the Minnesota Pollution Control Agency. The first phase of the project, which took place over the course of 2021, was to interview local manufacturers to identify operational best practices that could be shared with the rest of the industry.

The interviewees consisted of fourteen random metal fabrication businesses from a variety of sectors. Each participant was sent a standardized survey and then asked to participate in a follow-up interview. All the companies shared similar equipment and processes for various machining, milling, fabricating, and assembling activities (with the exception of two electroplaters). There was representation across a wide range of company sizes as well, from small to large ends of the scale, but nine of the respondents were small job shops with fewer than 150 employees. Based on these conversations, MnTAP realized that coolant reuse is a high priority in the field.

It is well known in the industry that machining fluid, whether aqueous or oil-based, is an important resource to conserve. Not only is it essential for maintaining cutting tool life and achieving a high quality finish on the machined part, but it can also be expensive since it has to be paid for twice: once during purchasing and once during disposal. Between contamination, misting, spills, and additive depletion, some loss is inevitable. MnTAP found that 83% of interviewed businesses with machining processes filter out their metal chips and then reuse the coolant. The high prevalence of this practice demonstrates the value that these processes can have for the business's bottom line. However, when asked what percentage of fluid was being reclaimed, many businesses did not know the answer.

One company that has developed an impressive system for recycling cutting oil is Roberts Automatic Products. This precision machining company has been run by three generations of the Roberts family over the last 74 years and is currently located in Chanhassen, Minnesota. The company has a wide variety of Swiss, CNC, and screw machining capabilities. Roberts cuts aluminum, steel, stainless steel, brass, and nickel alloys to provide products to medical, aerospace, defense, and industrial clients, among others.

Originally, Roberts, like so many others, separated their lubricant from their chips through gravity draining. With this process, they were able to recover 80-85% of their cutting oil. Then, 30 years ago, the company began using centrifuges to spin their chips. Their recovery rate instantly increased to 99%, but they noticed not all of the oil had the same quality and had to continue disposing of 10,000 gallons per year.

The big change for Roberts came in 2011, when they sought to find a single oil to use for both machine lubricant and cutting oil. "The first step was realizing why we're buying so much oil and throwing so much away," says Bill Roberts, Senior Process Engineer at Roberts. They found their machine lube and cutting oils were mixing together, particularly in their automatic screw machines. They were spending approximately $250,000 yearly on oil.

Roberts worked with LubeTech to get a new oil that could perform both as a cutting oil and as a lubricant for their machines. This solved the challenge of the cross contamination with tramp oil that was occurring. Once they completed the switch to the new oil, their next challenge was to figure out a way to process their oil to make it reusable.

The solution they developed was a comprehensive oil storage and recycling system. Spent oil from the machines is allowed to settle in the machine sump and passes through a rough filter to remove

larger metal turnings and particles. Next, it is pumped to a centrifuge that spins at 6,000 rpm to remove the fines, which are sent out along with their steel scrap. The oil is finally passed through a series of filters that start from approximately 10 microns. Cutting oil is filtered to 2 or 3 microns, whereas lube oil is filtered all the way down to 1 micron. The quality of their lube oil at this stage is generally as clean as or cleaner than the oil when it is first purchased.

The last step for oil that will be used as cutting oil is ensuring that it has a sufficient concentration of additives, which are heat activated at the point of the cut and need to be replenished. Roberts' oil supplier regularly checks a sample from their bulk recycled oil supply and determines adjustments needed to their additive feeder line.

By using this recycling system, Roberts was able to achieve an additional 80% reduction in their cutting and lubricant oil usage, saving around 8,000 gallons and $160,000 annually. While these waste and cost saving numbers are impressive, the key advantage of this solution was the impact it had on their operations. Clean cutting oil directly benefits other important aspects of machining operations, such as tool life, uptime, and product finish quality. All of these parameters are difficult to accurately measure and quantify, but Roberts is well aware of the benefits that coolant optimization has on their throughput and bottom line. "The biggest gain was that we had good oil in all our machines," says Bill Roberts. "We saw a big difference in the quality of the oil for cutting."

Thanks to the time and expertise shared by companies like Roberts, MnTAP is better prepared moving into the second phase of its precision manufacturing project: technical assistance. If you or your company would benefit from free, confidential, and non-regulatory help improving your:

- Compressed air
- Coolant management
- Recycling
- Parts cleaning
- Water treatment
- Process bottlenecks,

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Bill Roberts, Senior Process Engineer, in front of the reclamation system control panel.