

Nanofluids:

Bringing Nanotechnology to CNC Machining

New coolant technology offers advantages in performance, productivity, and environmental friendliness

NANOFLUIDS are a new class of coolants that have a carrier liquid, such as water, that are dispersed with nanoparticles. These nanoparticles enhance the heat transfer capabilities of the resulting coolant compared to the carrier liquid alone.¹

Tool-X is a brand of a nanofluid additive for metalworking fluids that contains trillions of carbon-based nano-onions in solution. Nano-onions are carbon-based nanostructures composed of multiple concentric shells of fullerenes. A fullerene is a form of carbon having a large spheroidal molecule consisting of a hollow cage of atoms.

When used in conjunction with metalworking fluids, these fluid-saturated nano-onions flow between a tool and workpiece to change the characteristics of the metal-working action. The result is longer-lasting tools that cut truer, with more precision, and with less force required than with conventional metalworking fluids. In addition, reworks, tool sharpening, and deburring steps can be reduced or eliminated.

With a nanofluid such as Tool-X, surface finish is improved through lower Ra and fewer and smaller distortions. Feeds and speeds can be increased, often by 25% or more. Tool life is extended. Problems caused by excess heat (white film layers, long chip sizes, metallurgical damage) can be avoided. According to Jim English, President of Tool-X LLC and a former GM engineer, “Nanoparticles are used to dissipate heat from the machining process, transferring that heat from the cutting point to the coolant in the tank. Normally, coolants simply move heat around; they do not transfer heat and controlling heat in this way represents a major difference in the cutting processes where Tool-X is applied.”

For manufacturers that want to lower their chemical footprint: “A water-based coolant like Tool-X has only 12 chemical ingredients, in contrast to the 30-40 chemicals in many coolant formulations,” said Mr. English. “The next noteworthy advantage is that Tool-X produces little to no foam, because there are no chemicals in the solution to make it foam. And machine operators will recognize there is no noxious smells produced by the cutting fluid. Tool-X includes a nanoparticle component that kills bacteria that may develop in the sumps. The “rotten egg” smell that many cutting fluids develop will never be the result for shops using Tool-X,” he added.

These advantages come with a price. According to a Tool-X data sheet, Tool-X metalworking fluids cost more than conventional fluids—as much as twice as much. But the savings that are possible, through extended tool life, increased productivity, and parts with better surface finish and better dimensional accuracy, can provide users with substantial returns on investment.²

For more information on Tool-X, contact Jim English by email at jenglish@tool-x.net or call 248-495-4367.

¹ <https://en.wikipedia.org/wiki/Coolant#Nanofluids>

² Tool-X Tech Data Sheet 109

Tool-X Case Study

Customer: A manufacturer of components for robotic tooling solutions for industrial and commercial use.

Application: Horizontal CNC machining 1018 cold-rolled steel in a job shop environment.

Problem: Insufficient material removal rates and poor tool life.

Evaluation Process:

- 1) The initial evaluation was conducted across two identical CNC machines using a water-based cutting fluid.
- 2) This side-by-side assessment demonstrated Tool-X's ability to reduce spindle loads, improve the surface finish, extend tool life, and increase material removal rates.

Results: The Tool-X MP-101 nanofluid increased the performance and throughput.

- 1) Production rates were increased from 75 parts per shift to 125 parts per shift using Tool-X.
- 2) Tool life was increased from 31 to 250 parts per sharpening.
- 3) Tooling costs were reduced substantially and production capacity was increased by 67%.

Outcome: After the testing and evaluation over several months, the customer changed to using Tool-X's water-based nanofluids for these key production machines.

Source: Tool-X Case Study 103