Grinding Trends - Grinding Tech Cell

http://w w w .cimindustry.com/article/grinding/grinding-trends March 3, 2011

Automation, controls, and software make grinding even more precise and predictable

February 1, 2011

New control technology enables closed-loop grinding.

Just like any other operation commonly found on Canadian shop floors, the grinding process is evolving, becoming more automated and more productive.

Today manufacturers want to grind parts in a single clamping. And, thanks to advanced CNCs, new software, and an increasing number of axes available on modern grinding equipment, a single machine now can perform various grinding operations within the same work envelope.

Automating the load/unload process also has made grinding more productive, as has the automation introduced for changing the grinding wheel.

It is the CNC and software technology, however, that has driven most of the productivity growth in grinding.

“One of the big changes in CNC grinding, like many other processes, is that new control technology is making the machines easier to run,” explained John Manley, president of Machine Tool Systems, Toronto.

According to grinding expert Manley, one of the largest steps forward recently has been the ability to simulate the grinding process in an offline environment.

“The big challenge in simulation is reproducing the actual shape of the wheel going into the part and compensating for any change in the profile when you do 3-D simulation in an offline environment,” said Manley.

Grinding is a truly dynamic machining process. The part changes as it is ground, the grinding wheel breaks down from use, and changes in temperature cause changes in the machine. It is these changes that make the simulation process much more difficult.

Similar to many other machine tools, the controls on grinding machines are becoming more sophisticated and powerful, yet at the same time are becoming easier to use. They are also combining previously separate peripheral devices and displays into a single unit.

“What Studer has done in its controls, for example, is taken all of the peripheral devices that are normally separate human-machine interfaces (HMIs) and made them icons on the control’s screen. Now the control handles all the interfaces,” said Manley.

This eliminates the need to program each device separately through its own HMI and allows the operator to do so through one control, either directly at the machine or remotely. Also, the more devices that can be brought under the command of a single control, the better the program can be simulated. It also eliminates possible maintenance issues that can arise in multiple-HMI setups.

“What you now have is one air-conditioned device that controls everything in the process,” said Manley.

Even as the controls become more powerful and more intuitive, less programming is being performed at the machine.

“One of the trends I’m seeing in grinding is the centralization of the programming,” said Manley. “Not only can the machine be programmed offline, something that is rapidly becoming mandatory, but the process itself also can be monitored remotely as well.”

Automation in Grinding

Another trend in grinding is the automating of the machines.

One of the big changes in loading and unloading a grinding machine takes its cue from the horizontal machining center (HMC): pallet changers. While pallet changers have been commonplace in HMC applications for years, when you add this type of load/unload device to a grinder, the parts need to be located in a known position because of the tight tolerances involved in grinding.

This time the solution comes from the electrical discharge machine (EDM) way of loading and unloading pallets. In this manner, parts are preloaded onto a pallet outside of the machining environment and trued to the prequalified pallet. The machine then switches the finished set of parts with a new pallet of blanks.

Setting up parts while the machine is in use increases machine utilization as well as throughput.

“You are creating free cycle time while you are grinding other parts,” said Manley. “If you can do this, it can have some serious implications on the capital cost per piece because in traditional grinding environments, load/unload time can be upwards of 30 percent of your cycle time.”

While load/unload devices are relatively easy to install and understand, what is more difficult is the clamping of the part, which must be repeatable.

Another option is an autoloader, such as a gantry loader or a multiaxis robotic loader.

Other automation available in new grinding systems includes quick-change wheels, which allow shorter just-in-time (JIT) runs.

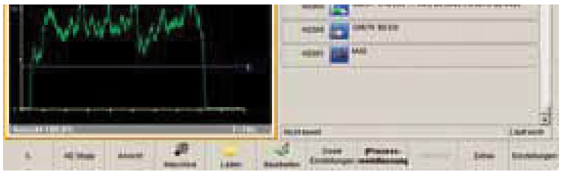
However, according to Manley, in order for automation to work effectively in grinding, a closed-loop process is necessary.

“Automating grinding is extremely challenging because there are so many variables. We are making tremendous strides forward in software and in the mechanics of the machines to minimize those influences,” said Manley. “By making the process a closed-loop one, output and quality can both be guaranteed.”

Cpk and Grinding

There is a difference between being able to produce a part in a one-off scenario, or in a small production run, and being able to produce a part consistently over the long term with no quality errors.

Cpk, an index for measuring process capability, is a tool that is becoming more popular in many manufacturing situations. Cpk measures a process’s ability to create a



part within specified tolerances.

Any process that produces a Cpk that is less than 1 is deemed poor, and the higher the number, the better the process.

“There is also a new movement to go from a traditional 1.33 Cpk to 1.67 or even 2.0 Cpk in some cases,” said Manley. “Every time Cpk expectations are raised, you put tighter constraints on the dimensions of the part. Pretty soon turning and milling — and even hard turning and hard milling – are no longer options for creating your part because they are not as repeatable as grinding.”

Grinding is very predictable in terms of wear, as opposed to hard turning, for example, in which a lot of time, money, and effort can be spent trying to predict tool failure with no results. This unpredictability makes quoting jobs very difficult.

“I do turnkeys regularly with my partners whereby we guarantee consumable costs,” explained Manley. “These systems are extremely predictable from part to part. That is one reason that people like grinding — because of its predictable nature.”

Closed-loop Grinding

Sensing changes in the grinding environment, and automatically making adjustments on-the-fly for all of the variables in process, enables what is called closed-loop production.

As each variable changes, such as the size and profile of the grinding wheel or the shifting created by thermal change, grinding systems are now able to change as well. This is because new software and controls can take these factors into account and make minute adjustments to the process.

“Thermal stability of the machine is important in any grinding operation,” said Manley. “Ideally, the base of the machine is a very thermally stable material as this will reduce errors caused by thermal growth. A lot of new grinding machines also are equipped with linear drives, which can eliminate the backlash compensation necessary with mechanically driven ball screws.”

Dressing solutions can also make a difference in part quality, according to Manley.

“Following the dressing cycle, the wheel can be a couple of tenths smaller, and that difference needs to be accounted for in the part’s program,” he said.

During the grinding and dressing processes, the grinding wheel and dressing wheel produce inaudible noise. When the grinding wheel touches the workpiece or dresses, this noise increases. Today acoustical sensors like the Sensitron can judge distances based on when the noise change occurs.

As the wheel approaches the dresser, it logs its position from the glass scale using acoustic sensing. Then, when the wheel is finished being dressed and approaches the part, more sensors “look” for the material in order to eliminate nongrinding time.

“Uptime isn’t the only worry in the grinding process; reducing airtime is also vitally important. The more time the grinding wheel is in the air, away from the surface of the part, the less actual grinding is being performed. Automation, statistically tighter tolerances, more complex parts, and simpler operator interfaces have been massive undertakings in grinding. With the right partner, these capabilities can greatly enhance the Canadian grinding industry.” said Manley.

For more information, visit www.machinetoolsystems.com.