Deburring Can Be a Real Drag

Deburring automotive transmission sprockets is a costly, yet necessary process for producing high-quality parts. Most manufacturers use a mass finishing process that involves first placing loose parts in grinding or finishing media and then applying a vibratory or rotational motion to move the media across the surface of the parts.

Stackpole's Automotive Gear Division, in Mississauga, Ontario, has recently begun using a mass finishing process known as drag finishing, in which parts are attached to special fixtures and dragged in a planetary motion through the polishing media. According to the manufacturer of the equipment, Walther Trowal, this process increases efficiency and is successful at deburring contoured parts such as sprockets, while eliminating the possibilty of part-on-part contact.

Stackpole manufactures powdered metal sprockets for the automotive industry. Their automotive gear division operates around the clock, producing 20,000 sprockets per day. Each sprocket must be deburred and cleaned of heat treat scale to meet customer specifications.

Prior to installing two Walther Trowal TMD 80-1 drag finishing units, Stackpole employed 10 workers per shift to operate centrifugal barrel mass finishing machines. Today, the company expects that they will be capable of finishing the same quantity of parts with only five employees per shift. In addition, annual consumable costs, including the costs of finishing media, are expected to be one-third of their previous cost.

The new machines installed at Stackpole are the first of their kind from Walther Trowal. Earlier versions using the drag finishing principle were capable of finishing 10–30 parts per hour. However, the incorporation of an automatic unload system, as well as some advances in part fixturing, have greatly enhanced production capabilities, says Jeff Puckett, manufacturing manager for Walther Trowal. Each of the machines at Stackpole finishes approximately 500 pieces per hour.

Walther Trowal is a member of the USF Surface Preparation Group.

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RecurDyn: The Next Step in Virtual Prototyping

New product development, having gone from prototyping to rapid prototyping to virtual prototyping for parts, has taken the next step to virtual prototyping for whole systems with multibody dynamics software packages. While they allow designers to test a system under different circumstances, the way they handle data and images has tended to limit their flexibility. Now that has changed. Developed by Dr. Dae Sung Bae, a professor of mechanical engineering at Hanyang University in Seoul, Korea, RecurDyn offers users more flexible and realistic virtual prototypes than previously possible.

Sprockets in a drag finishing unit. Courtesy of Walther Trowal.

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One example of this flexibility comes from the Samsung Motor Company. According to Dr. Hyuk Kim, a dynamic analyst formerly with Samsung, "Automobile simulations with differential gear models generally running at extremely high speed are frequently terminated in the middle of analysis and solutions. These situations are very sensitive to integration error tolerance. Meanwhile, the same simulations have been carried out successfully with RecurDyn without any numerical troubles."

According to Dr. Bae, the reason for this success is RecurDyn's reliance on a relative coordinate system. "Relative coordinate systems require the minimum number of coordinates to define a shape," said Dr. Bae. "Absolute systems require the maximum. Also, because they plot every point, absolute systems require more difficult governing equations of motion and have many constraints that relative systems do not." Dr. Bae explained that by using relative coordinates, the governing equations for motion are ordinary differential equations and not the more difficult differential algebraic equation. Also, because absolute coordinate systems define the design under analysis using a predetermined set of rules while the simulation

and analysis are running, the scope of that analysis is much narrower. "RecurDyn defines the system first," said Bae. "Then it does the analysis according to the situation parameters set by the designer, making it an ideal software package for "what-if" studies of virtual prototypes. With a relative system such as RecurDyn, the scope of analysis is much wider." Such analyses include multibody dynamics and kinematics as well as compliance characteristics.

Using RecurDyn is fairly simple from the operator's point of view, but gear and power transmission designers should understand that RecurDyn's strength is its multibody system modeling, not its gear design capabilities. According to Dr. Bae, "You would use CAD to generate the drawing and then import the geometry files into RecurDyn. Then you would install all the other mechanical elements needed to complete the system and run the analysis. After that, the software plots the results and you can revise your system." RecurDyn can import shell, rapid prototype and IGES files. Plans are in the works to enlarge this list.

Dr. Bae was recently in the United States, holding meetings with various companies here in hopes of expanding on the success RecurDyn already enjoys in Korea. "Hyundai Motor Company has chosen RecurDyn as their standard dynamic analysis program due to not only easy customization but also RecurDyn's robust solver and user-friendly interface," said Chungsup Song, senior design engineer for Hyundai. Other large Korean firms, such as Samsung and LG, are still conducting trials with the software. According to Dr. Bae, his meetings in the U.S. were very positive and there is a great deal of interest on this side of the Pacific in both using and marketing RecurDyn.

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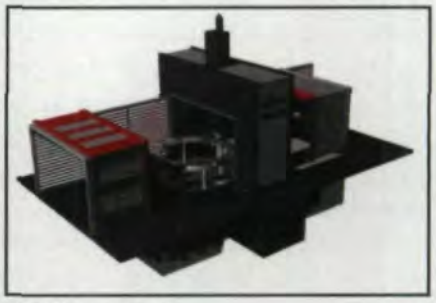

Höfler's Porta 3000

World's Largest Internal Gear Grinder

The year 2000 will see the arrival of the world's largest internal gear grinder at the Höfler works in Ettlingen, Germany. Designed to meet the growing demand for large, high-quality ground gears, the Porta 3000 can grind internal gears up to 3 meters in diameter with face widths up to 900 mm and weights up to 35,000 kg. The workpieces are usually precut or cast gears that are put on the Porta 3000 for finishing.

The machine is designed from the ground up for high accuracy. Across the hydrostatically operated machine table and table slide, built below floor level, extends a massive mineral cast gantry made from a concrete polymer bond. "The vibration dampening ability of the

mineral cast is at least 20 times better than that of cast iron with greater thermal stability," said Omar Sharif, sales manager. "Also, it costs 25% less to manufacture and makes assembly of the machine faster and easier because very little work is needed to finish the pieces. The machine stands are almost ready because the steel mechanical connections are premanufactured and placed in the molding form prior to casting." On this is mounted the rigid grinding slide with a large grinding wheel and 30 kW hydraulic motor wheel drive. This design allows the machine to grind both internal and external gears (in the profile grinding mode). The grinding slide strokes vertically through the gear with the grinding wheel swiveled into the tooth angle. Cutting oil is the primary lubricant for the grinding operation. The oil is applied using high-pressure pumps that dispense the oil through specially shaped oil supply nozzles to the tooth gap surface. "Grinding time for a precut gear of the largest size would be about five hours," said Sharif.

The Porta 3000 now offers industries where precision in large gears is a necessity the same level of quality that grinding has offered to consumers of smaller gears. These include the wind power and naval shipbuilding industries, where gears have to meet very tight quality standards for the kind of quiet and efficient operation demanded. "From the Porta 3000," said Sharif, "we can expect gears to meet DIN 3 (AGMA 14) quality standards." This is verified by the machine's on-board inspection system. Designed and assembled by Höfler, the Porta 3000 employs a CNC inspection system that uses touch probes to inspect the workpieces. "We use an integrated inspection system for the automatic inspection of involute, lead and pitch," said Sharif. "The diagrams can be reviewed on the screen and documented on a laser printer according to the DIN 3962 standard, which details tolerances for cylindrical gear teeth in terms of deviations in individual parameters, tooth trace and pitch span. All such deviations are corrected based on the inspection results."

The first Porta 3000 machine was installed in Höfler's own climate-controlled production building in Ettlingen, Germany, and brought online in March. According to Sharif, the company extended its production floor space by 8000 square feet to accommodate the Porta 3000. "Business will be very good with the Porta," said Sharif. "We have a lot of demand for it." ○

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