Innovations in centerless grinding machine and its operations

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Centerless Grinding operation is a mass production process in which cylindrical components are ground without reference to center. This operation is used as the final process in majority of the components where the tolerances and the quality parameter are stringent.

The grinding process is basically designed for mass production. As the cost of manufacturing is increasing, the users are trying to extract more and more production from a grinder in order to lower the cost per piece. The user feedback and experiences highlighted the problems faced during day to day work, and solutions need to be implemented for future expansion projects and existing machinery.

Below are some suggestions, to improve the quality level and productivity, while bringing down costs in Centerless grinding:

- Land costs are at an all-time high, which necessitates the reduction of machine foot print and floor space dedicated to a single machine.
- In any centerless grinding operation, the major non-productive time is the dressing time. Hence, a method needs to be devised so that the dressing time also can be used productively.
- As the working cost is increasing, more automation is required so that an operator can run more than one machine.
- With cost of power increasing all around the world, more energy efficient motors should be explored.
- The fuel prices are increasing at a phenomenal rate and it is essential to produce fuel efficient vehicles. This calls for components with higher quality standards and a need to explore different materials to reduce vehicle weight. Consequently, machines with capability to grind these components efficiently need to be devised.

To resolve the above issues, our engineers did brain storming and devised various options:

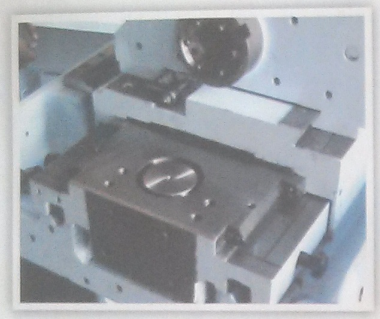
1. To reduce the floor space there should not be any compromise in terms of the rigidity and stock removal capabilities of the grinder. We designed a grinder similar in size to our smallest model. At the same time, we increased its rigidity by adding weight to make it equivalent to our bigger sized model. The center of gravity was kept constant at the working area so that the vibrations would always be at that point. The vibration analysis was conducted to ensure that it was maintained at a very low level.

2. Total Usage Time = Productive Time + Non-Productive Time (Dressing Time) The challenge for us was to convert the non-productive time into productive time. To achieve the same, we designed a diamond roll dresser for the machine. The CNC controls were programmed in a manner that when the dressing is done on the wheel, grinding of the component is also in process. Therefore, the total usage time is now equal to the productive time. This enables the customer to grind more components. The savings was substantial in terms of productivity.

3. Working Cost = Running Cost (Power + Employees + Overheads) + Consumables (Hydraulic Oil + Coolant + Grinding wheel + Regulating Wheel + Diamond Dresser)

To reduce the working cost of a machine, it is important to reduce all

Diamond Roll Dresser



Linear Guideway

Servo Regulating Wheel Drive

the above costs to an optimum level.

Power Cost:

The maximum power consuming motor is the grinding wheel motor. We procure the motor such that during idling time of grinder in each cycle it would draw very low current, while providing full torque during the grinding process. Such motors have rating of Eff 1 or better. The other options include soft start for grinding wheel motor or Variable Frequency Drive for regulating and grinding wheel motor. These options avoid peak current required for start-up of the motor.

Employees Cost:

Machine automation is designed in such a way that the operator can run more than one machine at a time. In mass production plants, the focus is to have one skilled person to look after the setting and inspection of finished components for all grinders. Loading, unloading and other routine operations are done by unskilled employees. CNC options also reduce the operator intervention to a large extent and thereby reduce the cost. At the time when customer sends the plant layout, we give suggestions and inputs to reduce material handling and make it ergonomically convenient in order to reduce operator fatigue.

C) Variable Frequency Drive is installed to achieve Constant Surface Speed for Grinding Wheel. This helps in reducing the dressing frequency even when the wheel diameter is reduced. Hence, the grinding wheel is used to its optimum level.

D) The other consumables like oil, coolant, diamonds and wheels are selected with the help of various manufacturers' input and expertise, to suit each application.

The increase in fuel prices and depreciation of Indian currency has put a lot of burden on manufacturers to improve the fuel efficiency of vehicles. This calls for more close tolerance in manufacturing parts. Quality Parameters are a combination of Size Tolerance, Roundness, Cylindricity and Surface Finish. We use Precision Linear Guideways to achieve practically friction free movement. This enables the slide to move with high accuracy, as close as 0.25 microns and helps in maintaining size in close tolerance.

To achieve roundness in 1 to less than 1 micron, it is necessary to have rigid spindles and vibration free grinding. We mount Automatic Wheel balancers, which balance wheel with vibration level less than 1 micron. This also helps improve Cylindricity.

Coolant supply while dressing the wheel has to be forced at the point of contact of diamond and wheel. Proper forced coolant supply helps to dress well, which in turn helps in improving surface finish on component. Coolant supply during grinding is conventionally done by free flow of coolant on the part. Due to air turbulence because of wheel rotation, most of the coolant does not reach the actual grinding area. With redesigned nozzles and flapper to stop air turbulence, the coolant now reaches grinding hot spot to almost 90% level. The overheating of parts and burning marks are reduced and surface finish improved. Above are the few innovations and adaptations incorporated in the machine to meet the demand of the industry for better and greener tomorrow.

For more information
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