Streamlining the Finishing Area

by Todd Peterson, Project Engineer, Texas Precision Metalcraft and Stephen Murtagh, Engineering Manager, A W Bell Machinery

Four years ago Texas Precision Metalcraft (TPM) began their search for a solution to a particular family of parts that was consuming significant resources. Reviewing all possible avenues, TPM ended up partnering with A W Bell Machinery to develop a customized machine for their needs. The collaboration was not only able to deliver a solution that greatly improved the quality of the casting while reducing cycle time, but also demonstrated the importance of customer-vendor relationships to achieve advancements in the modern foundry.

Todd Peterson, Project Engineer for TPM explains the problem they faced, "The impetus family of parts were taxing on resources for after initial gate removal on an automated plunge grinder, the parts still required further manual grinding that could only be performed on the edge of a grinding wheel by a very skilled operator. This made the entire process time consuming and demanded not only our skilled operators but the use of multiple pieces of equipment."

With the decision to look at alternative options for processing these parts, TPM identified three key requirements that the new system needed to achieve; improve cycle time, reduce the need for highly skilled operator and consistently produce high quality final parts.

Figure 1: Part Family after Initial Plunge Grind

For TPM, improvement in the cycle time was absolutely necessary to ensure the project was financially viable. ROI for this particular machine was heavily dependent on the amount of volume that could pass through it. Hard data on the cycle times determined volume capacity, hence an improved cycle time would allow greater production and in turn income. To assist cycle time improvement it was important to move this process from a choke-point operation to a floating operation. As well as overcome the long and inconsistent cycle times created by the physical aspect of the then current process. One of the few benefits of human-controlled grinding is that they have the ability to adapt to the part that they have in their hand.

The gate removal process required one of TPM's most skilled workers in finishing to devote vast amounts of time and energy to hand-grind the gate surface. This was due to the gate surface being ground flush to the part with no witness, something only a very skilled worker could accomplish to the desired standard. This tied up supervisor-level personnel whose knowledge could be better served elsewhere within the business.

The quality of the part and the physical appearance of the part were extremely important to TPM's customer. While TPM was fortunate enough to have a customer that was willing to work with them throughout this project, it was important that the new system consistently provided high quality output.

Figure 2 & 3: Final Grind Operation

The Path to a Solution

Prior to speaking with AW Bell Machinery, TPM considered several avenues for gate removal.

A consideration was a dry-machining center utilizing a six-axis ABB robot. After some testing it was discovered that the physics of the machining operation

as well as the variability inherent in castings eliminated dry-machining as an option. More traditional machining operations were also ruled out due similar reasons as well as the cost of entry and the cycle time required.

Belt grinding appeared a promising option for faster cycle time, employee knowledge and part quality. Though the rigidity of a machine was questioned. Could a machine that is built to do the same operation every cycle overcome the variability inherent in castings? Could this machine be used for other parts outside this family if this particular business were to go away?

TPM had successfully worked with AW Bell Machinery in the past on an automated grinding system. This previous experience gave TPM confidence in the quality that AW Bell Machinery could deliver. It also presented the advantage of greatly reducing training time as their shop employees would be familiar with the user interface. After initial contact from TPM with their requirements, AW Bell Machinery began work on a machine proposal that would, after reviewing at the 2013 ICI conference become a reality.

The first step taken by AW Bell Machinery was to gain an in-depth understanding of the needs and requirements of the job. "The most important part of the whole process was to have clear communication and open dialogue between everyone involved. Within this, the factors of clear project goals and risk mitigation played a prevalent role," said Stephen Murtagh, Engineering Manager for AW Bell Machinery. "TPM was able to fully convey to us their requirements including the dimensional and cosmetic requirements of the final part, as well as their concerns and limitations that we needed to overcome."

After conducting preliminary testing on TPM castings, it was determined that a 1.5" contact wheel would allow grinding of these parts. AW Bell Machinery's model PGS850 was specifically designed to remove stress concentrations from the internal radius of a sand casting by using a hydraulic drive and a 1.5" contact wheel. Having the knowledge from this proven model, AW Bell Machinery were confident they could design and build a machine that addressed all the problems faced by the current method of gate removal.

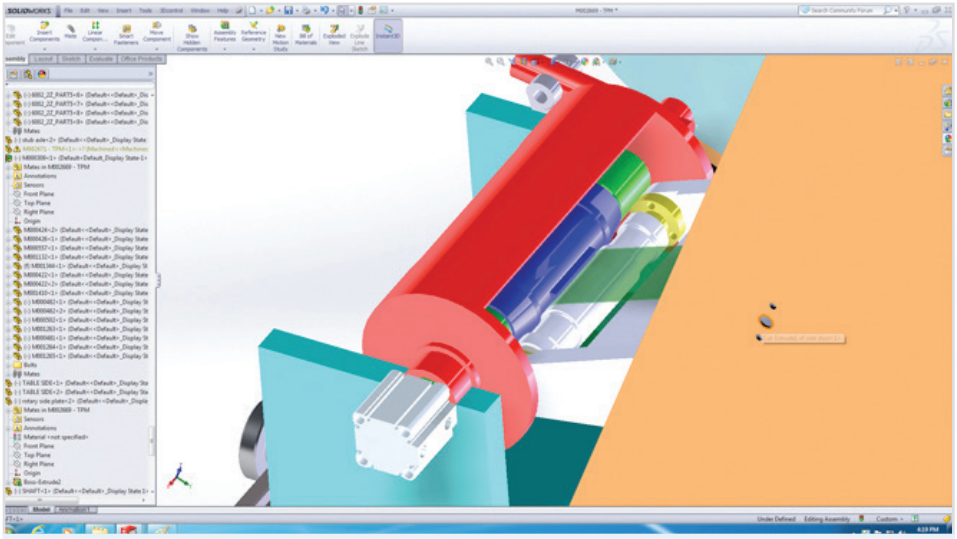
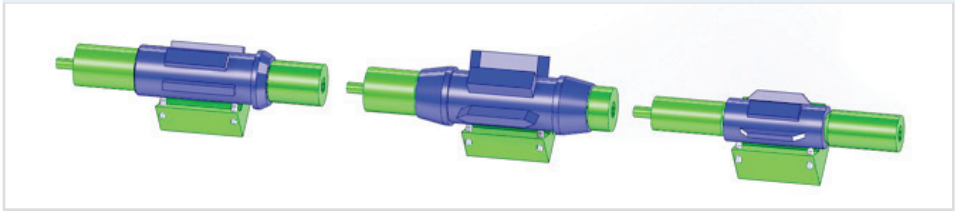


Figure 4: Grinding Fixture & Contact Wheel (above)

Figure 5: Interchangeable Inserts (below)



A W Bell Machinery Detailed Proposal

Following a scheduled service call on TPM's existing machine, AW Bell Machinery carried out further discussions and on-site assessment of this project. With a clear understanding of not only the requirements but also a viable solution, the task was now to provide a clear proposal that would give TPM the confidence to move forward.

The below pictures show the preliminary CAD designs offered by AW Bell Machinery to obtain customer feedback and demonstrate the overall design intent.

After initial supply of this proposal, a face-to-face meeting with TPM allowed for a number of concerns associated with the project to be addressed such as the risk of purchasing a customized machine to process one family of parts and what the outcome would be if these parts were lost. Through this discussion, AW Bell Machinery was able to re-assure TPM that through smart design and use of standard components, this 'custom' machine could be easily configured to accommodate other part families. As part of the project scope, TPM supplied a minimum number of production parts for AW Bell Machinery to test the machine prior to releasing it from the build floor on a range of parts. This would ensure minimal disruption to TPM production environment upon installation and prove the versatility of the machine.

As this machine was designed as a customized machine for TPM, it was important for both parties to have input throughout the design process. Part of the agreement was for TPM to approve final design before manufacturing of machine commenced. Through these design meetings, a number of improvements were made to the clamping fixture based on TPM suggestions, mainly focused around quick change and identification

Continued on pg X

of components for the multiple parts to be run on the machine.

Once the machine was built, initial testing on production parts was very successful. This was in part thanks to the technical help from 3M on optimum belt selection for the process. It was also realized that with the aid of Incremental Mode, it was possible to remove all material from the parts from the cut-off stage, eliminating the need for the initial automatic plunge grind. The consultation between A W Bell Machinery and TPM established the exact requirements for part finish, with test results being presented to TPM for discussion. Sample parts were also provided to TPM to present to their customer for a final approval.

Figure 6: Parts before grind (foreground) and after (above)
Figure 7 & 8: CAD & Finished Product Comparison (below)

Outcomes

Through a process of in-house testing, consultation, machine design, manufacture and finally production testing, AW Bell Machinery was able to deliver a customized machine to TPM that met their requirements.

"Working with AW Bell Machinery was great, they have been able to exceed the three main goals established at the beginning of this project. Furthermore, the risks identified above have all been successfully addressed. The machine is currently being used beyond this family of parts with great success," said Peterson.

Prior to the automated grinding machine, the cycle time for one part was between 4 and 5 minutes when completed by the finishing supervisor. By the end of the day, it would not be uncommon for this to have drifted into the 6 to 7 minute range. The new machine by AW Bell Machinery can complete a full cycle in less than 1 minute. This dramatic increase in throughput has allowed TPM to properly coordinate the scheduling of both the finishing and foundry departments.

The one minute cycle time is constant whether it is being completed by the finishing supervisor or by the most recent hire with minimal training. This has allowed supervisors to tend to more pressing matters that require

Figure 9: Machine Installation

Figure 10: Completion of Production Parts

their knowledge and expertise. If tweaks to the machine are needed to account for slight casting differences, an operator can also complete those tasks without the need for supervisor intervention.

Last, but certainly not least, the part quality and consistency of the finished part has left TPM's customer very pleased. They know that each batch of parts will be the same as the last. The controls built into the machine allow for a precise level of control so that consistency can be maintained.

Conclusion

The collaborative endeavor by TPM and AW Bell Machinery prove how beneficial it can be for a vendor to partner up with a customer. TPM has achieved improved capacity, efficiency, quality, and safety, while A W Bell Machinery has further expanded their skills and technical capabilities in the finishing area.

As Stephen Murtagh summarizes, "The foundry industry needs customers and vendors to work together for the advancement of technology and streamlining of the investment casting process. The customer and vendor bring unique expertise and requirements to the table and must share this knowledge with each other if a like goal is to be achieved. This marrying of responsibility, information, and end-goals is vital to the overall success of the project. It cannot be left to the vendors alone to provide solutions, nor the customers to spend their time researching new technologies."

For more information on the services of TPM or AW Bell Machinery visit their websites at www.txpm.com and www.bellmachinery.com.