Transform the Manufacturing of Dental Molded Products into a Lean Process

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Abstract *— The Non-Conformance process in a manufacturing company is known for delaying the product delivery to the customer due to having the product quarantined during the investigation phase. In some instances, this non-conformance process provides value as new causes are investigated, but in a molding process the cause for flash tends to be the same. Therefore, a new process workflow was created were the rework of this flash would be performed instantly as it is found instead of creating a non-conformance. In addition, a preventive maintenance program is known to greatly reduce defects on the products if performed correctly. With these new processes, the end goal of delivering the product to the customer faster is being achieved.*

Key Terms *— Flash, Injection, Maintenance, Non-Conformance, Rework, Tool.*

INTRODUCTION

During the manufacturing of dental molded products, numerous of non-conformances are created due to flash found in the product. These non-conformances are required to be investigated by an engineer or a production lead. During the investigation process, the product is quarantined and the delivery to the customer is delayed. As part of this project, a new process workflow was developed to reduce the flash that is found on the product and to create a direct process that will not require a non-conformance. The time it takes to perform investigations was greatly reduced allowing the engineer to work on other higher priority projects. This process allows the manufacturing of the products to be completed in a faster manner with the end goal of delivering the products to the customer faster.

BACKGROUND

A dental manufacturing company provides a variety of products where 60% of them are molded parts. The process of injection molding is a very complex process that requires the correct tool design and the appropriate process setup parameters to produce an acceptable part. But there are instances in which a product may reflect a defect, such as flash, that in a manufacturing company this defect will require a non-conformance report. These defects can be due to an incorrect tool design, an incorrect process setup or just tool damage over time. As part of this project, flash as a defect will be the main focus and ways to eliminate or reduce flash to evade a non-conformance process will be evaluated.

Flash is an excess of material in the part that is mainly due to leakage of material in the parting line of a tool. One of the causes of flash, and the least probable one, is an incorrect mold design. If the mold and clamping unit are loaded unevenly, this may cause the mold to be forced open on one side causing flash. In addition, the number and placement of the ejector pins is an important part of the design that if not done correctly may cause flash [1]. Another cause for flash may be an inadequate process setup and having these uncontrolled. The process parameters that are normally evaluated are melt temperature, clamp pressure and injection pressure [2]. But the most important aspect is that these process parameters are controlled during the compression stage to keep the flash constant, or hopefully produce parts without it [3].

Prior to releasing parts into a manufacturing process, these undergo a validation process where the tools are verified and process parameters are defined. After these are introduced to

manufacturing, if flash is seen on the parts, these are quarantined and a non-conformance report is created. A non-conformance investigation may take from 30 to 90 days, which in turn means that the product will not reach the customer for an additional 30 to 90 days, and profit is not generated from the manufacturing of these parts as expected. Each non-conformance created for flash will be investigated in a thorough manner to identify the possible causes and possible remedies for each. These possible causes will identify if the issue is related to tooling or process parameters.

The maintenance of the equipment and the tooling is also an important step to reduce flash. The initial process parameters chosen may be the correct ones, but overtime tools degrade, therefore a preventive maintenance scheduled will be suggested and the injection molding machines will in turn create better quality products.

From a quality process standpoint, the disposition of the non-conformances due to flash is to rework the part by trimming this flash. Independently if the cause is due to tool design, incorrect process parameter or just tool damage, the disposition always remain the same. Therefore, to obtain profit from this product in a faster manner, all work instructions will state that if flash is found, the employee will be required to trim this flash at a specific trimming station using approved product standards as reference.

DATA COLLECTION

A non-conformance report was generated for years 2016 to 2018, and sixty were related to flash on a molded product. Refer to Figure 1 for distribution of non-conformances per year. All these non-conformances took approximately three months to investigate, which means that the product was quarantined during three months and the delivery to the customer was delayed. A summary of the investigations performed during 2018 is the following:

- The disposition was always to rework the product and instructions on how to perform the trimming on the product was created per non-conformance.
- The root cause on all investigations was related to tool issue, such as worn ejector pin, incorrect tool setup, tool wear, worn parting line or old tool.
- The action plans were either to retrain employee on tool setup or repair the tool.

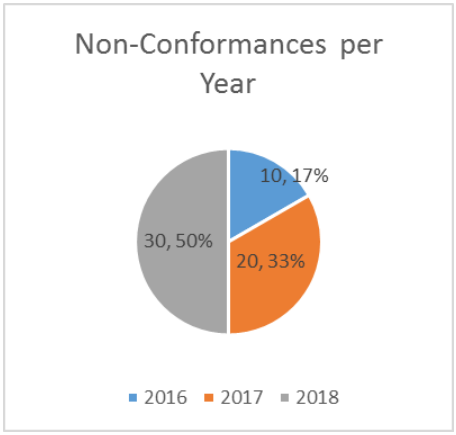

Figure 1
Number of Non-Conformances from 2016 to 2018

In addition, a preventive maintenance program is currently not performed on the tools and these are sent out for repair only when the issues occur. These delays further production as the tools are sent out to an external company and the repair of the tool takes longer than a preventive maintenance.

The procedures per product line did not have appropriate visual representation of what is an acceptable flash, and what is unacceptable. In addition, some operators were not hands on trained as they are expected to be self-trained through the electronic training system.

IMPLEMENTATION OF A LEAN PROCESS

A new process workflow was created that would allow the product to be sent to a trimming station if flash was found instead of creating a non-conformance. This trimming station contains the following:

- Updated procedures per product line with visual representation of acceptable and unacceptable standards.

- Procedure on how to use the blades provided to trim the flash out of the different types of products.

After all the procedures were updated or created, and prior to releasing the trimming station to operations, all operators were properly trained on how to perform the required tasks. A sample of each product line was at the station and the operators were provided the opportunity to trim these products and ask any questions necessary prior to releasing the station.

Since all the causes were related to tooling issue, a preventive maintenance program was developed for all the tools. A monthly scheduled maintenance was performed were the tools were verified for wear and proper action was performed prior to use. In addition, the ejector pins will be replaced every four months prior to wear.

CONCLUSION

As part of this project, the delivery of the product to the customer is being achieved by creating a new process workflow which would eliminate the requirement of a non-conformance process if flash if found and trimming the flash directly during the manufacturing process. This new process has been proven to be effective since there has been no back order reported in the last two months, and there has been no complaints reported since the process was implemented.

REFERENCES

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