Molding Scrap Reduction and Reutilization

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Abstract

A company named ABB, whose operations in Puerto Rico focuses on molded cable installation products, experienced Scrap generation during the subassembly processes. The scrap costs represented over $200K per year. The Plant management established an objective of reducing the scrap costs by 50% and the virgin material usage by 15%. Lean Six Sigma Methodologies were used to implement a solution to capture the scrap and reutilize it in the molding process, resulting in cost avoidance of $200K per year and reduced virgin material usage by 15%.

Problem

At ABB, we are continuously looking for ways to improve our processes, to better serve our clients, our community and our shareholders.

After the molding process, an area of opportunity was presented in the subassembly process due to random variation caused by the subassembly machine. This variation produced at least 4% scrap that translated to $200K per year in scrap costs. The scrap costs can be significantly reduced by implementing a scrap recovery machine that separates the nonconforming material and stores the conforming material for further use in our molding process.

Currently, our process uses only virgin raw material, nevertheless, regulatory agencies approves the use of regrind or recycled material up to 15%. This approval enabled us to reduce the virgin raw material consumption, hence reducing the amount of material purchased.

The project's scope was to implement a solution that captured the scrap generated and re-utilized it in the molding process as regrind to avoid scrap costs and reduce the virgin material usage.

Methodology

DMAIC is an ordered sequence of project phases where the project manager carries specific actions to objectively document tasks that ultimately solve a problem. These phases are Define, Measure, Analyze, Improve, and Control.

In the Define phase, the problem statement was clearly generated, the stakeholders were identified, and the project team was assembled with specific roles assigned.

Process Capabilities and Baselines Determination

In the Measure phase, A baseline was created acknowledge the actual state of the process before the improvements. Based on the project's scope, the material handler measured the process material usage by recording the amount of virgin material used in the molding stage and the amount of scrap generated in the sub-assembly stage, both measured in pounds. The molding process was stable through the duration of the data collection process, running within validated parameters and cycle time.

As part of the Analyze phase, a material usage was plotted, and a baseline was created, as seen in Figure 1. Based on the recorded data, the scrap rate was an average of 30%, with an average daily virgin material usage of 265 lbs.

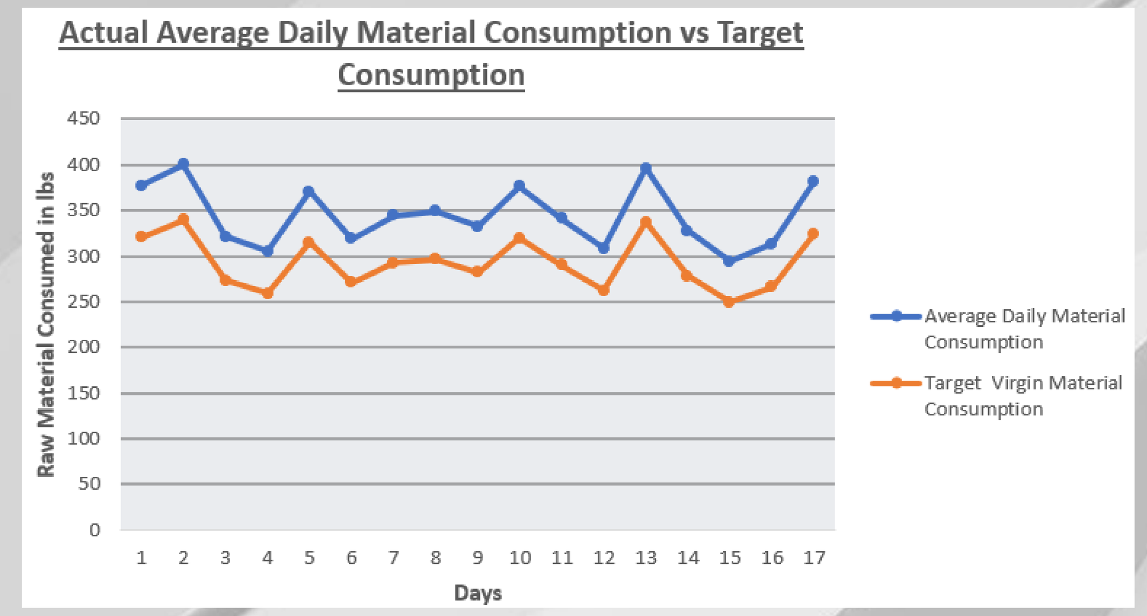

Figure 1: Virgin Material Usage Run Chart

Scrap Recovery Methods and Solutions

As part of the Improve phase, a solution was implemented to recover the scrap. The Pugh matrix was used in order to select the optimal design solution based on the operations requirements, as seen in Table 1, the sprocket design was the winner. The Pugh matrix utilization was a pivotal, decision making tool in order to determine the best solution to our problem. After selection of the design, as seen in Figure 2, a computer-generated model was created to simulate the scrap recovery process. An FMEA was also created to anticipate failure modes that could disrupt the subassembly process. In order to recover all the scrap that is generated, the machine was attached to the subassembly machine and synchronized so that all the scrap would be recovered.

Table 1: Scrap Recovery Design Pugh Matrix

Pugh Matrix

Expectations	0	1	2	3	4	5
Easy to Manufacture	DATUM	-	S	+		
Not space consuming		-	-	+		
Cost effective		-	+	+		
Maintenance intensive		S	-	S		
Adjustability		+	-	+		
Complexity		-	S	+		
Total +'s (better than datum)		1	1	5	0	0
Total -'s (worse than datum)		4	3	0	0	0
Total S's (same as datum)		1	2	1	0	0
Comparison						

Concept Summary	
0	DATUM
1	Robot integrated
2	Indexed Carrusel
3	Sprocket based design
4	
5	

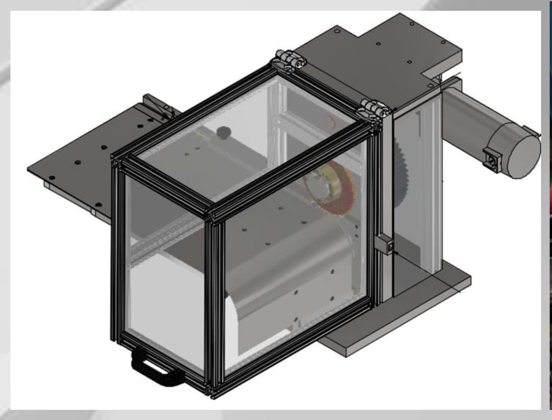

Figure 2:
Scrap Recovery Design Concept

Figure 3:
Scrap Recovery Final Assembly

Results and Discussion

After manufacturing the scrap recovery machine, as seen in Figure 3, a pilot run was conducted. As seen in Figure 4, the material usage was extrapolated annually to 96,725 lbs. The project objective was to reduce the virgin material consumption by 15%, which financially translates to $101K. Even though the virgin material is reduced, the use of regrind will compensate for the material usage. A process monitoring system was implemented to control the regrind lot and the blended percentage.

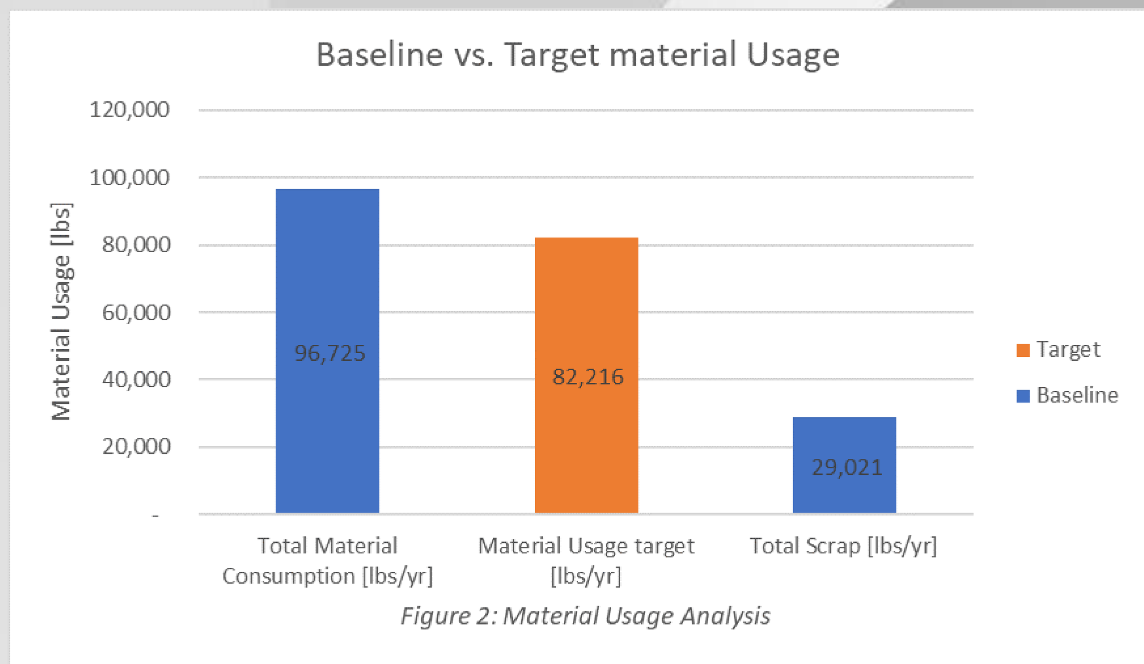

Figure 4: Material Usage Analysis

The use of regrind was limited because the excessive use will yield a negative effect on the product performance if the regrind is processed more than one time [1]. The approved limit of regrind was up to 15%, as approved by regulating agencies. Even though this regulation was limiting, the use of regrind, consequently dampening the financial benefits, it did not affect the improvements made in virgin material consumption.

The cost of scrap based on the agreed purchase of $7/lb was $205K, exceeding the target savings of $105K. Since the project's scope was to recover the scrap, it was used entirely and was incorporated into the molding processes, the regrind implementation is limited to a 15%, the scrap cost is avoided, and the virgin material usage is reduced by 15%.

Conclusions

Using the Lean Six Sigma philosophy with the DMAIC methodology, a solution was designed to successfully reduce the virgin material consumption by 15% and avoid $205K in scrap costs. The Lean Six Sigma philosophy for continuous improvement projects proved beneficial as a project manager because it provided a logical, objective structure in the methodology that enabled scientific problem-solving techniques. The results are a testimony of the success of the philosophy.

Future Work

The next step to further advance the project will be to address the root causes of the variation and reduce the scrap rate. Furthermore, study the financial impact addressing this issues will cause and compare it with the financial impact of the regrind usage.

Acknowledgements

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References

[1] Badia, J. D., et al. "The Role of Crystalline, Mobile Amorphous and Rigid Amorphous Fractions in the Performance of Recycled Poly (Ethylene Terephthalate) (PET)." Polymer Degradation and Stability, vol. 97, no. 1, 1 Jan. 2012, pp. 98–107,