Improvement of Efficiency in Biodegradable Packaging Process

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Abstract

This industrial research was studied an improvement of efficiency in natural fiber production plant. The objective was improvement process by using IE techniques which this method was once green technology for industrial problems solving. Now, process had build-up in process (WIP) due to unbalance times between trimming station and visual inspection of station. Therefore, the research studied work of staffs; time study and data analysis through 5W1H were used for analysis of WIP root cause. The cause of problems founded were the transportation loss of between section had over necessity and loss of visual inspection for repair. Therefore, it had bottleneck in process. Consequently, the researchers applied ECRS in each working processed by separation of repair station. Repairs of items were isolated from the main flow path of the process. Calculating of work flow rate was used for identified operator for repair station. As a result of the above production improvement, Times of visual inspection in a lot was decrease from 283.84 hrs to 160.19 hrs. It was decreased in 43.56%. In addition, the effect of separation from the repair process made the total times of all process was decreased from 792.78 hrs/lot to 669.14 hrs/lot. It was decreased in 15.60% and decreased work in process had from 17 lots/day to no work in process.

Keyword: Natural Fiber; Work-in-Process; ECRS

1. Introduction

Today, many people in every part of the world are still consume toxic substances that come with food and food containers without knowing the fact that these substances can adversely affect humans in number of ways raises serious public health issues. 7 Years ago in Thailand was developed Biodegradable packaging for stead foam or plastic food containers. The biodegradable packaging was advantages in natural conservatively and humans healthy than foam or plastic food containers. The basic reason, biodegradable packaging is made from natural fiber plant and then it can be fully renewable by natural.

Processes for manufacture of natural fiber food containers consist of wet forming, dry forming, trimming, visual inspection, and internal contamination check in order to deliver clean products suitable for food contact to customers. In present day, the production lines have faced an issue from huge orders from around the world and growing of work in process (WIP) between trimming by machines and visual inspection by human eyes. In addition, the work in process results in consuming of empty spaces making the build-up of work that could affect the courage of employees.

From a brain storming, at first, of the production line, a basic recommendation would be adding numbers of machines and staffs in order to decrease delay time and build-up of WIP. However, the management reviewed the behavior of this situation and commented that the build-up of WIP was after the trimming process prior reaching the visual inspection stations that should not occur in mass production. Then, a hypothesis was drawn that something must be wrong in the work flow. This because trimming process could be performed with only single step while inspection require carefully visualize of staff to control the quality of products.

In this case study, there was an aim to decimate WIP for smoothness of production line and also hope for increase its productivity.

2. Operation

Flow Process Chart	Summary			
Location โรงงาน	Event	Present	Proposed	Sa
Activity กระบวนการผลิตตั้งแต่ขึ้นรูปไปจนถึงการบรรจุลงกล่อง	Operation	4		
Date 08/10/09	Transportation	7		
Operater	Delay	-		
Circle Appropriate Method And Type	Inspection	3		
Method: (Present) Proposted	Storage	2		
Type: Man (Material) Machine	Time (min)			
Remarks:	Distance (m)	28.5		
	Cost			

Event Discription	Symbol	เวลา	ชนิดของเว
ขึ้นรูป	● ⇨ D □ ▽	931,397	VA
เคลื่อนย้ายไปไว้ที่วาง	○ ➡ D □ ▽	100	NVA
วางไว้ที่ที่วาง	○ ⇨ D □ ▼		NVA
เคลื่อนย้ายมายังเครื่องตัดขอบ	○ ➡ D □ ▽	60	NVA
ตัดขอบ	● ⇨ D □ ▽	1,964	NNVA
เคลื่อนย้ายไปไว้ที่วางWIP	○ ➡ D □ ▽	60	NVA
วางไว้ที่วางWIP	○ ⇨ ◗ □ ▽		NVA
เคลื่อนย้ายไปยังพนักงานตรวจสอบด้วยสายตา	○ ➡ D □ ▽	60	NVA
ตรวจสอบด้วยสายตา	○ ⇨ D ■ ▽	3,198	NNVA
เคลื่อนย้ายไปยังโต๊ะ QA	○ ➡ D □ ▽	60	NVA
QA ทำการตรวจสอบ	○ ⇨ D ■ ▽	90	NNVA
เคลื่อนย้ายไปที่รอตรวจโลหะ	○ ➡ D □ ▽	60	NVA
ตรวจสอบโลหะ	○ ⇨ D ■ ▽	100	NNVA
เคลื่อนย้ายไปรอนับ+ใส่ฉลาก+ใส่ถุง	○ ➡ D □ ▽	60	NVA
นับ+ใส่ฉลาก+ใส่ถุง	● ⇨ D □ ▽	370	VA
แพ็คลงกล่อง	● ⇨ D □ ▽	290	VA

Note; VA = Value Added, NVA = Non Value Added and NNVA = Necessary But Non Value Added

Fig. 1 Flow process chart for overall processing of biodegradable packaging.

From investigation and data collection in trimming and visual inspection process by motion study in Figure 1 which is a flow diagram showing flow of material and distance showed that there were 3 value added steps, 9 Non value added steps, and 4 Necessary but Non value added steps with its production rate of 3,198 second/bag (480 pieces per bag). From the study, there were many Non value added steps and a gap between trimming and visual inspection period was about double. For a solution, it's usually adding more visual inspection stations in order to balance the line. However, with above solution, there might be missing the actual behavior of the operation which could have a trend for re-occurrence. From the motion study of production line, a flow process chart could be created as Figure 2. Since the production could not set as "Zero Defect" manufacturing due to its production technology, the careful visual inspection was still required with repair procedure and elimination of contamination detected by human eyes of the products. From the variation of the process, it resulted in variation of time for inspection and required definition of product's quality criteria in order to set the quality level for visual inspection which consists of 4 types as the following:

Type 1: No repair required
Type 2: Accept with repair required
Type 31: Defect found and could not be repaired
Type 32: Defect found and could be repaired but required thickness consideration

Table 1 Time study of quality packaging types in visual inspection

Type	1	2	3-1	3-2
Cycle Time (Sec/Piece)	3.39	11.30	3.06	10.49

Result of time study in visual inspection for each type of products was shown in Table 1. Items required repair used time for inspection about 3.33 times of items without repair resulting in more time consumed compared to the other production processes. In addition, for total time for inspection was 1,021,808 seconds (from 151,200 pieces/lot), it resulted in WIP about 17 bags/day (or 8,160 pieces/day)

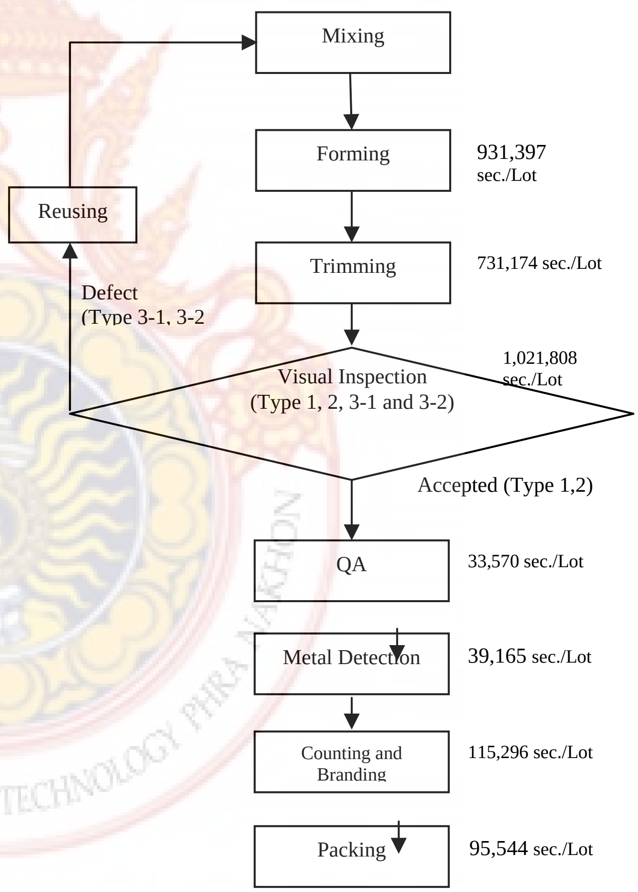

Fig. 2 Flow chart and cycle time each process (before improvement).

From Figure 2, in case of using standard procedure for visual inspection and repair by the same staff, it could result in more standard deviation of time used; ex in Type 2 and Type 32 due to time used of consideration for acceptance of quality level set. By using ECRS method for improvement, there could be drawn as the following:

- Case of Type 1, let the items pass as good products
- Case of Type 2, 31, and 32, separate items and wait for repair

Table 2 Time study of quality packaging types in visual inspection (comparing between before and after improvement)

Type	1	2	3-1	3-2
Cycle Time before improvement (Sec/Piece)	3.39	11.30	3.06	10.49
Cycle Time after improvement (Sec/Piece)	3.39	3.00	3.06	2.91

By setting a new standard work procedure by timing (as shown in Table 2), it could be seen that when the staff did not have to consider the quality level of items, the period used for inspection was decreased. In addition, time for consider defects that could be repaired for thickness consideration (Type 32) was also decreased from 10.49 seconds before improvement to 2.91 seconds after improvement.

In the lot studied, there were items with defects that could be repaired after thickness consideration at 15,017 pieces which could take 157,529 seconds for repair in prior improvement procedure but could take 43,700 seconds in improved procedure which was 113,829 seconds or about 72,26%.

The effect from standard work procedure improvement resulted in time for production decreased drastically. Therefore, it's set as a new standard procedure as shown in Figure 3 for production time and work flow.

Separation of sub-work between inspection and reparation and use of separated staff resulted in time used for inspection decreased from 11.30 seconds to 3.00 seconds. Then for all of the lot, it was decreased from 1,021,808 seconds to 576,671 seconds or 43.56% decrease.

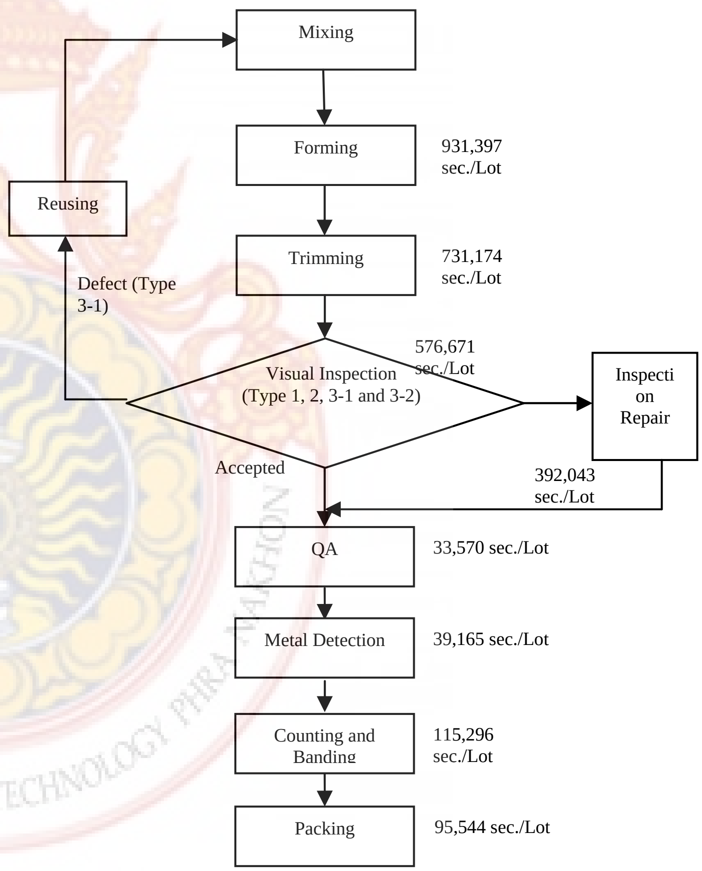

Fig. 3 Flow chart and cycle time each process (After improvement).

Time for overall production starting from forming to packing was decreased from 2,854,025 seconds/lot to 2,408,888 seconds/lot or about 15.60% decrease. The WIP decreased from 17 bags/day (8,160pieces/day) to zero. The results from using industrial management technique could help the organization to solve the problem without investment in machine but, on the other hand, achieve more productivity.

3. Conclusion

1) WIP and build-up of work in trimming process resulted from non-suitable work standard for quality level of item. It took time for consideration of item's quality.
2) Setting quality level and separating sub-work could increase production capacity.
3) Results from improvement by sub-work separation between inspection and repair could reduce inspection time from 283.8 hours (1,021,808 seconds) to 160.2 hours (576,671 seconds) or about 43.56% decrease.
4) Overall production time from forming to packing decreased from 2,854,025 seconds/lot to 2,408,888 seconds/lot or about 15.60% decrease.
5) The organization was not necessary to invest in machine and number of staff.
6) This problem solving method was basic to encourage the innovation of green technology.

4. References

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