Comprehensive Study on Enhancing Productivity by Minimizing Minor Stoppages in Beverages Industry Production Line

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ABSTRACT

Productivity can be improved in many ways, however many organizations do not pay attention on minor stoppages occurring at production lines because it is difficult to find information regarding minor stoppages. Minor stoppages happen every time throughout the whole production period. Total Productive maintenance (TPM) is the best practice which is used within the organization which is aimed at in improving manufacturing performance and predictability. TPM methodologies in problem solving (Kobetsu Kaizen) and data analyzing (Loss Tree Pareto) have been used in this research. By applying TPM methodologies a problem can be solved by focusing on the root cause of the problem.

TPM identifies 16 big losses and minor stoppage is one of them affecting to the performance of equipment. There are three losses affecting to equipment effectiveness, those are 'Availability losses', 'Performance losses and 'Quality losses. Though availability losses are the major factor to reduce Overall Equipment Effectiveness (OEE), in this research it is identified that the performance losses are also equivalently significant. System Application Program (SAP) gives detail description only for the first major problem and it is a duty of employees to recover that problem; and it is also important of treating to the second major problem, since those two are equivalently major in severity. This research would address that issue. Further, the research concludes that the importance of paying attention on minor stoppages which may be the root cause of many of the equipment failures and the importance of using TPM methodologies in problem solving.

KEYWORDS: Minor Stoppages, Overall Equipment Effectiveness (OEE), Total Productive Maintenance (TPM), Productivity.

INTRODUCTION

The Beverages industry is involved in large scale production in low-cost strategy. It needs to use best practices aimed at supply chain process to develop the production processes.

Total Productive Maintenance (TPM) is a Japanese approach which guarantees dramatic results, visibly transforms the work--place and raises the level of knowledge and skill in production and maintenance workers. TPM is a strategic business initiative that aims at improving manufacturing performance and predictability, relying on teamwork to eliminate breakdowns, defects and other losses in the system. The goal of TPM is to zero breakdowns, zero abnormalities, zero quality defects, and zero accidents. On the other hand TPM continuously improve supply chain process, while minimizing cost.

The organization is facing a problem in continual improvement of productivity. Especially the problem is occurring to sustain Overall Equipment Effectiveness (OEE). Meeting efficiency targets and sustaining those are the problems for beverages industry.

There are three components to improve OEE; those are availability loss, performance loss and quality loss. Availability loss is the major issue therefore that should come up with solutions. As this

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research identified the performance loss also has the similar severity that is important to take actions to resolve the problem.

Research Objectives are;

- Minimizing Minor stoppages occurring at Filler in feed in the model line (Production line-2) by 80%.
- Eliminate minor stoppages which are causing for new problems if those are occurring continuously.
- To get the problem solved through TPM techniques by deeply analyzing problems and focusing on the root cause of the problem.
- To enhance employee participation as they are the one who works with the problems.

LITERATURE REVIEW

Minor Stoppages

TPM has eight pillars and the base is 5S. Focused improvement is one pillar.

"Focused improvement includes all activities that maximize the overall effectiveness of equipment, processes, and plants through uncompromising elimination of losses and improvement of performance" (Suzuki, 1994).

"Minor defects are the root cause of many equipment failures and must be completely eliminated from all equipment. Machines with minor defects will always find new ways to fail" (Leflar, 1999).

Minor stoppages are unplanned equipment stops less than ten minutes. Minor stoppages are difficult to eliminate because of less information having regarding those. Companies often find that many of the people working in the line just accept these minor stoppages as the normal way the line runs and so they go unidentified as issues. Another reason these downtime events are not identified as chronic is that while each shift sees some of these events, no one identifies that it is occurring many times in a 24 hour period (Maintenance Management Technology, 2009).

V-Profile

The design of a packaging line (machine speeds) usually revolves around V-curve. Bottle neck asset has the lowest speed which is usually situated at the middle of a packaging line; that is at the lowest point of the V shape. V-profile is to ensure that bottle neck asset is neither starved nor blocked due to any issues upstream and downstream. Therefore it is fed with material at a greater rate that it can cope with. Similarly downstream process is also capable of running at a greater rate hence bottles are pulled away faster that it is processed in order to prevent blockages. This increases the speeds both upstream and downstream of the bottleneck asset, which is usually the filler, because this is also the most expensive equipment item.

Moreover sufficient accumulation at in-feed and sufficient space at out-feed should be there to reduce dependability of machines on each other (Saker Solutions ltd., 2004).

RESEARCH PROBLEMS

In this organization there are three production lines and TPM was only applied in production line-2. Among three loss-components affecting to OEE, the most significant loss is 'availability loss' regarding production line-2 (please refer Figure 1). But management has identified about a reporting error. That is 'speed loss' which comes under 'performance loss' erroneously reported under availability loss. (Performance loss is occurred due to two types of losses: they are speed loss and minor stoppages.) Thus it decreases efficiency of availability loss and increases performance loss. Following graph describes the OEE on July which has drawn prior to correct the reporting error.

This loss data (Figure 1) got prior to correcting the reporting error. After correcting the reporting error, OEE effecting components' efficiencies were measured and given in Figure 2.

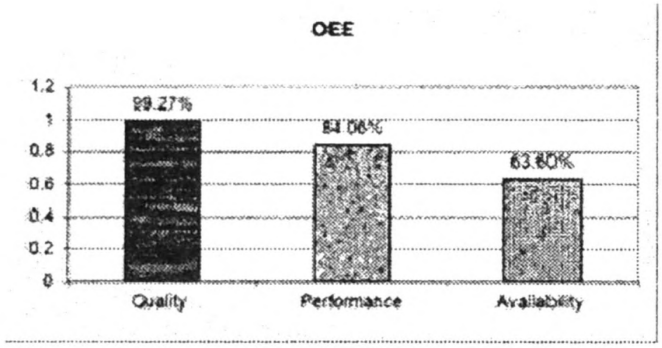

Figure 1: Loss Data on OEE – July 2010

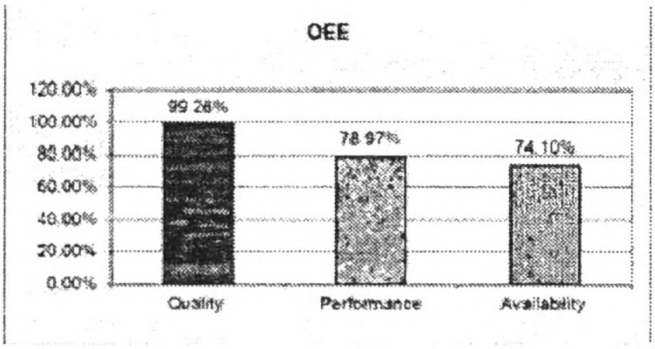

Figure 2: Loss Data on OEE – August 2010 (Reporting error was removed)

It is clear that after the correction of reporting error, the two losses, 'Availability' and 'Performance' are similar in severity. Still the major issue is availability loss. Since the organization focuses only on the major issue, research was focused on performance loss which had similar significance to availability loss.

METHODOLOGY

The Figure 3 shows the research methodology. Firstly the research topic was chosen according to management requirement. Then by referring secondary data and going through literature review, the background of the study was recognized. Then TPM methodologies were chosen to tackle the problem. To analyze the referring losses the Loss Tree Pareto method was used and by correcting the reporting error Minor stoppages loss was chosen to increase the efficiency. Short stop analysis method was identified as the most appropriate method for this study and the study was conducted to select one machine for further studies. Then in identifying root causes of the machine's minor stoppages it is used Kobetsu kaizen 12 step problem solving methodologies. The 12 steps are as follows.

Step1: Planning, Step 2: Collecting data, Step 3: Understanding the problem, Step 4: setting targets and KPIs, Step 5: Fishbone, Step 6: Verifying causes, Step 7: why why analysis, Step 8: solutions, Step 9: Implement, Step 10: Tentative standards, Step 11: Check results, Step 12: Horizontal roll-out

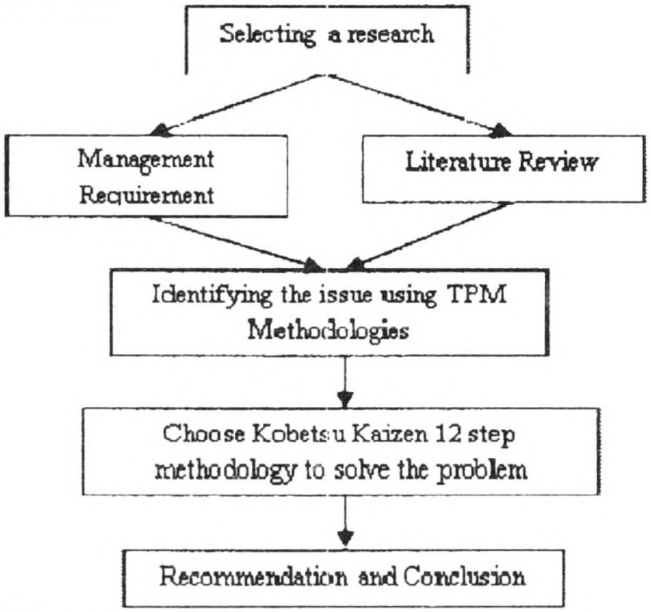

Figure 3: Research Methodology

DATA COLLECTION AND ANALYSIS

In research problem section, a data analysis has been done and, 'minor stoppages loss' has been taken into consideration for further studies.

Production line-2 was selected for the study and there are eleven machines and it was interested in choosing one machine which was causing from this issue at most. For that short stop analysis was done. That is in every machine minor stoppages (less than 10 minutes) were being taken down (the duration and the reason for the stoppage), throughout predefined period (usually1 ½ hours).

There were many reasons causing minor stoppages. The way was to choose the major cause was getting number of stoppages, and

out of all, calculate how many stoppages had been placed regarding one reason.

Every machine in the production line is not used in producing every package. Only six machines out of eleven are contributing in beverages production for every package. The summary of the comparison of short stop analysis between packages has been given in the following table.

Table 1: Comparison of Short Stop Summary between Packages

Machine	200ml	500ml	1000ml
De-palletizer	Conveyor over loaded (d)	Conveyor over loaded (d)	Conveyor over loaded (d)
Un-caser	Full bottle out feed (d)	Full bottle out feed (d)	Full bottle out feed (d)
Washer	Full bottle out feed (d)	Full bottle out feed (d)	Low water pressure (i)
Filler	Lack of bottles at in feed (u)	Lack of bottles at in feed (u)	Lack of bottles at in feed (u)
Caser	Lack of bottle in feed (u)	Error in bottle releasing (i)	Error in bottle releasing/feeding cases (i)
palletizer	Lack of cases in feed (u)	Turning cases (i)	Lack of cases at in feed (u)

By referring Table 1, it is clear that there are only three machines giving same major reason for minor stoppages in those machineries.

By going through the data it can be recognized that the filler machine is the critical one which is violating the V-profile principle. Hence it is interesting to have a further study of recognizing root causes of 'why the materials are blocked at filler in-feed'.

RESULTS AND DISCUSSION

The study of giving solutions to blockages at Filler in-feed follows Kobetsu Kaizen 12 step methodology of problem solving.

The important parts of this methodology were arranging Fishbone by conducting brainstorming sessions and after verifying those for every accepted causes preparing root cause analysis (why why analysis). Finally after the 'why why analysis' the solutions arise.

The solutions are;

- Apply Single Minute Exchange of Dies (SMED) techniques and procedures to improve change over process and use of checklists
- Fix an indicator light to get the attention of operator regarding single line blockages
- Pulp dozer gear box movement
- Longer the space in between filler and pulp dozer
- Standardize guides
- Invite professional o reset single line
- Layout modification

These are technically, operationally and culturally feasible. The order of the solutions has been arranged by considering economic feasibility.

The best feasible solution is 'Applying SMED techniques and procedures to improve changeover process and use of checklists'; since it is technically, economically, and operationally feasible.

As SMED training was given, from the company side it is economically feasible. From the employees' side it is technically feasible. Within the company it practices TPM and SMED is also a technology coming through TPM. This also allowed operationally feasible condition. By considering these every factor the above mentioned solution is the best feasible solution.

TPM methodologies address an issue in a very specific and indigenous way. By following these methodologies every point can be reached easily by paying less effort.

Though many companies do not pay much attention on minimizing minor stoppages, it is really important because by continuing those it may cause in creating new ways to fail.

CONCLUSION

As most of the bottling companies are falling in these kinds of minor stoppages problems, and because of the severity of this problem, solving this problem may give effective results. Though this is only one problem occurs at the production line 80/20 rule (Pareto principle) will works on this regard.

To protect the v-profile at the production line, choosing Filler machine will help in affecting OEE at a greater rate as the filler machine is the bottleneck machine in a bottling line.

Ideas got through brainstorming sessions are highly valued as the employees are the one who worked with those obstacles.

By applying the solutions it could reach the primary objective to reduce short stops by 80% at filler, in-feed in "production line-2".

By applying TPM methodologies on problem solving, would evolve in analyzing a problem successfully and may give realistic and worthy solutions. Though this situation may not arise in another place to apply these solutions as it is, by following the methodology it may give good outcomes, and it may much more applicable because of specified method has been followed.

By minimizing or eliminating minor stoppages, it may uncover the real situation and it may help in reducing other problems which caused by minor stoppages.

Following these processes need to have employee participation, thus the employees get knowledgeable about the work they are doing at. It encourages employee's suggestions and employees get skilled workers. It influenced in enhancing motivation towards work they are responsible for.

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