Chapter 2 Detection of minor stoppages in the packaging area of a brewing company in the town of Tecate B.C.

Capítulo 2 Detección de paros menores en el área de envasado, de una empresa cervecera de la localidad de Tecate B.C.

GARAMBULLO, Adriana, ACOSTA-MARTÍNEZ, Alejandro, PLAZOLA-RIVERA, Teresa and APODACA-DEL ANGEL, Lourdes

Faculty of Engineering, Administrative and Social Sciences, Autonomous University of Baja California, Mexico

ID 1st Author: *Adriana, Garambullo* / **ORC ID:** 0000-0002-1440-2276, **CVU CONACYT ID**: 397642

ID 1st Coauthor: *Alejandro, Acosta-Martínez* / **ORC ID**: 0000-0001-5440-034X

ID 2nd Coauthor: *Teresa de Jesús, Plazola-Rivera* / **ORC ID**: 0000-0002-5266-7021, **CVU CONACYT ID**: 277923

ID 3rd Coauthor: *Lourdes Evelyn, Apodaca-Del Angel* / **ORC ID**: 0000-0001-9349-7754, **CVU CONACYT ID**: 215689

DOI: 10.35429/H.2022.8.14.25

Abstract

The present research consisted of analyzing the packaging area of a brewery company in the town of Tecate BC, in order to detect the root cause of the minor stoppages that occur more frequently in the sub-areas where glass bottles pass through, and thus generate a corrective measure at the specific point where the process stops, since this has a direct impact on the useful time of annual beer production in this presentation. This project consisted of developing a series of activities that allowed planning how to attack the previously explained problem. With the help of the Deming Cycle methodology, Kaizen and quality tools such as Pareto Diagrams, Check Sheets and Standard Operation Sheets, to provide an optimal solution to this problem. The results show that with the tools provided, 91% of the 285.15 minutes that to date are accumulated by minor stoppages were eradicated and notably decreased, this is equivalent to an economic saving of $ 76,990.50 pesos m.n., taking into account that currently each minute of production is valued at $ 270 pesos m.n.

Minor stoppages, Enterprise, Production engineering

Resumen

La presente investigación consistió en analizar el área de envasado de una empresa Cervecera de la localidad de Tecate B.C., con el fin de detectar la causa raíz de los paros menores que se presentan con mayor frecuencia en las sub-áreas por la que la botella de vidrio pasa, y así generar una medida correctiva en el punto específico en donde se detiene el proceso, ya que esto repercute de manera directa en el tiempo útil de producción anual de cerveza en esta presentación. Esta investigación consistió en elaborar una serie de actividades que permitieron planear como atacar la problemática previamente explicada. Con ayuda de la metodología de Ciclo de Deming, Kaizen y herramientas de calidad como los Diagramas de Pareto, Hojas de Verificación y Hojas Estándares de Operación, para dar solución óptima a dicha problemática. Los resultados demuestran que con las herramientas aportadas se erradico y disminuyó notablemente un 91% de los 285.15 minutos que a la fecha están acumulados por los paros menores, esto equivale a el ahorro económico de $76,990.50 pesos m.n. tomando en cuenta que actualmente cada minuto de producción está valorado en $270 pesos m.n.

Paros menores, Empresa, Ingeniería de la producción

1. Introduction

Maintenance and having the least amount of losses possible is a challenge that is worked on every day, it is one of the fundamental axes within the industry, it is quantified in the quantity and quality of production. It is an investment that helps improve and maintain quality in production.

This document gave way to the implementation of a project aimed at detecting, eliminating and reducing situations that are the cause of minor stoppages on the L-030 line (responsible for receiving the 355 ml glass bottles, filling them, placing their respective label and pack them according to the presentation with which you are working) which have a duration between 1 and 5 minutes in which production is interrupted to be attended and thus continue with production.

Within the brewing company, there are different production processes, there are lines that are aimed at brewing, others are responsible for packaging the product in its different presentations, either in aluminum cans or glass bottles. Line L003, also known as line number 30, is responsible for supplying the product in 355 ml glass bottles. For the company, this specific line has presented contingencies during the year, derived from failures in the machinery due to wear in its components, such as belts, gears, etc. As well as the so-called "minor stoppages", which occur when the equipment stops for a reason beyond its function, either due to broken bottles, stuck or non-compliance with the maintenance orders that the entity provides to the operators. These stoppages are called minor since they stop production for minutes, until the problem is fixed, for example, in the event that a bottle falls and jams more bottles, the stoppage will last until an operator correctly positions the cause of the problem. unemployment. Despite not having long durability, they occur frequently in the process, which should not happen, since it reduces the operational time of the line and, consequently, less final product is obtained.

Throughout the production day there are various minor stoppages on the line, which last between 1 and 5 minutes in which production is interrupted at one of the following points on the line: depalletizer, bottle transport, rinser, filler, pasteurizer, labeler, packer or palletizer.

This section 1 presents the scope of this research, which consisted of developing a series of activities that allowed planning how to attack the problem previously explained. Firstly, it was necessary to know the area where the work was carried out, in order to become familiar with the process, and at the same time to be able to observe what are the causes that cause minor stoppages or their origin.

For this, a series of theoretical foundations are presented in section 2, which provide the basis for the development of said project, in section 3 the activities developed to reach the established objectives are presented step by step, this through of Deming's methodology. In section 4 an analysis is presented indicating the results obtained, in section 5 the discussion is presented and finally, in section 6 the conclusions and future lines of research.

2. Theoretical foundations

To carry out this research, the methodology of the Deming Cycle or PDCA Cycle (Plan, Do, Check, Act) was selected, a methodology commonly used by the company for a long time. With this methodology, it was intended to identify areas of opportunity that the entity had, analyzing data provided by the company, about minor stoppages presented at the beginning of 2018, to date, allowing team members to become familiar with the causes of the strikes, and their sources of origin. In turn, the Kaizen philosophy was implemented to improve aspects of production, such as eliminating downtime.

Deming Cycle Methodology

It was created by W. Edwards Deming in the 1950s as an easy to follow cycle of problem solving. Deming was tasked with helping Japan rebuild its economy in the 1950s. His purpose was to use PDCA with a continuous improvement process to help rebuild Japanese industries so they can compete in the world market in the future. (EcuRed, sf).

E. Deming establishes that the PDCA cycle of continuous improvement is made up of four cyclical stages so that once the final stage is finished, one must return to the first and repeat the cycle again. In this way, the activities are periodically reassessed to incorporate new improvements (Bernal, 2013), states that some of the benefits provided by an adequate improvement of processes are the following:

- Times: times are reduced, increasing productivity.
- Quality: errors are reduced, helping to prevent them.
- Cost: resources are reduced, such as materials, people, money, labor, etc., increasing efficiency.

In order to obtain previous results in process improvement, the 4 stages of the Deming Cycle must be developed, which are the following:

Plan (Plan). Management, based on the measurements, data and information it possesses, plans the changes. Broadly speaking, in the PDCA cycle of continuous improvement, this planning consists of determining what is to be achieved and defining the methods and forms of action that will be applied to obtain the desired results. This is what is called Focus. At the same time, the approach must be related to the strategy of the organization and be grounded; with well-defined processes (Alteco Consultores, 2020).

Do (Do). The time has come to carry out the action plan, through the correct performance of the planned tasks, the controlled application of the plan and the verification and obtaining of the necessary feedback for the subsequent analysis. On many occasions it is advisable to carry out a pilot test to test the operation before making large-scale changes. The selection of the pilot must be made taking into account that it is sufficiently representative, but without assuming an excessive risk for the organization. (Bernal, 2013)

Verify (Check). The results are systematically evaluated and analyzed, identifying and developing improvements. The effectiveness of the deployment of the approach is measured by well-defined indicators. This phase must involve learning to identify best practices and detect opportunities for improvement (Alteco Consultores, 2020).

Act (Act). Finally, after comparing the result obtained with the initially set objective, it is time to carry out corrective and preventive actions that allow improving the points or areas for improvement, as well as extending and taking advantage of the learning and experiences acquired to other cases, and standardizing and consolidate effective methodologies. In the event that a pilot test has been carried out, if the results are satisfactory, the improvement will be definitively implemented, and if they are not, it will be necessary to decide whether to make changes to adjust the results without discarding it. Once the act step is finished, the first step must be returned periodically to study new improvements to be implemented.

In conclusion, a quality management system allows an organization to develop policies, establish objectives and processes, and take the necessary actions to improve its performance. In this context, it is very useful to use the PDCA methodology promoted by Deming, as a way of seeing things that can help the company to discover itself and guide changes that make it more efficient and competitive (Alteco Consultants, 2020).

Kaizen

Kaizen is a Japanese term that many authors have translated as continuous improvement; This word comes from a combination of two Japanese words: Kai (change) and Zen (improvement). The main idea is to solve problems through corrective measures with a view to improving the production system. This kaizen philosophy is based on eliminating waste or factors that cause production delays. To achieve the objective of this methodology, there is a need to change the attitude of people in the company. It is about encouraging this change of attitude towards improvement, using the skills of all staff with the constant aim of leading the company to success. Kaizen is divided into three main sections:

- The elimination of everything that is unnecessary, causes waste or is simply expendable.
- The correct maintenance of facilities, equipment, vehicles, etc., where preventive activities and cleanliness and order are especially relevant.
- The standardization of work processes.

On the other hand, Kaizen promotes Maintenance 5 where analysis is required to separate and place the most important equipment so that they are accessible and maintain cleanliness both in the facilities and in the environment. workplace, review and standardize common practices and standardize all of the above so that work guidelines are standardized so that they are continuous and can continue to improve (Tague, 2005).

Minor strikes

Also considered "quick fix chess", it is one of the Six Big Losses; They are frequent events that interrupt the production process without major mechanical failures, and they have a short duration (1-5 minutes) during which they must be detected, analyzed and corrected so that the production line can continue.

On a large scale and high production, they have a great impact both economically and through the accumulation of lost production time, since the line must be completely stopped to solve any of these problems.

Pareto chart

A Pareto chart is a bar chart, where the lengths of the bars represent frequency or cost (time or money), arranged with the longest bars on the left and the shortest bars on the right. In this way, the graph visually shows the most important situations (Tague, 2005). So, this chart is defined as a visual representation of issues in a higher priority process and when they are resolved or eliminated, TQM compliance is promoted.

The advantage of developing this type of scheme is that it is possible to identify the most common defects, the most common causes of defects and thus create priorities according to what the unit would like to achieve. To set up this graph, you need a data series that reflects major failures or unexpected events, to analyze how often they occur. The source of information can be historical data or obtained by sampling.

In Pareto analysis, interested and measured items are identified on the same scale, and then address themselves in descending order, as a cumulative distribution. In general, 20% of the factors are evaluated by 80% or more general processes; Therefore, this technique is often referred to as 80-20 rules (Niebel and Freivals, 2009).

Advantages, according to García, Rojas and Torrealba (2008):

- Simplicity: No complex calculations or sophisticated graphing techniques are required.
- Prioritization: The elements that have the most weight or importance within a group are identified.
- Visual impact: The Pareto Chart communicates clearly, evidently and at a glance, the result of the comparison and prioritization analysis.
- Unification of Criteria: Focuses and directs the efforts of the components of the work group towards a common priority objective.
- Objective character: The decisions to be made are based on data and objective facts and not on subjective ideas.

While Coronado (2007) mentions the following disadvantages:

- It is recommended to use when the data can be classified into categories.
- It is recommended to use when the range of each category is important.
- Provides a simple and quick overview of the relative importance of issues.
- Determine what is the main effect of a problem and not the main cause that causes it.

Production

It is called the relationship between the output obtained by a system that produces a good or service and the resources used to obtain it. Labor productivity, that is, annual production, is generally measured, thus determining the amount of a good or service that each machine is capable of producing in a given period. Productivity refers to the best or worst use of an economy's factors of production, which theoretically reflects the ability of that economy to compete effectively in markets. Therefore, it evaluates the quantity of a good a company produces based on the number of people employed in it and the time, materials, and resources needed to produce that product. Therefore, to measure your productivity,

Productivity depends on a multitude of factors: the availability of the natural resources necessary to manufacture the product, the level of training of the workers, the capacity of the machinery and the technology that helps speed up the production process, labor regulation, internal rules of the company, the national situation of that specific industry, etc. (Tague, 2005). Or as indicated Riggs (2015) production is the intentional act of producing something useful.

Productivity

In general, productivity is understood as the relationship between what is produced and the means used; therefore, it is measured by the ratio: results achieved divided by resources used. The results achieved can be measured in units produced, parts sold, customers served or in profits. While the resources used are quantified by the number of workers, total time spent, machine-hours, costs, etc. So improving productivity means optimizing the use of resources and maximizing results (Gutierrez & Vara, 2013).

Riggs (2015) determines productivity is the quality that indicates the work, materials, materials and energy used. This is how certain resources are achieved to achieve the appropriate objectives that are explained by quantity and quality.

Process

An industrial process or manufacturing process is the set of mutually related or interacting activities, which transform input elements into results. The process consists of several steps or sub-processes, while the input or output consists of materials, materials, products or equipment. The result or output can be the product itself or a modification of the input, which in turn will be the input of another process (Gutierrez, 2013).

According to D'Alessio (2004) to obtain a specific product, a set of operations will be required to transform the elements. It includes factories (machines and materials) and labor (manpower), that is, technology, production assets, indirect materials, and knowledge.

Management

Huergo defines management as the method to achieve the interconnection of points of view, through the ways in which the organization serves and aligns with the goals and objectives of the organization. While Jones and George (2014) define management as the method to achieve the interconnection of points of view, through the ways in which the organization serves and aligns with the goals and objectives of the organization. Huergo points out that management must adapt to corporate goals and objectives, while Jones and George explain the effects of managerial performance, ranging from planning to talent control.

Business management, also known as business management techniques, differs from business management by combining strategic management with the application of technology and innovation. It is the strategic, managerial and controllable process of managing the resources of a company to increase its productivity, competitiveness, effectiveness and efficiency.

Business management guarantees that supply meets demand through "creative destruction", that is, with constant innovation to increase productivity and competitiveness (Business Management, 2019).

Corrective action

According to Nuns (2015) corrective action is an action or action taken to eliminate the causes of a detected non-conformity, a defect or an undesirable situation to avoid its repetition, as stipulated in this ISO (International Organization for Standardization) standard. The treatment of a corrective action, according to the international standard ISO 9001:2008, is due to an investigation that the company must develop to identify the root cause that generates the non-conformity, and once the corrective action has been implemented, make sure that it does not occur. its recurrence. That is to say, once the investigation has been carried out, and the remedy established, the problem should not recur.

This treatment is a deductive method for the analysis and solution of problems in organizations. As if it were the work of the legendary detective Sherlock Holmes, the methodology for corrective action must be handled through a skill-based approach to be able to think logically about the cause-effect relationship and be able to take concrete actions based on this analysis (Revelle, 2004).

3. Methodology

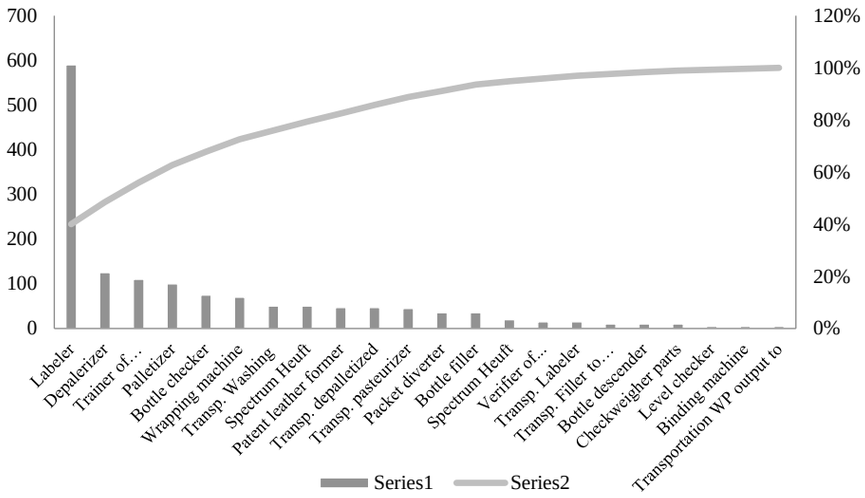
To carry out this research, the Deming Cycle was taken as a basis, which is explained in detail in section 2 of this chapter. The way in which each of its stages was developed is shown below:

To plan

Firstly, the information on the minor stoppages that occur in the different areas of line 30 was analyzed. This information is a log of failures registered by the operators since the beginning of the current annual period, where Registered information about the causes that cause minor stoppages in their respective areas, their origin, their frequency and the time they consume of the annually assigned available production period.

To perform a better analysis of the information, dynamic tables were used that allowed stratifying the strikes in their different areas where they occur. Once this was done, a Pareto diagram was drawn up (See graph 1), based on the information summarized in the tables.

Graph 1 Pareto diagrams showing the area with the most problem of minor strikes



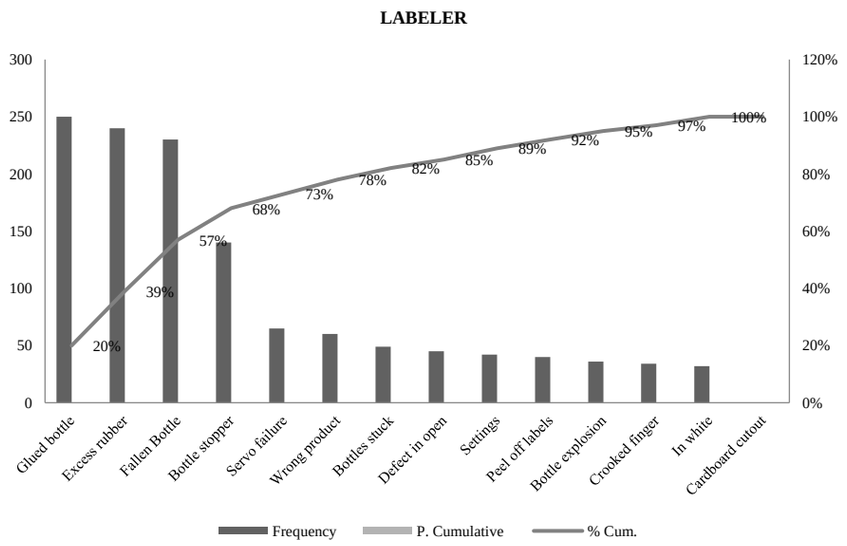
Source: Self Made

To make these graphs, the data were arranged from highest to lowest, then the relative frequencies were calculated (sum of times of the specific stoppage divided by the total time in which the area was stopped) and the absolute frequency (sum of relative frequencies) and with this, the main areas in which strikes occurred more frequently were determined. These areas were the labeling machine in charge of putting the labels on both the body and the neck of the bottle. This area was selected by the maintenance manager, who was interested in solving this problem of minor stoppages. Once the area where the improvement project would be implemented was detected, a face-to-face sampling was carried out, which focused on analyzing each of the areas to verify the veracity of the log data, and in turn , detect the presence of minor stoppages, and the exact place where they occurred, since the areas are made up of different sub-elements and processes where these contingencies can occur.

Do

Based on the data obtained, the next step was to make a series of Pareto diagrams showing the most frequent causes of each area. For these first, the failure modes were stratified with the areas in which they occurred, using the information from the period logs provided by the entity, see graph 2.

Graph 2 Pareto diagrams showing the most frequent causes of each area



Source: Self Made

The next step was to focus on the area where the improvement was applied, in order to filter only the causes of minor stoppages that were relevant to the project. Based on the descriptions that the operators write in the logs, categories were created that reflected the highest priority sub-areas and the most frequently occurring failure modes.

Once the causes that gave rise to most of the consequences were detected, the phase of recognition of faults and their detection was given. For this, samplings were carried out on different days and production days (See Table 1), with the purpose of understanding the origin and repetitiveness of the causes of minor stoppages. Being present in the area from the 12th of February, until the 27th of the same month.

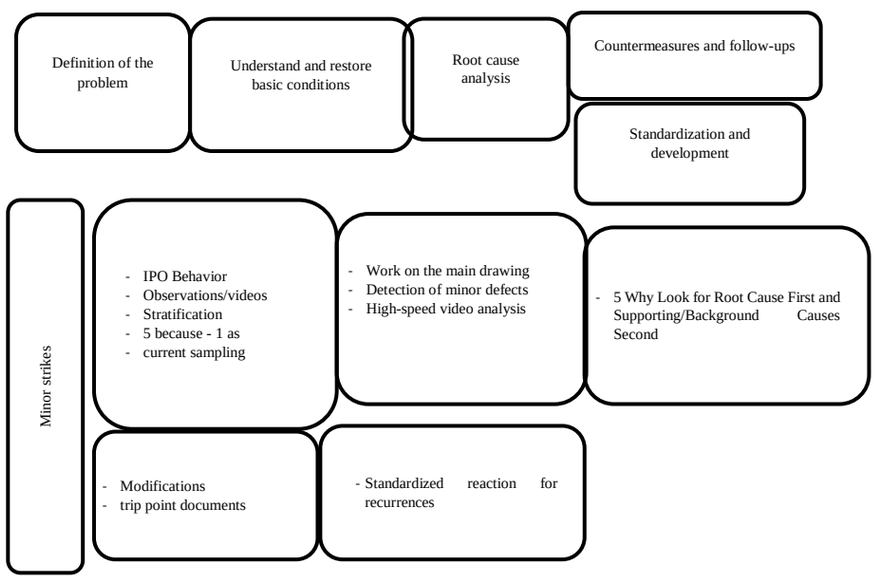
Table 1 Sampling Table

Registration Log Minor strikes					
Date	**Hour**	**Presentation**	**Type of unemployment**	**stop time**	**Stop Reason**
02/18 2019	4:10	indian exp	bottle stuck	2 minutes	excess rubber
02/18 2019	5:35	indian exp	Rubber	5 minutes	lack of rubber
02/18 2019	5:50	indian exp	misplaced label	5 minutes	Flow rate
02/20 2019	3:10	xx born	misplaced label	6 minutes	Flow rate
02/20 2019	3:23	xx born	misplaced label	4 minutes	Flow rate
02/25 2019	5:40	national indian	Rubber	6 minutes	lack of rubber

Source: Self Made

For the company there are 3 different causes for which the machinery loses useful production time, which are: breakdowns of the machinery, minor stoppages and loss of speed in the equipment. Said causes were previously divided by the entity with the purpose of stratifying the information. As explained above, for the purposes of this investigation, the focus was the resolution of the causes of minor stoppages. For the assembly of the action plan, 5 key stages were established that allowed the development of the project (See Figure 1).

Figure 1 Stages of the Action Plan against Minor Strikes



Source: Brewing Company

Definition of the problem

For this stage, the levels of the OPI (Overall Performance Indicator) indicator were verified, a sample was made which was prepared while in the areas of opportunity, once there, an observation of the line was made for two hours and a half. In the event that a minor stoppage occurred, its duration was timed, and its final duration was recorded in the sampling table that was prepared; The cause that caused the line to stop was also noted, either because of the bottle or a fault in the machinery.

In addition, an analysis was made with a video at low and high speed, and it allowed to observe the behavior of the line when there were no operators present. This analysis consisted of playing the video, observing the behavior of the bottles and detecting possible causes why they could fall or get stuck and stop the process.

Recognition and Restoration of basic conditions.

This phase consisted of carrying out a field reconnaissance, which was carried out by being present in the assigned line for 2 weeks in order to become familiar with it, as well as its areas, sub-areas and physically observe the causes of minor stoppages. and perform a recognition of the current state of the process and its behavior. While each area was analyzed, the registration log was filled.

Root Cause Analysis.

Once the line was sampled, it was observed that the most recurrent cause of minor stoppages was a stuck bottle and excess rubber due to the lack of inadequate maintenance provided to the parties involved in putting on both the rubber and the label. These parts are called Gum Pump and Gum Rollers.

Countermeasures and Follow-ups.

Upon determining the root cause, countermeasures were applied. Both the rubber pump and the gumming rollers were disassembled to give it a very complete maintenance, since previously it was only provided superficially (See Figure 2).

Figure 2 Rubber Pump and Gluing Rollers

Source: Brewing Company

For this, support was obtained from the maintenance team, since it was necessary to verify and perform a correct uninstall without affecting the components that were around it. In order for said rubber pump to have good maintenance, a series of steps were carried out, which in summary consisted of rinsing, lubricating and cleaning the entire pump, in addition to cleaning each of its hoses. In turn, the gluing rollers were provided with extremely optimal lubrication and cleaning maintenance which helped their operations to be in the highest conditions.

Verify

In order to create a standard that would allow the comparison between the current method and the proposed one, one of the process control tools was developed: the verification sheet (See Figure 3).

Figure 3 Check sheet

MINOR STOPS VERIFICATION SHEET				KEY CODE		
				REVIEW DATE		3/15/2019
				No. REVISION		1
ÁREA		ACTIVIDAD				RESPONSABLE DE
Line 03 Labeler		Verification of minor stoppages				OP. LABELER FRONT AND OP. LABELER
Presentation	TIME	MATERIAL AND/OR TOOL REQUIRED	STANDARD / POINTS TO CHECK			PPE NECESSARY
XX max	N/A	Verification Sheet	1.-During the standard product run, verify Minor Stoppages.			
SCHEDULE	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Total	OBSERVATIONS
7: 00 - 8:00							
8: 00 - 9:00							
9: 00 - 10:00							
10: 00 - 11:00							
11: 00 - 12:00							
12: 00 - 13:00							
13: 00 - 14:00							
14: 00 - 15:00							
15: 00 - 16:00							
16: 00 - 17:00							
17: 00 - 18:00							
18: 00 - 19:00							
19: 00 - 20:00							
20: 00 - 21:00							
21: 00 - 22:00							
22: 00 - 23:00							
23: 00 - 24:00							

Source: Self Made

Said verification sheet allowed an auditor or operator assigned by the company to carry out a real-time sampling of the number of minor stoppages that were recorded in different periods of the day, this with the purpose of observing if the number of stoppages was reduced. minor in the areas where the improvement plans were implemented, since the objective was to create corrective measures for these contingencies. In turn, the verification sheet allows greater control over the information on the number of stoppages, as well as the times in which they commonly occur.

Act

In order to carry out corrective and preventive actions to improve the conflict areas, the pertinent Kaizen's were carried out, which in this company consist of minor stoppage analysis sheets with a format already standardized by them, these sheets allow describing and reporting in a detailed way the failure mode, in addition to the countermeasures that will be taken for its corrective action. For the failure mode that consisted of fallen bottles, it was detailed in the minor stoppage analysis sheets that the improvements of critical conditions was to implement a maintenance plan, since for the correction, prevention and normalization of this situation they did not have an order. standardized on your system. This plan was carried out with a format already pre-established by the unit, which helped to better adapt and structure the steps to follow for the maintenance of the conveyor guides, as well as explaining how to use the bottle simulator mold.

4. Results

The objective of this research was to implement improvements in the areas of the 030 line where there will be a greater number of minor stoppages, and thus achieve optimal use of the machinery in terms of productivity and available useful time. The result obtained was the creation of maintenance standards and give structure to the development of the Deming cycle methodology and continuous improvement. During the stay within the company, work was done on the design and application of said methodology in the analysis sheets of minor work stoppages.

When implementing the methodology, information bases were created, such as dynamic tables and Pareto diagrams, which allow operators to identify the highest priority areas of opportunity that have not yet been addressed, since the line has various sub-areas and in all there are minor strikes that must be reduced or eradicated.

Once the maintenance plans were created, the results were shared with the operators, since they are involved with production on a daily basis, and must be informed of the new standards that were created, in order to train them in behaviors that promote autonomous analysis, since that the company wants every operator to be able to contribute ideas that are consistent with the mission and vision of the company.

With the help of the maintenance plans and the tools provided, 91% of the 285.15 minutes accumulated to date due to minor stoppages in the labeling machine were eradicated and significantly reduced, this is equivalent to an economic saving of $76,990.50 pesos mn taking into account that currently each minute of production is valued at $270 pesos mn.

5. Discussion

It is of the utmost importance that the company continues with all the stages of this investigation, since by implementing this methodology it will be possible to meet all the objectives and benefits.

Being part of the development and implementation of this type of project is transcendental, since it allows the company to continue growing and better integrate all members. Making all members part of this methodology allows improvements to be created within the processes and in turn generates trust among them, since by being trained they acquire security for the execution of their activities. Having mentioned the above, it is recommended to monitor the project and maintain communication with the workers.

6. Conclusions

Implementing a project of minor stoppages allows detecting and eliminating situations that are causing the line to stop for very short periods of time, but must be attended to quickly, even so, unplanned production time is consumed, generating losses both economic and production. These stoppages are caused by the lack of maintenance provided to the production line. For this reason, the adaptation of methodologies such as the Deming circle is of the utmost importance, in order to create an efficient countermeasure against these problems.

Future lines of research

According to the results obtained in the Pareto Diagrams of both figure 1 and figure 2, there are several areas of opportunity, which turn out to be potentially very interesting to develop in complementary works and that should be analyzed, since their scope is beyond those planned in this project, for which it is recommended to continue with the research, analysis and development of items such as dropped bottles, or bottle jams, since they have a high rate of occurrence in the labeling machine, as shown in figure 2, for it to be more efficient, and in the same way to develop research is the rest of the areas as they aredepalletizer, box former and palletizer, since although they are not as critical as the labeller, they also present a significant number of minor stoppages, and if these can be reduced or eliminated, it would be of great importance for the company.

7. References

Alteco Consultores. (2020). El ciclo PDCA de Mejora Continua.. Recuperado de http:// https://www.aiteco.com/ciclo-pdca-de-mejora-continua/ https://doi.org/10.19083/tesis/625469

Bernal J. (2013). Ciclo PDCA (Planificar, Hacer, Verificar y Actuar): El círculo de Deming de mejora continua. Recuperado de. https://www.pdcahome.com/5202/ciclo-pdca/

Coronado, A. (2007). Control estadístico en el proceso de fabricación de equipos de refrigeración comercial. Universidad de San Carlos de Guatemala. Recuperado de: http://biblioteca.usac.edu.gt/tesis/08/08_1730_IN.pdf https://doi.org/10.56039/rgn06a05

D´Alessio Ipinza, F. A., & Benzaquen de las Casas, J. (2004). Administración y dirección de la producción: enfoque estratégico y de calidad. Estado de México: Pearson Educación.

EcuRed (s.f.). Ciclo de deming. Recuperado de: https://www.ecured.cu/Ciclo_de_deming

García, O., Rojas, D. y Torrealba, D. (2008). Análisis de Pareto. Universidad Nacional Experimental Politécnica "Antonio José de Sucre"

Gestión empresarial (2019). Recuperado de https://www.significados.com/gestion-empresarial

Gutierrez, H. & Vara, R. (2013). Control estadístico de la calidad y seis sigma (3a ed.). McGraw Hill Education.

Huergo, J. (s.f.). Los procesos de gestión. Recuperado de: http://servicios.abc.gov.ar/lainstitucion/univpedagogica/especializaciones/seminario/materialesparadescargar/seminario4/huergo3.pdf

Jones, G. y George, J. (2014). Administración contemporánea. Monterrey: McGraw Hill.

Niebel, B. y Freivals, A. (2009). Ingeniería industrial Métodos, estándares y diseño del trabajo (12a ed.). McGraw Hill

Nunes, P. (2015, 1 octubre). Acción Correctiva. Knoow. https://knoow.net/es/cieeconcom/gestion/accion-correctiva/

Riggs, J.(2015). Sistemas de producción: Planeación análisis y control (3.a ed.). LIMUSA.

Revelle J. (2004). Quality Essentials: A Reference Guide from A to Z. ASQ Quality Press.

Tague, N. (2005). The Quality Toolbox. Second Edition, ASQ Quality Press