PRODUCTIVITY ENHANCEMENT OF CLIPPING MACHINE

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Abstract - *Kokuyo Camlin is manufacturer and designer of writing and stationary products for customer application. Quality with quantity is a main characteristics that helps a company stay on competition. At Kokuyo Camlin plant in Vasai pencils are manufactured using machines which are partially automatic. The paper presents the modifications in process and machine to increase the productivity. Our work is totally dedicated to design, manufacturing and on machine testing. Paper covers design, manufacturing and installation of hopper and feeder bowl. Detail study is done at shop floor level to find out root cause of rejections using various quality tools. Along with improvement in quality and productivity, reduction in manpower is done.*

Key Words: **Productivity, Design, manufacturing.**

1.INTRODUCTION

In Kokuyo Camlin plant of Vasai, 0.5mm of mechanical pencils are produced. Major operations are done by using pneumatic actuator. But for placing and moving clips on barrels still done manually. Numbers of labour working on this machine at present are 4 in 2 shifts and they are paid ₹370/day. Clips are placed by 2 labours in liner and 1 labour is allotted for placing barrel in jigs and remaining 1 is used for removing all the rejection material. Further the clipping operation is done by pneumatic actuator in which clips are inserted in barrel.

Our main objective is to make this whole system automatic. So after doing survey for few days and by performing various analysis we concluded that we have to place a part feeder system for clips and storage cum placing system for barrels. From our industrial visits, we had seen that feeder bowl of various types can be used as part feeder system. Similarly for storage of barrels we concluded that conical hopper will serve our purpose. Thus we are designing a feeder bowl , hopper , pick and place and various liners for increasing the productivity of the machine.

Also we are doing WHY-WHY analysis, ROUTE CAUSE analysis, NET PRESENT VALUE analysis and SIMPLE PAY BACK PERIOD analysis. By doing this all analysis we are able to know the exact reasons for rejections, its root cause and financial analysis for the machine.

Hence by doing all this design changes we are able to remove labour cost and the rejection rates of the machine.

Richard Silversides et[1] investigated the vibratory bowl feeder for automatic assembly, presented a geometric model of the feeder, and developed force analysis, leading to dynamical modeling of the vibratory feeder. Based on the leaf-spring modeling of the three legs of the symmetrically arranged bowl of the feeder, and equating the vibratory feeder to a three-legged parallel mechanism, the paper reveals the geometric property of the feeder. The effects of the leaf-spring legs are transformed to forces and moments acting on the base and bowl of the feeder. Resultant forces are obtained based upon the coordinate transformation, and the moment analysis is produced based upon the orthogonality of the orientation matrix. This reveals the characteristics of the feeder, that the resultant force is along the z-axis and the resultant moment is about the z direction and further generates the closed-form motion equation. The analysis presents a dynamic model that integrates the angular displacement of the bowl with the displacement of the leaf-spring legs. Both Newtonian and Lagrangian approaches are used to verify the model, and an industrial case-based simulation is used to demonstrate the results.
Development of a model for part reorientation in vibratory bowl feeders with active air jet tooling done by *Nebojsa I. Jaksic and Gary P. Maul*[2] stated that Vibratory bowl feeders (VBFs) are widely used in industry for feeding and reorienting small parts in high volume production. Standard VBF tooling consists of various mechanical barriers inserted in the bowl path which are prone to jamming and limit the feeder to only one type of part. Programmable feeders have been developed to improve the exibility of these devices, however feed rates are often low. This research describes the development of a model of part behavior required for reorienting a part with an air-jet-based computer controlled orienting system. This system can be used to eliminate jamming and improve feed rates in VBFs. The control algorithm accepts the part's weight, geometry, and its orientation. Sensors then compare the present with the desired orientation and the algorithm determines the appropriate pulse of air to produce the desired orientation. Feeders are devices that orient parts for production operations. They can be divided into two major groups: vibratory and non-vibratory. A typical vibratory bowl feeder (VBF) is comprised of a shallow cylindrical bowl supported by several leaf springs attached to a cylindrical base containing an electromagnet. Inside the bowl is an inclined

helical track. The cycling of the electromagnet causes the bowl to vibrate and the parts to move along the track either by sliding or by hopping.

Development of a flexible and programmable parts feeding system *M.L. Tay, PatrickS.K. Chua, S.K. Sim and Y. Gao*[3] described the development of a flexible and programmable vibratory bowl feeding system which is suitable for use in a flexible manufacturing system. Controlled by computer and driven by electro-pneumatic cylinders and stepper motors, this feeding system is capable of identifying the orientations of non-rotational parts and actively re-orientating them into the desired orientation. Three different neural network modules (ARTMAP, ART2 and Back propagation)were tested for their suitability for the orientation recognition system. The system developed extends the capability of conventional bowl feeders to include feeding parts with only internal features, and feeding a family of similar parts without costly retooling. These features are well suited to applications in flexible manufacturing systems.

Andrea Edwards [4] described a genetic algorithm approach to the automated design of the vibratory bowl part feeders. This genetic algorithm approach runs on a parallel computer and gives near optimal designs in much less time than previous reported optimal, brute force search methods.

2. THEORETICAL EVALUATION

For theoretical evaluation work station was kept under observation for few shifts and data collection was done. With the help of data & observation why -why analysis was carried out. Also known as 5 whys. It is an iterative interrogative technique used to explore the cause and root relationships underlying a particular problem. The primary goal of the technique is to determine the root cause of a defect or problem by repeating the question "Why?" Each question forms the basis of the next question. The technique was formally developed by Sakichi Toyoda and was used within the Toyota Motor Corporation during the evolution of its manufacturing methodologies.

Table -1: Rejection data

DAYS	CYCLE TIME (SEC)	CYCLES	TIME DURATION (MINUTES)	MANUFACTURED	REJECTED PENCIL	REJECTION %
DAY 1	12.3	720	180	10080	250	2.48
DAY2	12.3	847	180	11858	723	6.09
DAY 3	12.3	891	180	12474	594	4.76
DAY 4	12.3	894	180	10728	15	0.14
DAY 5	12.3	895	180	10740	12	0.11
DAY 6	12.3	893	180	10716	18	0.16
DAY 7	12.3	896	180	10752	15	0.13

2.1 Why why analysis.

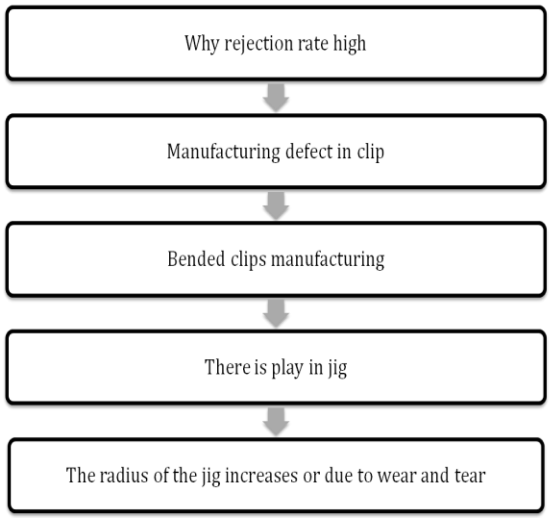

Figure 1 why why analysis

2.2 Root cause analysis.

Root cause analysis is a method of problem solving used for identifying the root causes of faults or problems. A factor is considered a root cause if removal thereof from the problems – faults- sequence prevents the final undesirable events from recurring whereas a casual factor is one that affects an event outcomes but is not a root cause. The primary aim of root cause analysis is to identify the factors that resulted in the nature, he magnitude, he location and the timing of harmful outcomes of one or more past events. To be effective root cause analysis must be performed systematically, usually as a part of investigation, with conclusion and root causes that are identified backed up by documented evidence.

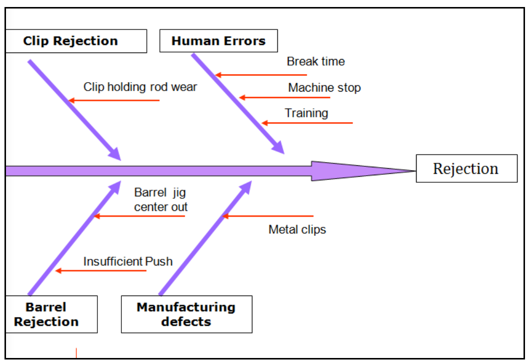

Figure 2 Fishbone diagram

3. DESIGN.

3.1 Hopper design calculation.

Area of hopper= $(250\times320)+\{(38\times135)-(2\times\frac{1}{2}\times38\times30)\}$

$= 80000+5130-1140$

$= 83990\ mm^2$

Area of barrel= $\prod\times r^2$

$= 56.74\ mm^2$

Number of barrels= Area of hopper/area of barrel

= 83990/56.74

= 1481

Time required=1481/60 =24.68 minutes.

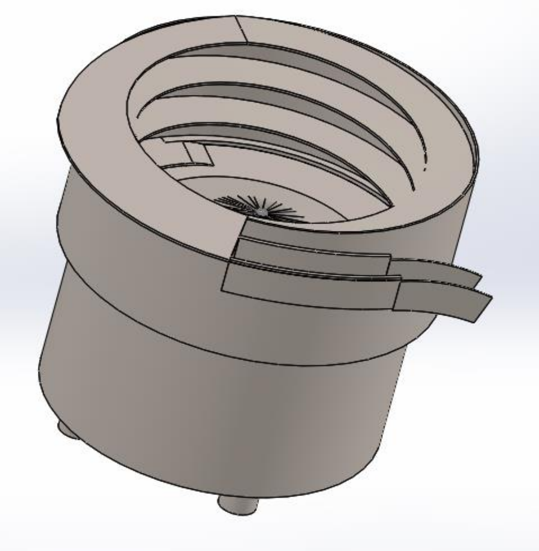

Figure 3 Feeder Bowl

In the bowl, Parts are in motion in translation and rotation, and may be in contact with the bowl feeder's wall, track, or with other parts in the feeder. This work considers the effects of only a single part traveling in the bowl feeder. It assumes that the part is small enough to be considered a point mass when compared to the bowl. This work also assumes that the part weighs significantly less than the bowl, and its weight does not affect the motion of the bowl. The part may be in contact with the track and undergoing static friction, in which case the part moves with the track. The part may be in contact with the track but moving relative to the track, undergoing kinetic friction. If the track has sufficient downward acceleration, the part will experience freefail during part of the drive cycle. A perfectly elastic collision is assumed to occur when the part impacts the bowl.

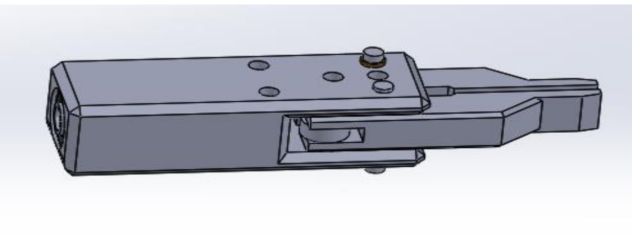

Figure 4 Finger

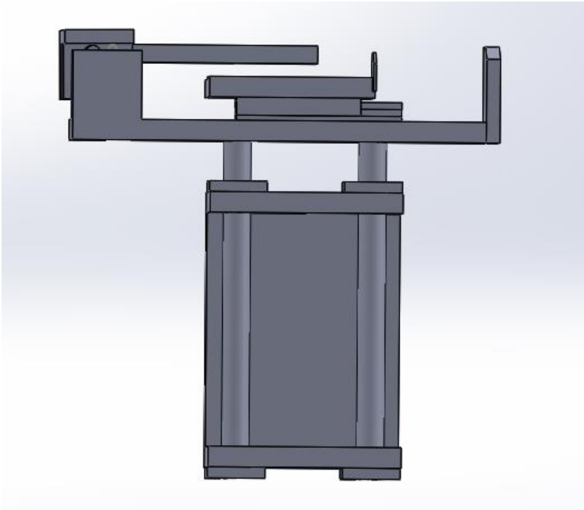

Figure 5 Pick & Place mechanism.

Figure 4 & 5 shows the model view of finger, Pick and place mechanism used in palacing the barrel. Earliear it was done maulally. The maual operation was replaced with pick aad place mechanism.

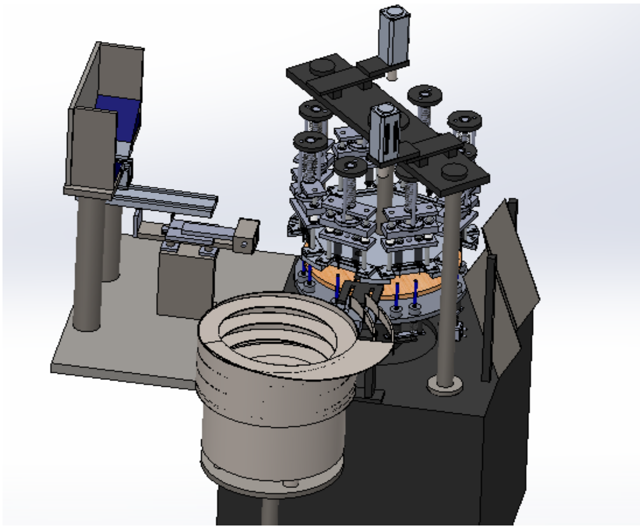

Figure 6 Workstation with feeder bowl ,pick & place mechanism

Figure 6 shows the assembly of workstation with pick and place mechanism along with feeder bowl.due to this whole modification maual operaion was completely eliminated. Due to which drastic drop in rejection was seen.

4.RESULTS.

4.1 NPV (Net Present Value)

It measures the financial planning of the project and provide, the company with all economical information needed to incorporate the project.

Cost Investment = Rs. 2 Lakh (capital + operational)

Pre-Assumed Savings

Labour cost = Rs. 370

Total manpower = 6 nos.

Days of work = 26 days

Time duration = 1yr

NPV = ∑ {Net Period Cash Flow/(1+R)^T} - Initial Investment

NPV={- 2 lakhs+(370*6*26*12)/(1+0.1)^1}

NPV= 4.3lacs

Hence the economical feasibility of the project is well defined by the Net Present Value Method.

4.2Feeder stand analysis

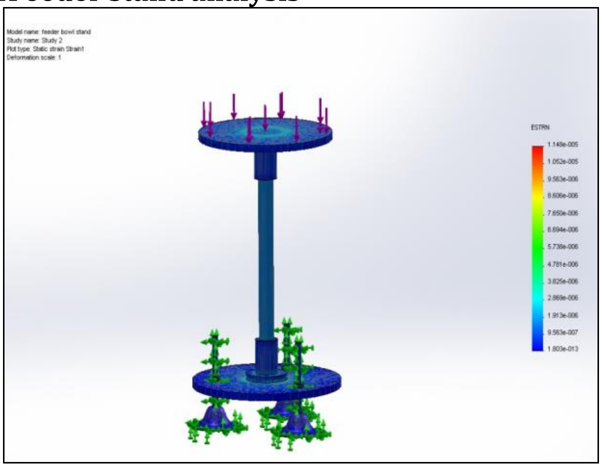

Figure 7 static strain analysis.

Figure 7 & 8 shows the static analysis done on ansys workbench. Design was found to be safe and within the desired limit.

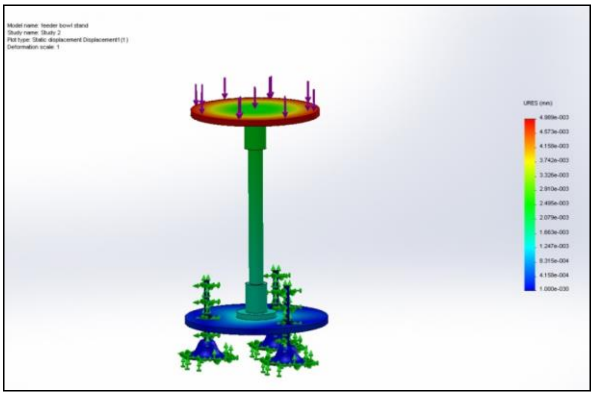

Figure 8 static displacement analysis.

3. CONCLUSIONS

From rejection, why why and route cause analysis we got the reasons and remedies for reduction in rejection rates. through net present value analysis with investments of 2 lacs we are able to get a profit of 230% .through simple payback period analysis, we would be able to recover the investment in 4 months. form model designing we are able to place hopper and vibratory feeder bowl without disturbing the original setup. through load analysis on simulation software we are able to analyse the bending , stress strain variation on the structure. in gripper machine we have doubled its production from 2200 pieces per hour to 4400 pieces per hour.

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