

Improvement of Overall Equipment Effectiveness of Valve Stem Seal Finishing Machine

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Abstract - Most over the top of present day creation lines is central as it sees an improved age and utilization of open assets. Parts adding to age line amplexness are work use and machine limit. There are different structures where we can apply computerization for better and precise outcomes. Computerization is no delicacy the best perspective enemy cost cutting by end squander as scrap, lessening work, decreasing time, controlling quality and improving everything examined execution of any, machine, structure or system in any industry. The association should have the choice to channel for fitting age information and to altogether expel up these information to see the different needs at creation level and to rapidly see how to improve advantage. A careful and online information the authorities structure can guarantee that these issues are drive forward. As a last resort Equipment Feasibility (OEE) of a machine expect a first improvement where execution and nature of the thing are of key centrality to the connection. The age rate can be improved by decreasing the individual time of the machine. This paper discusses thought of robotization, in which the pick slicing viewpoint is utilized to trim the dazzling piece of a Valve stem seals [VSS]. The motivation driving this evaluation is to locate the basic drivers of veritable age loss of the machine and to propose counter measures by which these issues can be reduced. This framework is utilized for improving reasonableness, methodology for execution of computerization and in a general sense sufficiency of the structure.

Key words: Overall Equipment Effectiveness (OEE), Valve stem seals (VSS), Automation, Pick trimming.

1. INTRODUCTION

In the present Global Scenario fabricating Efficiency and Agility isn't an alternative, however it is a key necessity. The creation cost is expanding quickly and the work cost, crude material cost, control cost, and so forth are not in our control of maker. Modernization of enterprises acquainted new advances with straightforwardness human on the creation lines. Ventures have introduced hardware to help laborers. This is known as semi-robotized procedure lines. A completely computerized procedure line is intended to full-fill large scale manufacturing yield and is in a perfect world fit to serve enormous. The idea of a creation line relies upon the multifaceted nature of the assembling parts, the generation volume, the affectability of the item and cost. Industries" the board plan and format their generation lines as indicated by explicit creation necessities. Automation plays a very important role in the automotive industries. Automation has leads to the increase in the production, reduction in the man power and at the same time provides the growth of the company by satisfying customer demands. The VSS finishing machine is used in the production of VSS seals which are used in the automobiles. The machine having many problems in the production which causes the loss of production and as a result OEE of the machine is lower than the industry standards.

Trimming and inspection unit: The downtime of the machine is considerably high compared to the other machines in the plant, downtime is mostly due to the unscheduled stoppages, and idling in the process. The improper trimming of the seals are the most important factors contributing to the low OEE of the machine, it is important to decrease the personal time of the machine which will help in eliminating the cause of major downtime to improve the OEE. Springing unit: The damage of the spring in the seals are the most important factors contributing to the low OEE of the machine, it is important to decrease the personal time of the machine which associates in getting out purpose for huge departure to improve the OEE. The system which colleagues in discarding explanation behind genuine individual time to improve the OEE. The structure targets heightening the Overall Equipment Effectiveness, to lessen the gadget individual time while improving quality and execution. S R Vijayakumar, et al., [1] have proposed a work wherein OEE of an imbue ment upgrade procedure was extended from 61% to 81% utilizing openness, better use of favorable circumstances, awesome things what's increasingly raised master soul and affirmation. T Rautio, et al., [2] have made and tried a system that displays the use of contraptions application to check Overall Equipment Efficiency. K C Ng, et al., [3] have separated a DMAIC approach, which served to apparent and delineates obviously the issue at the portrayed stage. It gives a systematic structure by giving all around referenced assessment in to progressively modest scale levels in order to get the genuine key driver and later offer sensible response for insistence the issue until the completion of time. T Kamaryt, et al., [5] have proposed a reliable gadget for considering the advantage of overseeing rigging and joins upkeep approaches and structures. OHEE offers a ricochet forward response for investigating supply structures where the reason

for intermixing of interest is the mechanical assembly. G R Esmailian, et al., [6] have comfortable a model with reduce RPN by improving everything thought about mechanical gathering limit (OEE) by using of heuristic mathematic model subject to Total Productive Maintenance record, this framework is used to decrease the degree of risk need number. W Amer, et al., [7] have executed and attempted a system in the district Liquefied Petroleum Gas (LPG) industry to improve Overall Equipment Effectiveness (OEE) achieving connected standard talking structure productivity. Z Q Bai, et al., [8] have shown a structure, which targets giving an OEE improvement system reliant on TOC. Regardless, the OEE improvement model containing OEE estimation model and OEE the directors module is gathered subject to the DBR speculation in TOC. D Daniel Sheu, et al., [9] have developed a thought of if all else fails data gear reasonableness (OIE) to complete the full state of the equipment profitability. The augmentation of the OIE and OEE along these lines builds up the certified everything considered equipment capacity which the maker names firm mechanical gathering advantage (TEE) all together not to confuse with the current OEE. Andrea Chiarini, et al., [10] have tended to the use and undertaking the heads of Six Sigma instruments and Lean Production by looking novel smart evaluation dedicated to the improvement of everything considered apparatus good judgment (OEE). The methodology joined into the system to develop a machine with another sub-unit which is a pick slicing procedure to extend the general proficiency of the structure showed up contrastingly in association with the past structure.

2. METHODOLOGY

[1] Existing System

A) Trimming and Inspection module

The Existing inspection system consists of blade trimming method for the trimming of the seals. The loading unit the existing system consists of rotary cylinders which increase the cycle time of the machine. The trimming and inspection unit of the existing system is shown in the Fig 1.1.

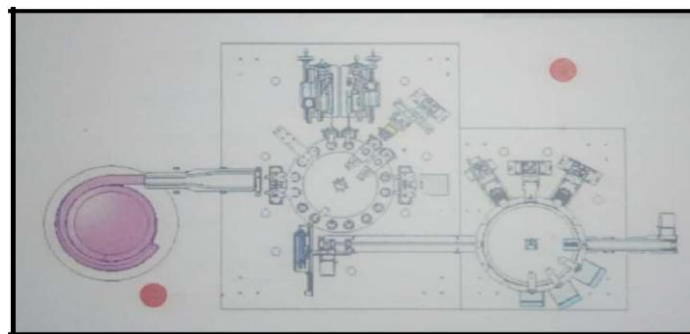


Fig 1.1: Trimming and Inspection unit machine layout

B) Springing Unit

The existing springing unit includes feeding of seals into the loading station horizontally from the conveyor. The existing springing unit machine layout is shown in the Fig 1.2.

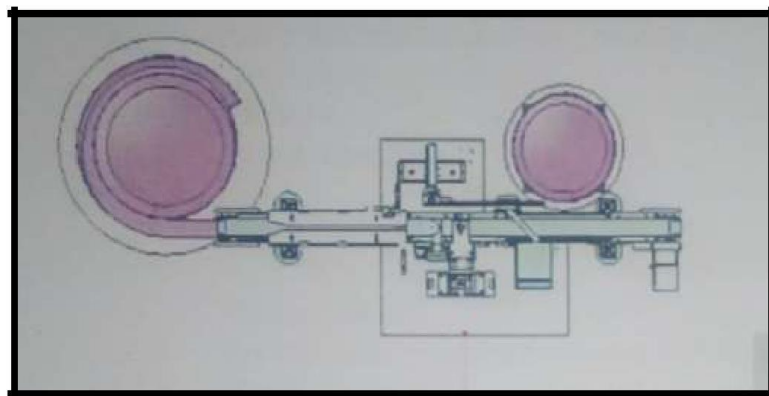


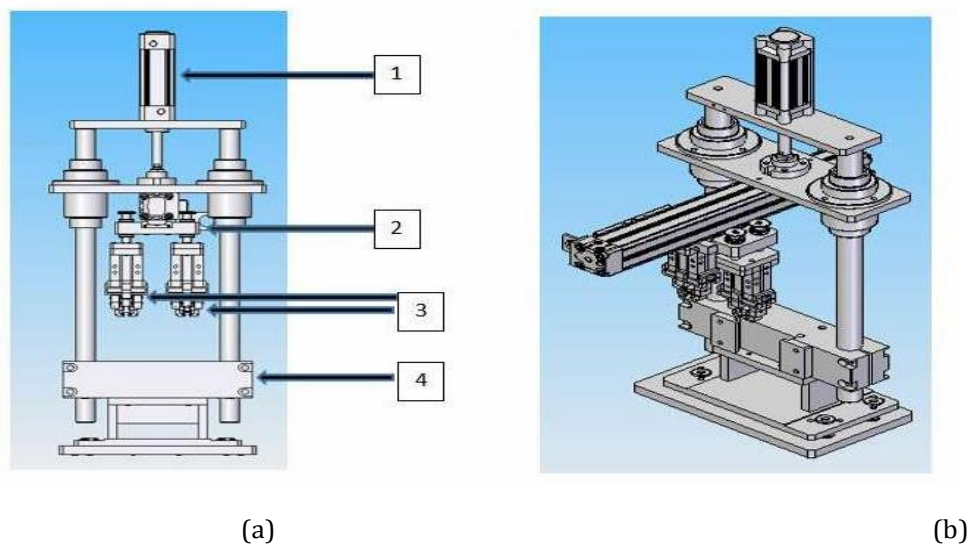
Fig 1.2: Springing unit machine layout

[2] IMPLEMENTED SYSTEM

The system is implemented with the automated trimming machine for trimming an unwanted portion of Valve Stem Seals (VSS) using a „seal pick trimming“ method. The input for this machine would be seals with rubber flashes. The rubber flashes on the seals are molded and formed on the seal during the molding process may be due to variations in amount of rubber added to the process. The scope of this machine is to remove the flash on the ID of the seal. The flash present in the ID will be removed by the pick trimming process. The pure cycle time of the machine is 1.5s. This means that the machine should give out 1 seals every 1.5s. The system consists of two indexer units IU1 [Indexer Unit 1] and IU2 [Indexer Unit 2]. Both the indexer units consist of several stations. IU1 is implemented with new units: in loading station rotary movement is replaced by forward/reverse movement pick and place unit, blade trimming is replaced by pick trimming unit, and seal butting unit is introduced for proper alignment of seals which helped for camera inspection.

(A) PICK AND PLACE ARRANGEMENT:

To place the seals from conveyor to the indexer unit pick and place arrangement was used. Previously cylinders with rotary movement were used to pick and place the seals to indexer unit. More cycle time was consumed due to rotary movement of the cylinder. In order to reduce the cycle time of that action cylinders with forward/reverse movement are used to pick and place the seals in required position. Pick and place arrangement with forward/reverse cylinders are as shown in Fig.1.3.



- [1] Top cylinder (up/down)
- [2] Horizontal cylinder (forward/reverse)
- [3] Grippers
- [4] Base plate

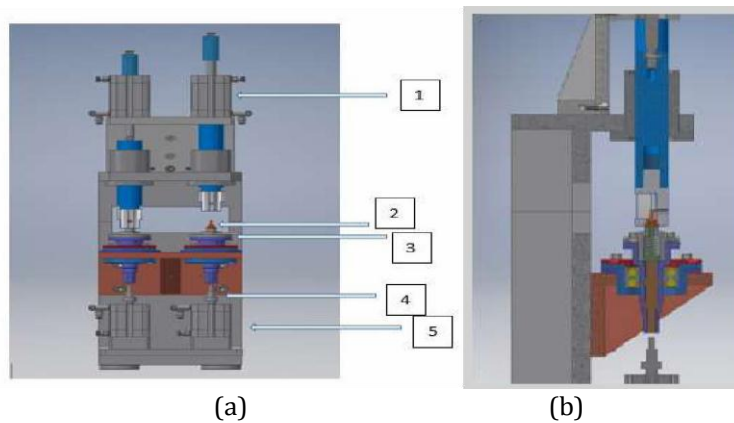
Fig. 1.3: (a) Pick and place unit front view and (b) Isometric view

ID TRIMMING STATION:

The ID trimming station will remove the Flash in the ID by pick trimming process. The ID trimming station will have a cylinder unit with sufficient force to push the spring loaded pin present in the spindle upwards to strip the ID flashaway. The trimming should not damage the seal’s main lip.

(B) PICK TRIMMING:

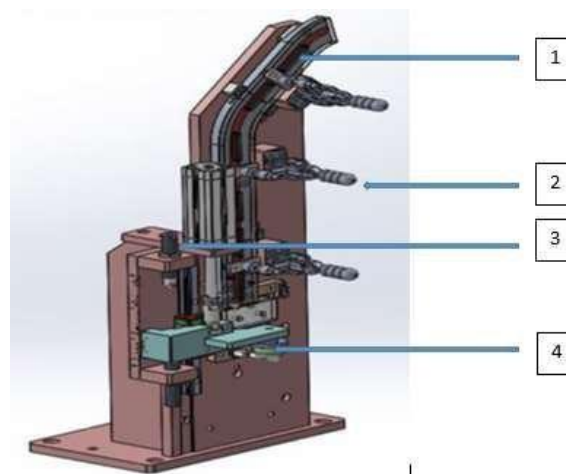
Blade trimming method was in use previously to remove the flash in the seals after molding process. Blade trimming method was not working effectively, defects were noticed. To overcome this trimming defects found in seals a pick trimming method is installed. The mechanical design of pick trimming unit is as shown in fig. 1.4. The pick trimming unit consists of two sections. Each section has top cylinder, bottom cylinder, mandrel to place seal, seal holding tool and seal pushing pin. When seals are not present in the mandrel cylinders will be in home position. When seal is placed on the mandrel bottom cylinder will move upwards which in turn will lift seal pushing pin upwards and top cylinder will move downwards which in turn will lift seal holding tool downwards. Now the seal will be placed in between seal holding tool and seal pushing pin. When the pin is pushed with high pressure flash on the seal will be removed. After the flash removal both top and bottom cylinders will reach the home positions. This is how the flashes on the seals will be removed properly without any defects.



- [1] Top cylinder + Seal holder
- [2] Seal
- [3] Mandrel
- [4] Pin
- [5] Bottom cylinder

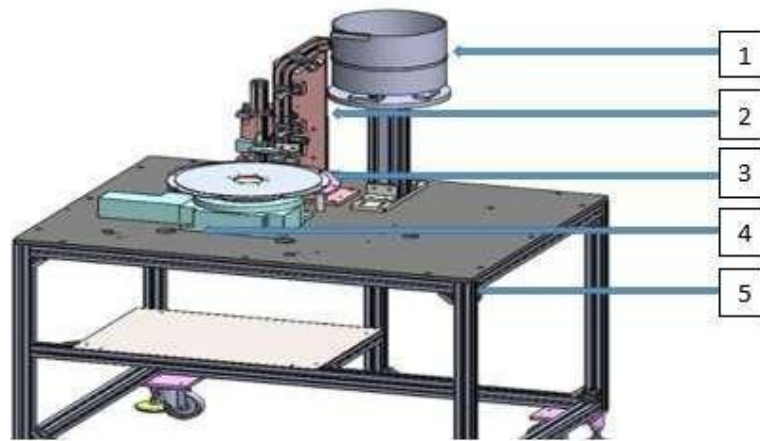
Fig 1.4: (a) Mechanical design of seal pick trimming unit front view and (b) Side view

(C) SPRINGING UNIT:



- [1] Vibro bowl feeder
- [2] Spring chute
- [3] Chute holder
- [4] Stopper
- [5] Springing tool

Fig 1.5: Springing unit



- [1] Vibro bowl feeder
- [2] Spring unit
- [3] Indexer plate
- [4] Linear feeder
- [5] Base table

Fig 1.6: Spring assembly unit

Springs are fed through a cylindrical bowl. The springs are fed through an elbow chute to a stationary end piece in front of the spring loading tool. A mechanical spring loading tool mounted on a horizontal-vertical Pick and Place picks the spring from the stationary end piece and load the spring onto the seal. The springing unit is as shown in Fig 1.5. The seal from the input conveyor is placed on the rotating indexer plate for spring assembly process. Spring assembly unit is as shown in Fig 1.6. The rotation of the indexer plate is stopped for the spring assembly to happen. A photo sensor will check the presence of the seal at the spring assembly stopper.

3. RESULTS AND DISCUSSION

The system was using rotary cylinders to keep the seals from linear feeder to the indexer unit using pick and place arrangement. This was time consuming, so to reduce the cycle time pick and place arrangement is replaced with forward/reverse motion cylinder. The system is validated by taking series of trials. Table 1.1 contains the validation result of new pick and place arrangement.

Trial No.	Pick		Place		Trial No.	Pick		Place	
	Right	Left	Right	Left		Right	Left	Right	Left
1	✓	✓	✓	✓	26	✓	✓	✓	✓
2	✓	✓	✓	✓	27	✓	✓	✓	✓
3	✓	✓	✓	✓	28	✓	✓	✓	✓
4	✓	✓	✓	✓	29	✓	✓	✘	✓
5	✓	✓	✓	✓	30	✓	✓	✓	✓
6	✓	✓	✓	✓	31	✓	✓	✓	✓
7	✓	✓	✓	✓	32	✓	✓	✓	✓
8	✓	✓	✓	✓	33	✓	✘	✓	✓
9	✓	✓	✓	✓	34	✓	✓	✓	✘
10	✓	✓	✓	✓	35	✓	✓	✓	✓
11	✓	✓	✓	✓	36	✓	✓	✓	✓
12	✓	✓	✓	✓	37	✓	✓	✓	✓
13	✓	✓	✓	✓	38	✓	✓	✓	✓
14	✓	✓	✓	✓	39	✓	✓	✓	✓
15	✓	✓	✓	✓	40	✘	✓	✓	✓
16	✓	✓	✓	✓	41	✓	✓	✘	✓
17	✓	✓	✓	✓	42	✓	✓	✓	✓
18	✓	✓	✓	✓	43	✓	✓	✓	✓
19	✓	✓	✓	✓	44	✓	✓	✓	✓
20	✘	✓	✓	✓	45	✓	✓	✓	✓
21	✓	✓	✓	✓	46	✓	✓	✓	✘
22	✓	✓	✓	✓	47	✓	✓	✓	✓
23	✓	✓	✓	✓	48	✓	✓	✓	✓
24	✓	✓	✓	✓	49	✓	✓	✓	✓
25	✓	✓	✓	✓	50	✓	✓	✓	✓

Table 1.1: Pick and place unit report

The proper trimming of the seals after replacing the blade trimming unit by pick trimming unit is validated by visual inspection system. Trimming defects was the main reasons for decrease in efficiency of the system. Table 1.2 contains the visual inspection data on the pick trimming unit.

Trimming Visual Inspection					
Sl. No.	Status	Remarks	Sl. No.	Status	Remarks
1	OK		26	OK	
2	OK		27	OK	
3	OK		28	OK	
4	OK		29	OK	
5	OK		30	OK	
6	OK		31	OK	
7	OK		32	OK	
8	OK		33	OK	
9	OK		34	OK	
10	OK		35	OK	
11	OK		36	OK	
12	OK		37	OK	
13	OK		38	OK	
14	OK		39	OK	
15	OK		40	OK	
16	OK		41	OK	
17	OK		42	OK	
18	OK		43	OK	
19	OK		44	OK	
20	OK		45	OK	
21	OK		46	OK	
22	OK		47	OK	
23	OK		48	NOT OK	Excess Trimming Flash
24	OK		49	NOT OK	Excess Trimming (Lip Damage)
25	OK		50	NOT OK	Over Trimming

Table 1.2: Visual inspection report

OEE data after implementation of new method

Table 1.3 contains the OEE data of the existing system, week wise data is collected. It is observed from the data that the OEE is less than the world class values, which means low machine performance due to the pick and place arrangement with more cycle time, trimming defects, frequent stoppages and idle time. The performance is also affected by the low feed rate. The quality is slightly less than the world class value and it can be improved. It is necessity to improve the machine performance and quality along with the availability.

Month		Calendar Hours	Scheduled Hours	Available Hours	Performance Hours	Effective Hours	Availability Rate	Performance Rate	Quality Rate	OEE
MAY	Week 1	192	142	138	120	118	97%	87%	98%	83.098591549295800%
	Week 2	189	149	148	122	120	99%	82%	98%	80.536912751677900%
	Week 3	188	140	128	118	117	91%	92%	99%	83.571428571428600%
	Week 4	190	148	138	122	119	93%	88%	98%	80.405405405405400%
JUN	Week 5	186	152	140	133	129	92%	95%	97%	85%
	Week 6	190	162	152	142	139	94%	93%	98%	86%
	Week 7	189	148	139	132	129	94%	95%	98%	87%
	Week 8	192	168	161	149	141	96%	93%	95%	84%

Table 1.3: OEE data after the system improvisation

To improve the efficiency of the system OEE of the machine is studied. Week wise data. If OEE before the implementation of new methods are collected. The OEE data after implementation of new methods are calculated. Both the data's are compared and checked for the OEE improvement. Fig 1.7 shows the comparison of OEE of the machine before and after implementation of new methods. From the graph it can be clearly seen that the OEE is improved after implementation of new methods. The system is successful in providing good efficiency by increase in OEE. The OEE values are taken in average before and after implementation and represented in graph. By viewing this, the exact percentage of OEE improvement can be noted.



Fig 1.7: Comparison of OEE week wise data

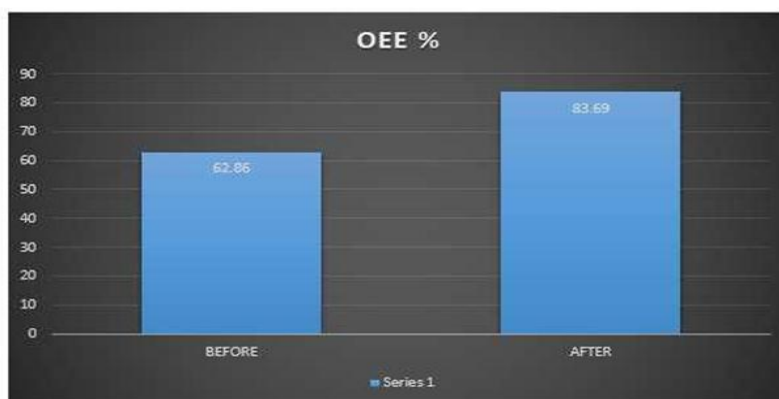


Fig 1.8: OEE data before and after implementation of new system

From the graph we can say that the OEE of the system is increased by 20.83% after implementation. Fig 1.8 shows the graph of OEE improvement in average. From the above results calculated after implementations and modifications it can be observed that there are considerable improvements in all factors of OEE and also mainly in the performance, availability and quality by which the objective of the study is fulfilled.

4. CONCLUSIONS

It is fundamental for an association to improve the age rate and nature of the things. In order to achieve this, the Overall Equipment Effectiveness was improved with low machine breakdown, less sitting and minor stops time, less quality defects, diminished disaster in plants, extended the productivity rate, streamlined system parameters, worker affiliation, improved advantages through cost saving procedure, extended buyer reliability and growing arrangements. The conventional root causes identified provide some structure to the process of human event problem solving. This study of root cause identification provided idea to prevent the problem from recurring. Thus, it is the process which allows all the participants to have a clear idea and the reality to promote its effective solution all the time. The root cause identification method could be utilized according to prevalent conditions and situations of Man, Material, machines, Process and system.

The Overall Equipment Effectiveness of the Valve Stem Seal completing machine was expanded from 62.86% to 83.69% through the usage of accessibility, better use of assets, excellent items and furthermore raised representative assurance and certainty.

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