ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 2, Issue 9, September 2017

Reduction of Rejection in 26AH model battery by Using Variable Search DOE Methodology

[1] K. Madhu sudana, [2] D.Kanakaraja, [3] Venkatamuni .K
[1] Student Master of Production Engineering and Engineering Design, AITS-Tirupathi
[2] Professor Dept. of Mechanical Engineering, AITS-Tirupathi
[3] Deputy Manger IE projects, Amara Raja Batteries Ltd.

***Abstract*:-- One of the company who is pioneer in VRLA battery in Asian Pacific Rim has foray into automotive batteries with its new brand addressing automobile segment launched across country by opening many franchises & pit stops covering all metros, major cities and urban towns. Batteries are one of the major components manufactured in the industry. Battery is also called SLI (Starting-lighting-ignition). In order to satisfy the customer needs the battery should be made defect free at the industry itself. This cell short will lead to a large problem, if not rejected in the industry itself.**

This project is on the account of Reduction of rejections in the Formation process of battery that are useful for the customers which is vital battery functioning results in Providing the Maximum Output without any obstruction of power to the customers. Historical data collection found that Cell Shorts Mode of rejections is more in the 26 AH battery model by Brain Storming and DOE Approach Identified the Root cause for the rejections and solved the issue so that this analysis is also used to reduce the rejections in the other similar models and this leads to more customer satisfaction and cost reduction to the company with the results of the six sigma Methodology, Analyzed the Problem generating stage in Pasting section and Parameters affecting to create problem by Six sigma tools application and implemented the solution. These results in reduction of Cell shorts in battery and by this project Cost saving and Customer satisfaction is improved

***Key words:* Six sigma, DMAIC, DOE, Variable search, Suspected Source of Variation (SSV's).**

I. INTRODUCTION

1.1 What is Six Sigma methodology:

1. The methodology which are going to discuss is specially focused one eliminating wastes in the manufacturing processes papers and books have been published addressing the fundamentals of Six Sigma .Topics include: What is Six Sigma? (Harry and Schroeder, 1999); Why do we need Six Sigma? (Pande et al., 2000); what makes Six Sigma different from other quality initiatives? Six Sigma deployment (Keller, 2001); critical success factors of Six Sigma implementation (Treichler, 2005); hurdles in Six Sigma implementation (Gijon and Rao, 2005); and Six Sigma.

2. Six sigma helps in eliminating the waste Sigma (σ) represents variation in the process With respect mean (average line). Six Sigma is a data-driven approach to process improvement .Objective of this methodology is to achieve zero defect by reducing variation. Six Sigma was first time developed & introduced by Sir Bill Smith in Motorola in1987. Organizations world over has implemented Six Sigma successfully for more than 20 years with the aim of continuously improving the process. Six Sigma continues to be the best-known approach to process improvement (Taghizadegan, 2006). Six Sigma was introduced in manufacturing processes; today, however, marketing, purchasing, billing, invoicing, etc., functions are also implementing Six Sigma methodology. Implementation of Six Sigma methodology is having a significant impact on profitability and customer satisfaction of the organization, if successfully deployed (Breyfogle, 1999). It takes users away from 'intuition-based decisions' to 'fact-based decisions' (Breyfogle, 1999). A number of in manufacturing process by two methods.

a. Problem solving:

This helps in reducing scrap ,rework and customer complaints.

b. Existing process optimization:

This help's in increasing the productivity and also helps in fixing the correct

2.1 Types of problems:

After selecting the culprit area, now it is decided that which problem is to be killed as per cause and solution of the problem. Some problem becomes chronic because management issues, lack of technology, lack of awareness or lack of facilities. So Problems in any organization are found basically in four categories as shown in fig. Priority is to be given to each category as shown in figure to kill the problem..

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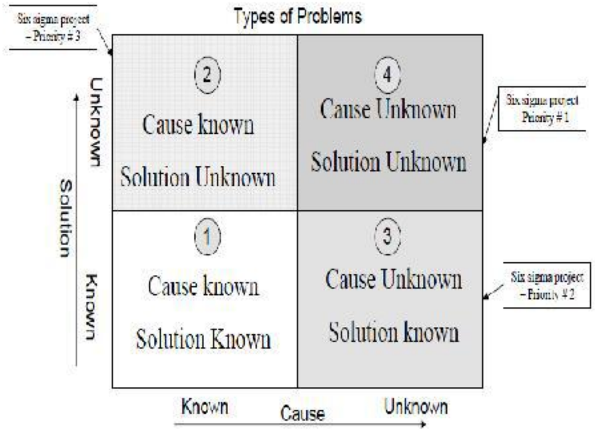

DMAIC Process :
a) Phase-1 : Define
b) Phase-2 : Measure and Analysis
c) Phase-3 : Improve
d) Phase-4 : Control

3.1 Introduction to DMAICcycle:
a. Once the project is selected, the first step is we needed to DEFINE the Problem in
Phase -1.
b. The next step is to use DOE techniques to pin point the root cause(s) of the
Problem. This is done in phase-2.
c. When the root cause(s) are pin pointed, we have to plan and implement Process
Improvement action .This is done in IMPROVEMENT PHASE. Root cause is also validated in
Phase-3.
d. Once the process improvement actions are implemented, we need to ensure that
the actions stay permanent in process. This is done in phase-4

4.1 Application of DOE tools:
4.1.1Variable search:
The problem is due to design parameters of Product/Process, and Parameters are >3. It can be used for problem solving only when all the related SSV's are eliminated and the cause is confirmed as process design is also used for existing Process optimization to arrive at an Optimal setting for cost, productivity and quality.

4.1.2 B vs C:
When root cause of the problem Or optimal setting for a process is identified and it has to validated.

4.1.3 Product/Process Search: Product/Process Search:
SSV's related to the process parameters or input materials which can be measured in both good and bad parts, 'Product process search DOE tools used Examples Temperature, Pressure.

4.1.4 Component Search:
When problem is on an assembled product& the assembly can be disassembled and re-assembled without damaging parts. Response can be either attribute or Variable Is used for assembly related problems (HV Failure, Leakage, Vibration, Pressure Drop etc.).

4. 2 Guide lines for tear down analysis:
The Tear down analysis is to be done to know the root causes of the problem.

4.2.1 Purpose:
To establish the failure mode and assess the severity of defects/ damages through teardown analysis and identify quality improvement measures in the manufacturing process.

4.2.2 Scope:
Detailed analysis by way of organized, systematic tear down and through investigation to diagnose the root cause of failures with specific reference to individual elements in the manufacturing process shall be carried out with the objective of enhancing the product quality resulting in reduction and elimination of failure in the field.

4.2.3Procedural steps:
1.Intimation shall be given to the service head to send the failed cells to the plant based on the STR and the nature of the failure modes.
2.The warranty return cells shall send to the plant from the field offices through log service support to facilitate effective tear down analysis by quality assurance.
3.Based on FRB/STR intimation quality assurance shall to do the physical inspection and leak test . if cells are in physically good condition the charge discharge process will be continued .if cells are not physically good send them for scrap.
4.If cells deliver the rated capacity, report shall be sent to CFT members for necessary action.
5.Tear down shall be carried out for the cells failed to deliver the capacity.
6.After completion of the tear down the cells shall be disposed to scrap yard vide scrap memo (GPUR-SFS-23).
7.The findings of tear down analysis ,failure mode standard shall be registered in tear down register

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(PRD(MVRLA)-SFR-22),based on the observation noted in analysis report (COM-SFS-00).

8.Quality assurance shall circulate the warranty failures and failure modes with data representation through appropriate tools like pareto analysis on monthly basis.

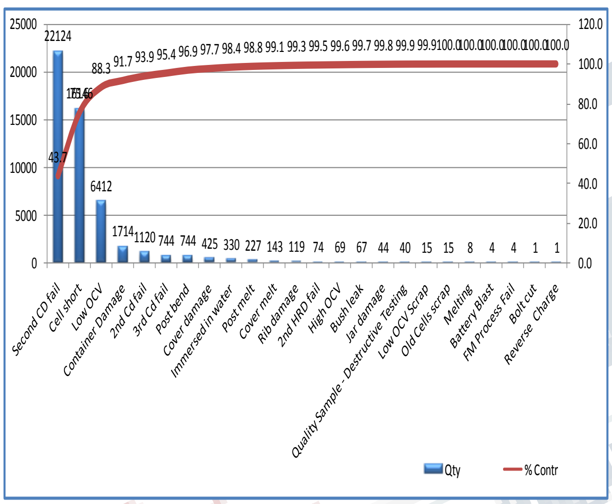
9.A detailed analysis report for corrective measures(COM-SFS-00) will be submitted to marketing ,servicing and to customer if it is required.

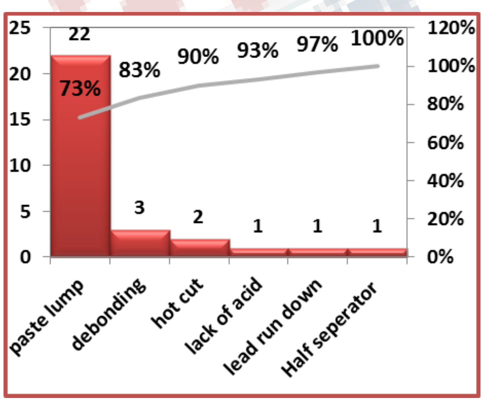
4.3 PROCEDURE FOR TEAR DOWN ANALYSIS

i. Receipt of the cells
ii. Inspection
iii. Electrical test
iv. Tear down analysis

5. PROBLEM SELECTION:

first level stratification of problems from KPI





Second level stratification of problem

5.1 DEFINE: PROBLEM STATEMENT

•More Internal reworks due to cell short

Last manufacturing process stage where the Problem is generated

•Group stocking

Process stages where the problem is inspected currently

•Battery Charging

Current average rejection in % for last 6 Months

•1.9%

Maximum and Minimum rejection in % for the last 6Months

Suspected physical phenomenon's that can lead to the problem

	Month	Rejection
Maximum	May	2.13%
Minimum	March	1.38%

Improper conversion of plates due to Paste lump Photograph of defect part

Final list of Suspected Sources of Variation (SSV's) for the physical phenomenon of the problem

No.	Suspected Sources of Variation (SSV's)	Design SSV or Variation SSV
1	Improper function of Pressure plate	Variation SSV
2	High plate Moisture (AOM)	Variation SSV
3	Improper function of aligner	Variation SSV
4	Low Paste Density	Variation SSV
5	Low Hopper Speed	Variation SSV

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6.MEASURE AND ANALYSIS

6.1Loose Pallets due to Improper function of Pressure plate
Setting :
1. Low Compression pressure plate springs.
2. 4.5mm Bushes.

+Setting :
1. High Compression pressure plate springs.
2. 5 mm Bushes.

TEST	-SETTINGS	+SETTINGS
1st run(% rejections)	4.5	1.5
2nd run(% rejections)	5.2	1.3
3rd run(% rejections)	6.0	1.6
MEDIAN	5.2	1.5
RANGE	1.5	0.3
D(Difference b/w two medians)	**3.7**	
d(Average of two ranges)	**0.9**	
D/d	**4.11**	

Since D/d ratio is >3 this is a cause

6.2 Loose Pallets due to Improper function of Aligner
-Setting :
1.Air Pressure 5.5 Bar
2.Side Joggers are Not touching Bunch Equally
-Setting :
1.Air Pressure 4.5 Bar
2.Adjusted to Keep the Bunch in aligner center

Trial done for 10000 plates in each run

TEST	-SETTINGS	+SETTINGS
1st run(% rejections)	5.5	0.5
2nd run(% rejections)	4.5	0
3rd run(% rejections)	7.0	1.2
MEDIAN	5.5	0.5
RANGE	2.5	0.7
D(Difference b/w two medians)	5	
d(Average of two ranges)	1.6	
D/d	3.125	

Since D/d ratio is >3 this is a cause

Improve
Validation using B vs C

1	**Part number selected for validation**	Ups 100Ah
2	**Better Condition**	BETTER Setting : 1. Pressure plate bush height has been changed to 5 mm 2.Alinger air pressure increased to 5.5bar. 3. Hopper speed changed to 110rpm.
	Current Condition	CUURENT Setting : 1. Validation using B vs C Pressure plate bush height is 4.5mm 2. Aligner joggers pressure is at 4.5bar 3. Hopper speed is at 90rpm
3	**Sample size**	3B,3C
4	**Sample type**	Batch
5	**Response decided for monitoring**	% of Rejections
6	**Lot quantity (for batches)**	300

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Data obtained during validation

Trial	B	C
1st Run	3.86	1.01
2nd Run	3.93	1.27
3rd Run	3.88	0.4
Median	3.88	1.01
Range	0.07	0.87
D	2.87	
d	0.47	
D/d	6.11	

CONCLUSION:

There is no overlap between Better Vs Current condition rejection, so the root cause was validated

RESULTS & CONCLUSIONS

After implementation of Modifications in parameters Optimization of the Process Parameters, the cell short due to paste lumps is totally eliminated in this particular model type.

Benefits:
1. Elimination of quality complaint
2. Improved productivity
3. Operator fatigue reduction in rework
4. Rejections reduced
5. Problem solving methodology in shop floor

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