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Reduce Rejection in Tempering Process Spring Manufacturing Industry India by using TRIZ Methods

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Abstracts

In this research the researcher are reduce the rejection. Today many big organizations involve in producing products with high degree of customer satisfaction. The success of a product or service largely depends on how they meet the customer demands more efforts are employed in getting the information necessary for determining what the customer truly wants. In this research collected the all process data to finalized the products in spring manufacturing industries. there was analyzed by activity-based-costing (ABC analysis). According to that selected the process where is most rejection, most wastage of cost in that process, than applying TRIZ in the tempering process and reduce the rejection in tempering process & improve the product quality.

Keywords: Spring manufacturing industry, TRIZ, Rejection, Tempering.

Introduction

Today many big organizations involved in producing products with high degree of customer satisfaction. The success of a product or service largely depends on how they meet the customer's demand. More efforts are employed in getting the information necessary for determining what the customer truly wants. A continuous improvement is required to catch up with rapidly changing development throughout the world. Understanding of customer needs leads to successful product and shorter development time.. Improved quality, higher product performance with good service, and wider range of products. In large scale industries work is distributed among the trained employees according to their efficiency which improves the productivity.

On the other side, the factories in small-scale sectors in India are generally less efficient in process and energy utilization as compared to larger enterprises in India as well as to enterprises of equivalent capacity in other countries. There have been very few studies aimed at strategy development by small scale industries for competitiveness. They face many pressures and constraints due to their limited resources such as lack capital. Skilled manpower and latest technology.

Literature review

G, ALTSHULLER, 1946-1950 started developing TRIZ and conducting his first TRIZ training sessions. At this time he realized a key role of resolving a technical contradiction in order to come up with an inventive solution. G, ALTSHULLER, 1950-1954 wrote a letter to Soviet leader, I. Stalin, with a sharp critique of Soviet system of inventiveness. As a result he was imprisoned as a political prisoner. In 1954, he was released and rehabilitated. G, ALTSHULLER AND R, SHAPIRO, 1956 published the article "About Technical Creativity" in the journal Questions of Psychology, #6, 37-49. 1956 . It was the first official TRIZ publication, which introduced such concepts as technical contradiction, ideality, inventive system thinking (currently known as "System Operator" or "Multi-Screen Diagram of Thinking"), the law of Technical System Completeness, and Inventive Principles. G, ALTSHULLER, 1956-1959 The algorithm included 15 steps and 18 Inventive Principles (sub-principles); a step with "Ideal Final Result" was introduced. G, ALTSHULLER, 1971 ARIZ-71included 35 steps, 40 inventive principles (with 88 sub-principles), and the Matrix for Resolving Technical Contradictions with 39x39 parameters (it is the same matrix for resolving technical contradictions which is still in the wide use today).ARIZ-71was a major step in TRIZ development. It introduced Operator "Time-Size-Cost", the first version of the Method of Little Men, and included references to physical effects for solving inventive problems. G, ALTSHULLER AND N. KHOMENKO, 1989 The first TRIZ software "Invention Machine™" was released by Invention Machine Labs (later evolved to "Tech Optimizer™" and "Gold fire Innovator™" by Invention Machine Corp.), which included Function Analysis, 40 Inventive Principles, Matrix of Resolving Technical Contradictions,76 inventive Standards, Databases of Physical, Chemical, and Geometric

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Effects, and Feature Transfer (Alternative Systems Merging). The software brought back the Matrix of Resolving Technical Contradictions as an independent tool due to its simplicity of use by TRIZ beginners (a modern version of software also includes Semantic Search Engine to index patent and document information according technical functions, and the Database of Effects now includes thousands of entries.) G, ALTSHULLER, 1994-1998 had passed away and further coordination of TRIZ developments almost disappeared. G, ALTSHULLER, 1998-2004 Different organizations with TRIZ expertise developed their own versions of TRIZ (I-TRIZ, TRIZ+, x TRIZ, Creax TRIZ, OTSM-TRIZ), thus a set of TRIZ tools developed under a guidance of Altshuller before 1998 is now titled "Classical TRIZ" to avoid confusion. G, ALTSHULLER, 2004-2008 A number of new tools emerge to help with complex problem analysis and management, which still remained a weak part of TRIZ: Root Conflict Analysis (RCA+) for decomposing inventive problems, Problem Flow Technology, Problem Networking for managing complex problems involving networks of contradictions. VELERI SOUCHKOV, 2010 TRIZ and some its techniques with focus on technological applications of TRIZ. And Accelerate innovation of TRIZ. VLADIMIR PETROV, 2011 continue to adapt tools and concepts of TRIZ for IT. Now I am trying to adapt the inventive principles and matrix.". Christoph Dobrusskin,and MDes, 2012 a number of challenges that the freshly trained "TRIZnik" may face when returning from the training, as well as a number of recommendations for him or her, the direct manager, but also the company management, to safeguard the successful deployment of this powerful innovation tool. Haochen wang and , 2013 This paper briefly presents the history of development of the TRIZ namely the Theory of the Solution of Inventive Problems, introduces the current situation of the theoretical research and the application of the TRIZ, and propounds the emphasis and direction of the research and application of the TRIZ in China, which will contribute to the enhance the efficiency and benefits in Computer Aided Manufacturing.

Research methodology

ABC Analysis (Activity-Based-Costing):-Activity-based costing is an administrative accounting technique for categorizing business costs by activity in order to assess the cost of individual activities. The technique, which has long been used in the private sector to manage costs, is recently being adopted by government agencies. An analysis of a range of items that have different levels of significance and should be handled or controlled differently . It is a form of Pareto analysis in which the items (such as activities, customers, documents, inventory items, sales territories) are grouped into three categories (A, B, and C) in order of their estimated importance. 'A' items are very important, 'B' items are important, 'C' items are marginally important.

- A ITEMS: very tight control and accurate records.
- B ITEMS: less tightly controlled and good records.
- C ITEMS: simplest controls possible and minimal records.

Theory of inventive problem solving (TRIZ) method

Triz is a Russian acronym meaning "theory of inventive problem solving". In 1946, generich altshuller, the founder of triz, was a patent reviewer at the Russian naval patent office at the young age of 20. He perceived that there is a definite pattern in the way innovations takes place in technical systems. he started a study of 200,000 patents to look for the basic principles and pattern in the world's most innovative patents, he found that each of the most inventive patents primarily solved an inventive problem. Altshuller defined inventive problems as those which contain conflicting requirements. Which he called contradictions further he found that the same fundamental solutions were used over and over again, often separated by many years. He reasoned that if latter inventors had the knowledge of earlier solutions their task would have been simpler he therefore, set about extracting, compiling, and organizing such knowledge.

The collect patent database and subsequent analysis revealed a natural pattern of innovation that can help solve similar technological problems, this study was continued, by altshuller and his disciples, over the past 50 year and has yielded a systematic approach to definition and identification of innovative problems, a set of problem solving tool, and a vast knowledge database, which can help solve current technical problems in an innovative way. . Today, the triz software database includes the essence of over 2,500,000patents

Methods and tools of TRIZ

Altshuller's research of over fifty years on Creativity and Inventive Problem Solving has led to many different classifications, methods and tools of invention.

Inventive problem "as contradictions or conflicts":

One of the first findings of altshuller was that "inventive problems are those that have contradictions/conflicts"

Triz defines two kinds of contradiction, "**physical and technical**"

Physical contradiction are resolved by using 6 separation principles,

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Triz has 6 classical ways to resolve "physical contradiction" and these are known as "separation principles for "physical contradiction",

1. separation in space
2. separation in time
3. separation at micro level; transition to sub system
4. separation at macro level; transition to super system
5. separation in condition
6. convert to technical contradiction

Technical contradictions are resolved by using contradiction matrix and 40 inventive principles

Contradiction Matrix (39 x 39) and 40 inventive principales:

Contradiction appears while trying to improve one desirable property another desirable property deteriorates! Conventional problem solving generally leads to a compromise solution. As mentioned before, the most inventive solution is obtained when a technical problem containing a contradiction is solved by completely eliminating the contradiction.

Altshuller, from his research on over 40,000 most inventive patents, found that there are only "39 Features" which either improve or degrade. So, every problem could be described as a conflict between a pair of parameters (2-out-of-39 parameters). Many patents had, in the past, resolved these individual conflicts in several different fields. The conflicts were solved over and over again, sometimes; these were spaced several years apart. He concluded that only "40 inventive principles" were used to resolve these contradictions fully, and not as a trade-off or compromise. He further argued that, if the latter researchers knew these earlier results, they would have solved their own problems with more ease.

Altshuller, therefore, set about to extract and to organize the frequently occurring contradictions and the principles of the resolution of these contradictions. He put it in the form of a matrix of 39-improving parameters and 39-worsening parameters (39 X 39 matrix) with each cell entry giving the most often used (up to 4) inventive principles. This matrix is known as the "CONTRADICTION MATRIX" and remains to be the simplest and the most straightforward of TRIZ tools.

Contradiction matrix and examples (corresponding to each inventive principle) forms the first of the knowledge databases of the TRIZ. This is not given in these notes, as it is a part of the TRIZ software "TechOptimizer-3.0". in the principles module. Physical contradictions are situation where one object has contradictory, opposite requirement.

Identify the problem

We begin with " 5W's and an H " of Innovation. Ask these question of every system so that the system function and problem is identified.

W1. Who has the problem?

W2. What does the problem seem to be? What are the resources?

W3. When does the problem occur? Under what circumstances?

W4. Where does the problem occur?

W5. Why does the problem occur? What is root cause?

And

H1. How does the problem occur? How can the problem be solved?

Case study with result and discussion

This chapter present an example of the proposed approach through a case study in the industry to illustrate the usefulness and case of application of the method as well as considering the practical implimation of the approach. The case study is undertaken at a small scale process industry (rail spring karkhana sithouli Gwalior) involved in producing coil spring product. The application of the methodology to a real case would require interviewing industries members, to get information based on their infield experience. Such information should be expressed following the linguistics scale and should be translated in TRIZ method for computational process.

Sample and data collection

Data collected for the past one month. The operation is based on the three shifts per day every shift is for eight hours the planned down time per shift 15min at the end of each shift for cleaning and tiding up the work area.

In view of this following data for last 1 month was calculated and analyzed.

Rail spring karkhana sithouli is ISO-9001 certified company, there are 456 employees. There are 28 machines available in two line . The company's products include suspension products, coil/helical springs. The company has its production facilities in India. It manufactures coaching stock and locomotive springs ranging from 3.8 kilograms to 171 kilograms. The main product of the company was coaching stock and locomotive springs.

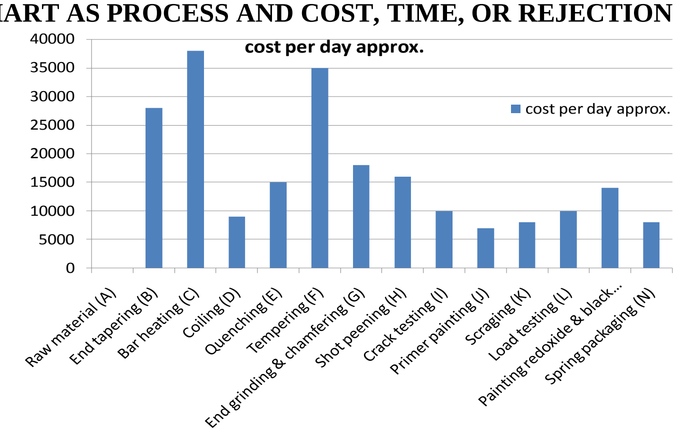
After the selection of machine data collection have been carried out. For seven days of analyzation during data collection and data of actual problem have also been collected. I found three common problems of machines cell which were occurred again and again on the machine and I also made corrective action plan for reducing such problems. After implementing TRIZ Researcher makes them to distort major problems by analyzed pareto chart.

Data analysis

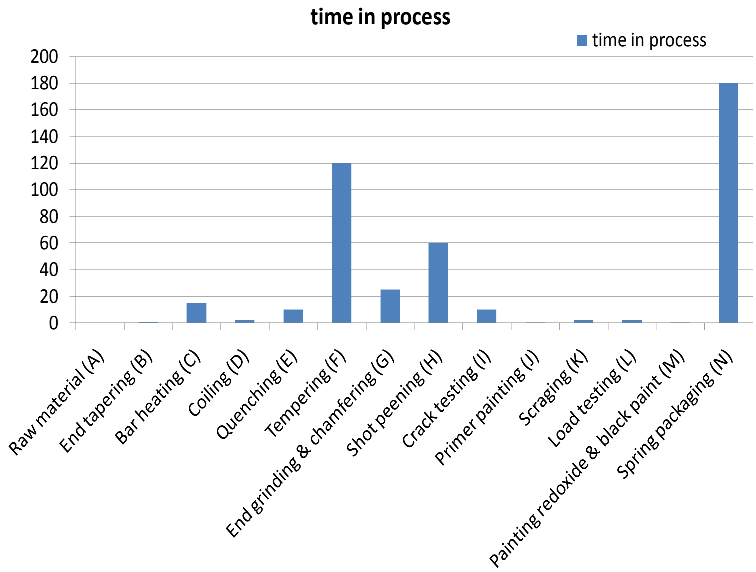
Step1. Coil spring pareto chart before implimation of triz method

S. no.	Process	Path	Cost per day (approx.)	Time in process (minutes)	Rejection in bar
1.	Raw material (A)	-	0	0	0
2.	End tapering (B)	1-2	28000	0.83	2
3.	Bar heating (C)	2-3	38000	15	-
4.	Coiling (D)	3-4	9000	2	2
5.	Quenching (E)	4-5	15000	10	-
6.	Tempering (F)	5-6	35000	120	3
7.	End grinding & chamfering (G)	6-7	18000	25	-
8.	Shot peening (H)	7-8	16000	60	-
9.	Crack testing (I)	8-9	10000	10	2
10.	Primer painting (J)	9-10	7000	0.30	-
11.	Scraging (K)	10-11	8000	2	-
12.	Load testing (L)	11-12	10000	2	2
13.	Painting redoxide & black paint (M)	12-13	14000	0.40	-
14.	Spring packaging (N)	13-14	8000	180	-

DRAW COLUMNS CHART AS PROCESS AND COST, TIME, OR REJECTION



GRAPH-4.1. PROCESS AND COST CHART



GRAPH-4.2. PROCESS AND TIME CHART

GRAPH- 4.3. PROCESS AND REJECTION CHART

STEP2. THE ABOVE TABLE TAKE IN COST TERM BEFORE IMPLIMATION OF TRIZ METHOD

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes (approx.)	Cost of Rejection bar (approx.)
1.	Raw material (A)	-	0	0	0
2.	End tapering (B)	1-2	28000	2200	4400
3.	Bar heating (C)	2-3	38000	3200	0
4.	Coiling (D)	3-4	9000	3700	4400
5.	Quenching (E)	4-5	15000	4200	0
6.	Tempering (F)	5-6	35000	5200	15000
7.	End grinding & chamfering (G)	6-7	18000	5700	0
8.	Shot peening (H)	7-8	16000	6700	0
9.	Crack testing (I)	8-9	10000	7200	20000
10.	Primer painting (J)	9-10	7000	7700	0
11.	Scraging (K)	10-11	8000	8000	0
12.	Load testing (L)	11-12	10000	8500	20000
13.	Painting redoxide & black paint (M)	12-13	14000	8600	0
14.	Spring packaging (N)	13-14	8000	10000	0

STEP3. USING ABC ANALYSIS METHOD

ABC method follow 80/20 rule means 80% of rejection those are most important in industry**.**

Assume scale- 10000 rs = 1 rs

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx.)	Cost of Rejection bar(approx.)	Total
1.	Raw material (A)	-	0	0	0	0
2.	End tapering (B)	1-2	2.8	0.22	0.44	3.46
3.	Bar heating (C)	2-3	3.8	0.32	0	4.12
4.	Coiling (D)	3-4	0.9	0.37	0.44	1.71
5.	Quenching (E)	4-5	1.5	0.42	0	1.92
6.	Tempering (F)	5-6	3.5	0.52	1.5	5.52
7.	End grinding & chamfering (G)	6-7	1.8	0.57	0	2.37
8.	Shot peening (H)	7-8	1.6	0.67	0	2.27
9.	Crack testing (I)	8-9	1	0.72	2	3.72
10.	Primer painting (J)	9-10	0.7	0.77	0	1.47
11.	Scraging (K)	10-11	0.8	0.8	0	1.6
12.	Load testing (L)	11-12	1	0.85	2	3.85
13.	Painting redoxide & black paint (M)	12-13	1.4	0.86	0	2.26
14.	Spring packaging (N)	13-14	0.8	1	0	1.8
		Total	21.6	8.09	6.38	36.07

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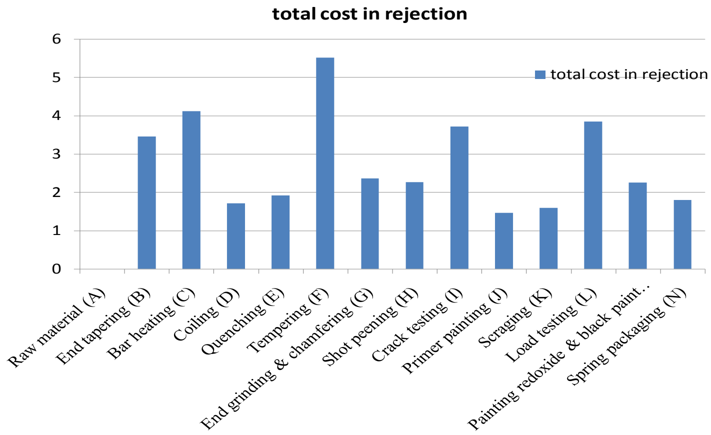

GRAPH-4.4. PROCESS AND TOTAL COST OF REJECTION CHART BEFORE IMPLIMATION OF TRIZ

STEP4.TAKING THE PERCENTAGE OF REJECTION BASE TABLE BEFORE IMPLIMATION OF TRIZ METHOD

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx .)	Cost of Rejection bar(approx.)	Total	Percentage of rejection (%)
1.	Raw material (A)	-	0	0	0	0	0
2.	End tapering (B)	1-2	2.8	0.22	0.44	3.46	9.59
3.	Bar heating (C)	2-3	3.8	0.32	0	4.12	11.42
4.	Coiling (D)	3-4	0.9	0.37	0.44	1.71	4.74
5.	Quenching (E)	4-5	1.5	0.42	0	1.92	5.32
6.	Tempering (F)	5-6	3.5	0.52	1.5	5.52	15.30
7.	End grinding & chamfering (G)	6-7	1.8	0.57	0	2.37	6.57
8.	Shot peening (H)	7-8	1.6	0.67	0	2.27	6.29
9.	Crack testing (I)	8-9	1	0.72	2	3.72	10.31
10.	Primer painting (J)	9-10	0.7	0.77	0	1.47	4.07
11.	Scraging (K)	10-11	0.8	0.8	0	1.6	4.43
12.	Load testing (L)	11-12	1	0.85	2	3.85	10.67
13.	Painting redoxide & black paint (M)	12-13	1.4	0.86	0	2.26	6.26
14.	Spring packaging (N)	13-14	0.8	1	0	1.8	4.99
					Total	36.07=100	99.96=100

STEP 5. PERCENTAGE OF REJECTION IS SHORT BY INCREASE TO DECREASE BEFORE IMPLIMATION OF TRIZ METHOD

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx .)	Cost of Rejection bar(approx.)	Total	Short by percentage
1.	Tempering (F)	5-6	3.5	0.52	1.5	5.52	15.30
2.	Bar heating (C)	2-3	3.8	0.32	0	4.12	11.42
3.	Load testing (L)	11-12	1	0.85	2	3.85	10.67
4.	Crack testing (I)	8-9	1	0.72	2	3.72	10.31
5.	End tapering (B)	1-2	2.8	0.22	0.44	3.46	9.59

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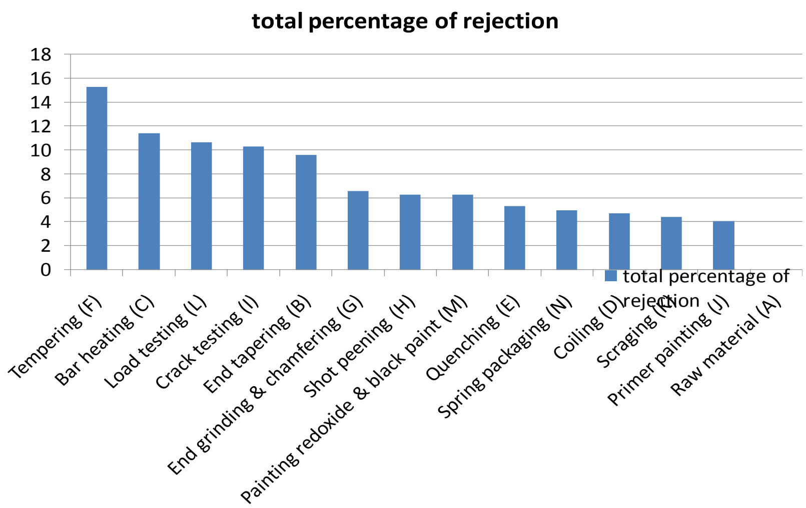
6.	End grinding & chamfering (G)	6-7	1.8	0.57	0	2.37	6.57
7.	Shot peening (H)	7-8	1.6	0.67	0	2.27	6.29
8.	Painting redoxide & black paint (M)	12-13	1.4	0.86	0	2.26	6.26
9.	Quenching (E)	4-5	1.5	0.42	0	1.92	5.32
10.	Spring packaging (N)	13-14	0.8	1	0	1.8	4.99
11.	Coiling (D)	3-4	0.9	0.37	0.44	1.71	4.74
12.	Scraging (K)	10-11	0.8	0.8	0	1.6	4.43
13.	Primer painting (J)	9-10	0.7	0.77	0	1.47	4.07
14.	Raw material (A)	-	0	0	0	0	0
					Total	36.07=100	99.96=100



GRAPH-4.5 Process and total percentage of rejection before implimation of TRIZ method

STEP7 USING TRIZ METHOD AND CONTRADICTION METRIX BASED SOLUTION

In above study the found that the maximum rejection in tempring process according to ABC analysis so appling TRIZ Methods in Tempring Process.

TEMPERING

Que 1 :-who has the problem?
Ans :- factory management
Que 2:-what does the prob. To be seem? What are the resources?
Ans :-after tempering process the hardness of spring not within limit. Due to change in latic structure of spring material .
Que 3 :-when does the problem occur ? Under what circumstances?
Ans :- during tempering process. Under the variation in heating temperature or cooling process.
Que 4:- where does the prob. Occur?
Ans :- during tempering machine.
Que 5:- why does the problem occur ? What is root causes?
Ans :- hardness depend on the temp., time. And Duration of cooling in tempering. The root cause of improper heat treatment of tempering.
Que 6 :- how does the problem occur? How can be solve ?
Ans :-after tempering process change in structure of spring. We can solve this prob. Is Maintain the tempering temperature, cooling and heating time during heat treatment.

Final problem

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hardness of spring goes out of limit because of improper heat treatment during starting and end of process. It mean

1- flow of material is not same for all.
2- heat temperature for all spring is not same.
3- Cooling time and quality of oil is not same for all.

Physical contradiction

there is no physical contradiction in tempering process. Convert it to a technical contradiction b/w 2-or-39 feature

- Refer to the contradiction matrix.

Use contradiction matrix

Worsening prob./improving prob.	Object generate harmful factor
Speed	2,24,35,21
Temp.	22,35,2,24
Quantity of substance	3,35,40,39

2. Taking out
24. Intermediary
35. Parameter change
21. Skipping
22. blessing in disguise or turn lemons in to lemonade
3. Local quality
39. Inert atmosphere
40 composite materials

According to TRIZ solution

35. Parameter change

a. change an object's physical state (e.g to a gas ,liquid or solid)

b. change the concentration or consistency

c. change the degree of flexibility

d. change the temperature

40. Composite material

a. change from uniform to composite (multiple) material.

More suitable answer IS

1- Change the concentration or consistency.
2- Change the temp.

Conclusion

Tempering is a heat treatment process. Proper heat treatment necessary from starting to end of process. Temperature in tempering m/c should maintained for all spring (480 degree centigrade). The hardness of spring should be in range 415-450 HBN for chrome moly spring steel. To make the hardness of spring within limit we have to keep constant flow of spring through the tempering m/c. with this cooling time and temp. Should remain constant. And maintain the consistency.

Result and discution (comperetively analysis)

COIL SPRING PARETO CHART AFTER IMPLIMATION OF TRIZ METHOD

S. no	Process	Path	Cost per day (approx.)	Time in process (minutes)	Rejection in bar
1.	Raw material (A)	-	0	0	0
2.	Tempering (F)	5-6	35000	120	0

THE ABOVE TABLE TAKE IN COST TERM AFTER IMPLIMATION OF TRIZ METHOD

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx.)	Cost of Rejection bar(approx.)
1.	Raw material (A)	-	0	0	0
2.	Tempering (F)	5-6	35000	5200	0

USING ABC ANALYSIS METHOD :-ABC method follow 80/20 rule means 80% of rejection those are most important in industry**.** (Assume scale- 10000 rs = 1 rs)

S. no	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx.)	Cost of Rejection bar(approx.)	Total
1.	Raw material (A)	-	0	0	0	0
2.	Tempering (F)	5-6	3.5	0.52	0	4.02

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TAKING THE PERCENTAGE OF REJECTION BASE TABLE AFTER IMPLIMATION OF TRIZ METHOD

S. no.	Process	Path	Cost per day (approx.)	Cost in Time minutes(approx.)	Cost of Rejection bar(approx.)	Total	Percentage of rejection (%)
1.	Raw material (A)	-	0	0	0	0	0
6.	Tempering (F)	5-6	3.5	0.52	0	4.02	13.53

Results

After the use of TRIZ method we reduce the 1.5 % of rejection in this process.

Conclusion

In this thesis or research, an integrated TRIZ (theory of inventive problem solving) method was proposed to enhance leanness in manufacturing process of small scale industry. After the use of TRIZ method we reduce the 1.5% of rejection in this process. To reduce the delivery time and Increase the production

S. NO.	PROCESS	TOTAL REJECTION IN COST BEFORE IMPLIMATION OF TRIZ	IDENTIFIED PROB. THROUGH TRIZ	SUGGESSION	TOTAL REJECTION IN COST AFTER IMPLIMATION OF TRIZ	REDUCTION
1.	TEMPERING	5.52	hardness of spring goes out of limit	To make the hardness of spring within limit we have to keep constant flow of spring through the tempering m/c. with this cooling time and temp. Should remain constant. And maintain the consistency	4.02	1.5

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