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ALTERNATIVE MATERIAL FOR SERRATED LEVER

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ABSTRACT

EN24 Alloy Steel has a wide variety of applications in different industries. The Challenge of modern machining industries is mainly focused on achieving high quality, in term of part/component accuracy, surface finish, high production rate and increase the product life with lesser environmental impact. It is necessary to change and improve existing technology and develop product with reasonably priced. So, it is necessary control the process parameter in any manufacturing process.

In this paper an attempt is made to reduce the operation time and manufacturing cost of the component without compromising with the quality

KEYWORDS: Hardness, Chemical analysis, Microstructure

INTRODUCTION

EN24 engineering steel is easy to treat and temper and is supplied hardened and tempered. The alloy offers a good combination of strength, ductility and wears resistance. It is a very high strength alloy engineering steel.

EN24 is a very high strength steel alloy which is supplied hardened and tempered. The grade is a nickel chromium molybdenum combination – this offers high tensile steel strength, with good ductility and wear resistance characteristics and corrosion. With relatively good impact properties at low temperatures, EN24 is also suitable for a variety of elevated temperature applications.

The different alloying elements have specific effects on the properties of a stainless steel. It is the combined effect of all the alloying elements, heat treatment, and, to some extent, impurities that determine the property profile of a certain steel grade. It should be noted that the effect of the alloying elements differs to some extent between the different types of stainless steel

C	Si	Mn	S	P	Cr	Mo	Ni
0.36 -0.44	0.1-0.35	0.45-0.7	0.04	0.035	1-1.4	0.20-0.35	1.3-1.7

Table 1 Chemical composition of materials

CrNiMo steel can be heat treated to produce tensile strength of the order of 980-1180 N/mm sq. in medium size and 900-1100 N/mm sq. in bigger section thickness. It also possesses good ductility and resistance to shock. It has good hardenability enabling it to be used for medium tensile strength, in fairly large sections, and possesses good resistance wear. It can also be used for flame and induction hardening, nitriding, used for high tensile strength machine parts, leads, screws, spindles, collets, boring bars, crankshafts, gears, high tensile strength bolts.

Benefits of implementing EN24

Reduction of cost: As EN24 contains comparatively more carbon content than EN354, carburizing and annealing can be neglected. Hence the cost of production can reduced to great extent.

Reduction of operation time: Generally carburizing and annealing requires 12-13 hours of process time. By skipping this process the overall operation time can be reduced and rate of production can be increased.

Requires less space: Carburizing setup requires large space as it contains large furnaces and induction chamber, by eliminating this process large floor space can be saved.

Introduction to EN354 (current material used for manufacturing serrated lever)

EN354 is case hardened steel. A tough core and a hard case are the desired attributes of case-hardened steel components. This combination of properties provides wear resistance and fatigue strength at the surface,

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and impact strength in the core. It is achieved by carburizing the component's surface, then quenching and tempering the part. Carburized components include gears of all kind, camshafts, and universal joints, driving pinions, link components, axles and arbours. All these components must resist wear and fatigue, have inherent toughness, and still be machinable.

C	Si	Mn	Cr	Ni	Mo
0.12-0.18	0.02-0.35	0.5-1.0	0.75-1.25	1.5-2.0	0.1-0.25

Although various Metal Cutting machines are being manufactured at HMT Bangalore, among them Radial drilling machine is major machine tool manufactured. In radial drilling machine serrated lever is the primary component which is more essential. So to manufacture this serrated lever EN354 material is being used in HMT which consume more standard time for manufacturing and it costs more. So we choose serrated lever as our work specimen.

LITERATURE REVIEW

Literature survey is carried out by surveying numerous papers published in various sources like reputed international journals, conferences, dissertations etc. *Rajesh K. Khatirkar, et. al.* [1] (2012) have studied heat treatment response of En24 steel titled Structural and wear characterization of heat treated EN24 steel was investigated by variation of hardening and tempering temperature in relation to microstructure and hardness. The microstructures were studied through a combination of the hardness decreased with the increase in hardening temperature from 1123 to 1000 Celsius, whereas it increased slightly with the increase in hardening temperature after tempering at 550 Celsius. *M.Korat, et. al.* [3] studied Optimization of effects of cutting parameters on surface finish and MRR of EN24/AISI4340 work material by employing Taguchi techniques. Results were obtained minimum surface roughness (SR) and maximum material removal rate for optimal cutting parameters. . *Krishankant, et. al*. [4] investigated optimization of turning process by the effects of machining parameters applying Taguchi methods to improve the quality of manufactured goods, and engineering development of designs for studying variation. EN24 steel is used as the work piece material for carrying out the experimentation to optimize the Material Removal Rate. The MRR values measured from the experiments and their optimum value for maximum material removal rate. *Jakhale Prashant P. et. al.* [5] investigated surface roughness in turning of alloy steel (EN24) with with process parameters cutting speed, feed, depth of cut using three insert geometries. The results shows that highest surface finish (lowest Ra) is obtained at a cutting speed of 100 m/min, feed rate of 0.24 mm/revolutions and a depth of cut of 1mm. and Best surface roughness at high cutting speed (i.e 150 m/min) is obtained from DNMG (12 06 08) insert than other two type of insert. *Sabita Ghosh, et. al.* [6] have highlighted the applicability of BIT for evaluating flow behaviour of engineering structural steels En24. Standard mechanical properties like ultimate tensile strength, yield stress, strain hardening coefficient evaluated for steels with varying microstructures generated through heat treatment. To determine fracture toughness from the flow behaviour, non-linear damage models have been utilized. Using this model, fracture toughness of the En24 steel at different heat treated conditions has been computed using the results generated by the BIT. *Rahul Davis, et. al.* [7] investigated that, optimal setting of these turning process parameters –spindle speed, feed rate and depth of cut, which may result in optimization of tool life of Carbide P-30 cutting tool in turning En24 steel (0.4 % C). Turning operations were performed by Carbide P-30 cutting tool under various dry cutting conditions by using sample specimens of EN-24 steel. The results depict that Spindle speed followed by feed rate and depth of cut was the combination of the optimal levels of factors that significantly affects the mean and variance of the tool life of the carbide cutting tool and gives the optimum tool life.

EXPERIMENTAL PROCEDURE

A. HARDNESS OF MATERIAL

The hardness of material before all the treatment is found out by Brinell hardness tester. According to Indian The hardness of material before all the treatment is found out by Brinell hardness tester. According to Indian standard, with the 10mm ball and a load of 3000 kg. the hardness are shown below on the table.

PARAMETER	DESCRIPTION
Ball diameter	10mm
Applied load	3000Kg
Avg. diameter of Indentation	4.42
Brinell Hardness(HBW 10/3000)	185

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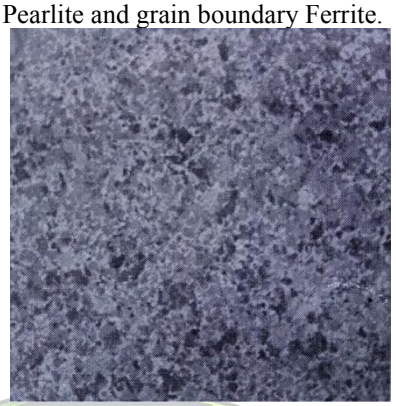
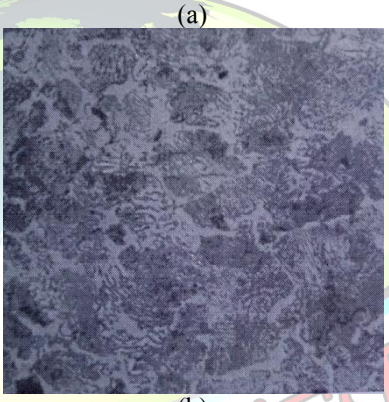
Table 3 Hardness Test Result

B. MICROSTRUCTURE

The microstructure is taken by optical metallurgical microscope (EPIPHOT 200). The microstructure of specimen consists of fine grains of Pearlite and grain boundary Ferrite.



(a)



(b)

Figure 4 (a) & (b) showing fine grains of pearlite and grain boundary ferrite at 100x and 500x.

C. CHEMICAL ANALYSIS

The chemical composition analysed by optical emission spectrometer BAIRD-DV6 is listed in table

CONTENT	PERCENT
C	0.357
Si	0.226
Mn	0.472
P	0.029
S	0.019
Cr	1.076
Mo	0.209
Ni	1.111

Table 4 chemical analysis result

PERFORMED OPERATIONS

The operations are carried out according to the drawing provided. Following processes are carried out

- Cutting
- Facing and core drilling
- Turning
- Electrical discharge machining
- Milling
- Radial drilling
- Tapping
- Fitting
- Flame hardening

- Tempering
- Grinding
- Honing

RESULTS AND DISCUSSION

From the experiment conducted we observed the total cost of sample piece is reduced and also the following comparisons are made between EN354 and EN24.

Cost analysis for manufacturing using EN354

SERIAL NO.	DESCRIPTION OF OPERATION	SETUP TIME(Ts) Min.	OPERATION TIME PER PIECE (To) Min.	MACHINE HOUR RATE (MHR)	COST PER PIECE Rs.
1.	Cutting machine	15	4	365	69.35
2.	Turning and Facing	66	10	435	311.75
3.	EDM	-	-	-	650
4.	Fitting	10	4	305	45.75
5.	Radial Drilling	45	20	470	329
6.	Fitting	10	2	305	35.4
7.	Horizontal Milling	66	11	455	332.15
8.	Radial Drilling	36	5	470	178.6
9.	Fitting	12	7	305	64
10.	Carburising	0	4	770	51
11.	Flame Hardening	30	1	365	95
12.	Rotary Surface Grinding	36	4	530	191
13.	Honing	30	4	615	190.65
	TOTAL	**356**	**76**	**- - -**	**2543.64**

Table 5 Cost estimation using EN354 material (per component

Cost analysis for manufacturing using EN24

SERIAL NO.	DESCRIPTION OF OPERATION	SETUP TIME(Ts) Min.	OPERATION TIME PER PIECE (To) Min.	MACHINE HOUR RATE (MHR)	COST PER PIECE Rs.
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10.	Flame Hardening	30	1	365	95
11.	Rotary Surface Grinding	36	4	530	191
12.	Honing	30	4	615	190.65
	TOTAL	**356**	**72**	**- - -**	**2492.6**

Table 6 Cost estimation using EN24 material (per component)

Comparison between manufacturing serrated lever using EN354 and EN24

PARTICULARS	EN354(C2R)	EN24(C3R)
Number of processes	13	12

Time taken to produce a component	76 min	72 min
Material cost (per Kg)	Rs. 85	Rs. 78
Cost of manufacturing a piece	2543.64	2492.6
Weight of single component	292gms	292gms

Table 7 Cost incurred in manufacturing single serrated lever

Comparison table for 1000 component

PARTICULARS	COST (Rs.)
Cost of manufacturing using EN354	27,98,640/-
Cost of Carburizing	51,353/-
Cost of manufacturing using EN24	27,26,600/-
Savings	**1,23,393/-**

Table 8 comparison table

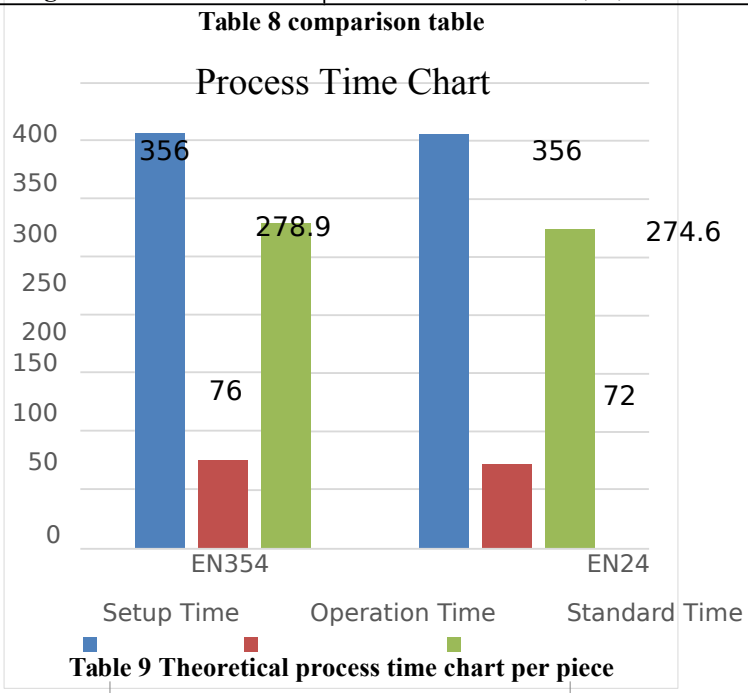
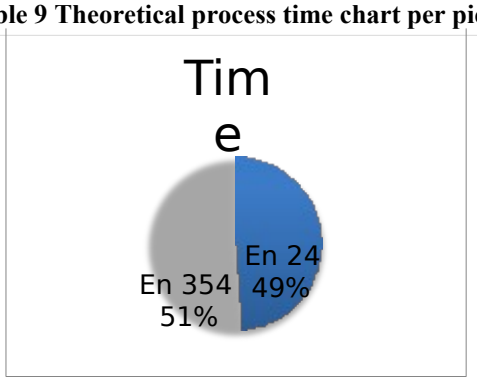


Table 9 Theoretical process time chart per piece



Pie chart for time

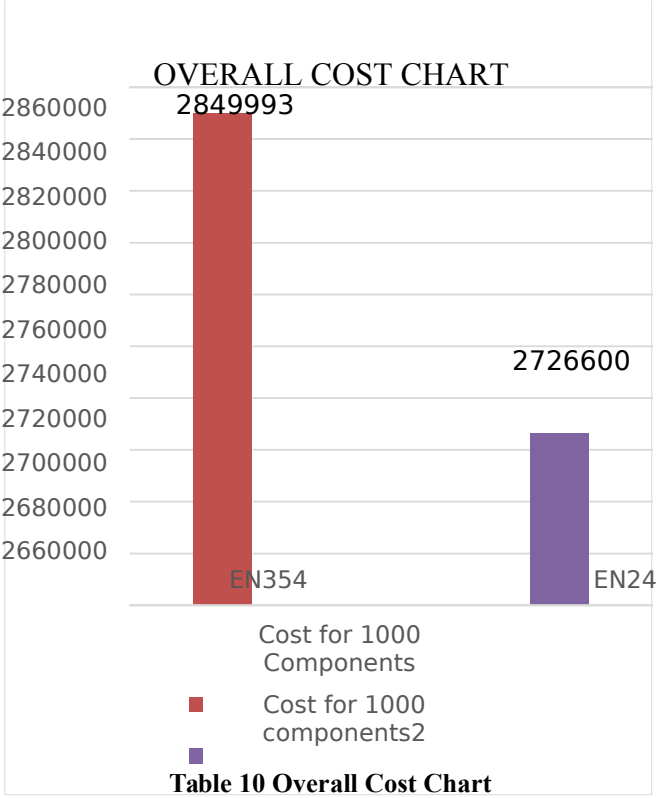


Table 10 Overall Cost Chart

CONCLUSION

A comparative measurement of operation time and standard time in serrated lever manufacturing process before and after replacing the material was concluded through this project.

- Using EN24 material is better than using EN354 material for manufacturing serrated lever of radial drilling machine.
- From the observation and result it is clear, that the total productivity in the manufacture of serrated lever of radial drilling machine has been increased.
- Due to replacement of material the operation time of the specimen has been reduced.
- The cost of production is also reduced.
- The project concludes that EN24 is the best material to replace with the present using material. i.e., EN354.

SCOPE FOR FUTURE WORK

- A research is going on to substitute EN24 material for serrated lever which intern used in different fields.
- Since there are several types of alloy steels present, we are analysing and manufacturing on selected material i.e., EN24
- Due to limited time, we couldn't check the durability of this material. The component is assembled in radial drilling machine and is in trial run.

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