
ABSTRACT

The aim of this research is to study the effect of changing various parameters of the shot peening process on the productivity of the manufacturing of coiled springs. The manufacturing process of Coiled spring involves various processes including shot peening. This process strengthens the steel to resist metal fatigue and cracking during its lifetime of repeated flexing. Within this research a modification in the finishing operation of shot peening process is presented. The variation of the Peening time with the variations of projection angle and Pulley Diameters is observed. The results have been verified and presented. It has been found that with the adjustment of the proper projection angles and pulley diameters for the shot blasting process the manufacturing time can be reduced by 5 to 6 minutes.

KEYWORDS: Shot Peening, spring manufacturing, Coiled Spring, Projection Angle

INTRODUCTION

A spring is equipment that changes its shape in response to a force, and return to its original shape when the force is removed [7]. The energy used in deforming the spring is stored in it and can be obtained when the spring returns to its previous shape. Generally, the quantity of the shape change is directly proportional to the quantity of force exerted. If a large force is applied, the spring will permanently deform and will never return to its previous shape [6]. In this research we are dealing with compression coiled spring.

Spring Manufacturing Process

The current experimental investigation was conducted in Lal Ji Gopinath ji Industries, Pantnagar (U.K). The first step in the spring manufacturing process is the coiling process which is done in the CNC machine. The CNC method for the coiling is the universally adopted method and is used extensively. The spring steel wire is coiled in to the spring of required shape and size.

The next step is the tempering of the coiled spring at a high temperature. The temperature used in the tempering is 320 Degree Celsius. The tempering is done for a period of 30 Minutes. A conveyor is used for the tempering process of the springs.

After the tempering is done the next step is grinding. The grinding is done to make the two ends of the springs grind. Grinding is an important process and is done using the grinders of appropriate Shapes and sizes.

After the above processes the Shot peening of the springs is done. In the process of Shot Peening the spring is kept exposed to shots or small metal balls. The Shot peening is done to reduce the residual stress in the spring material and to increase the fatigue life of the springs. The fatigue life of the spring is increased by about 10 times by the Shot peening process. the Shot peening is done for a time period of 15-17 Minutes.

After the Shot Peening Process the Angle checking and the length checking of the springs are performed. The angle of 90 degree is checked. Also the setting of the inner diameter and outer diameter is performed.

After this the second phase tempering is performed. The second phase tempering is performed at a temperature of 280 Degree.

After above all the processes the final process of powder coating is performed. The spring is powder coated with the chemicals of required quality and appearance. The spring after this is packed and dispatched to the vendors ready to use.

Shot Peening

Shot peening is a process of cold working a part to increase its resistance to metal fatigue and some types of stress corrosion [3]. It involves the bombarding of the surface of the desired part with metallic (steel), glass, or ceramic beads with enough force to have dent on the surface [13]. When done properly, it can increase the lifetime of some of the parts by up to 1000 percent.

Shot peening cause plastic deformations in the surface of the peened part. It relieves surface tensile stresses that may have been introduced during the machining of the part, and more significantly introduce a beneficial compressive residual stress that serves to strengthen the surface of part [3]. Shot peening is also occasionally used to control and change the shape of thin parts.

METHODOLOGY ADOPTED

The process of shot peening was repeated in the Spring Manufacturing firm, Lal Ji Gopinath Ji Industries. The parameters “projection angles and Pulley Diameters” were varied and the required shot peening time was measured. The time for successful peening of the product was measured with the help of a stop watch. The projection angles and Pulley Diameters were varied in the experimental investigation.

Why We Focused on Shot Peening for the Productivity Enhancement?

The process of Shot Peening was used in our research for reducing the time of the process and thus increasing the productivity. The reason for this is that there is highest scope of the reduction in the process time of the shot peening. The shot peening process is dependent on various parameters and the parameters can be varied to reduce the peening time effectively. The other process like Tempering of the spring at high temperature are not focused as reducing the tempering time will impair the quality of the springs produced and thus there is very little scope of reducing the tempering time. Also the coiling process is performed with the help of a CNC machine and it takes the minimum time in the coiling process. Thus the scope of reducing the coiling time is also limited.

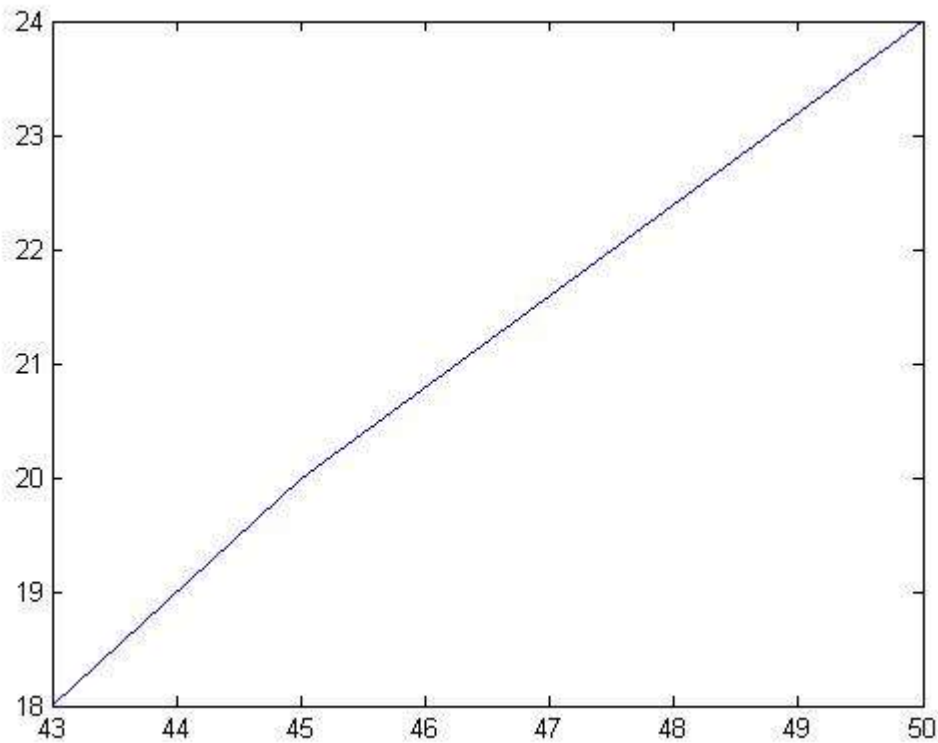
Thus based on the above investigations the Shot peening was the area which was decided to focus on to reduce the process time.

RESULTS AND DISCUSSIONS

Projection Angle

The projection angle of the shot peening was changed and the shot peening process was repeated several times. The projection angle was varied from 41Degrees to 53 Degrees and the peening time for complete shot peening was measured. The data measured is tabulated in the table below:

S.nos	Projection Angle	Peening Time (Minutes)
1	50	24
2	45	20
3	43	18

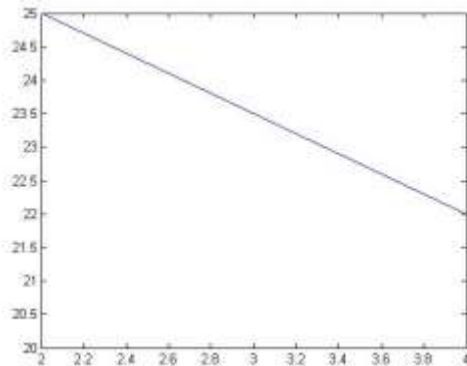


PEENING TIME V/S PROJECTION ANGLE

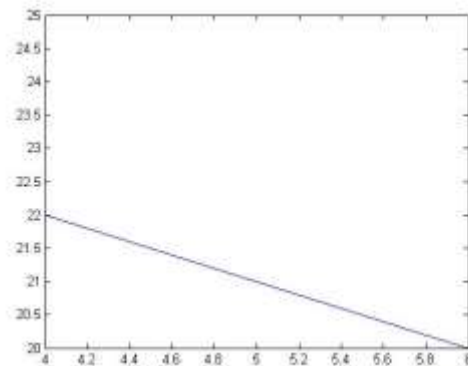
Pulley Diameter in Inches (Pulley A and Pulley B)

The pulley diameters for the pulleys used in motor for the shot peening was changed and the shot peening process was repeated several times. The two pulleys diameters were changed from 2 inches to 6 inches and the peening time for complete shot peening was measured. The motor attached with Pulley A is of 5 HP and that with Pulley B is 7.5 HP. The data measured is tabulated in the table below:

S.NO	Dia Pulley A (inch)	Dia Pulley B (inch)	Peening Time
1	2	4	20-25
2	4	4	20-22
3	4	6	18-20



PEENING TIME V/S DIA A



PEENING TIME V/S DIA B

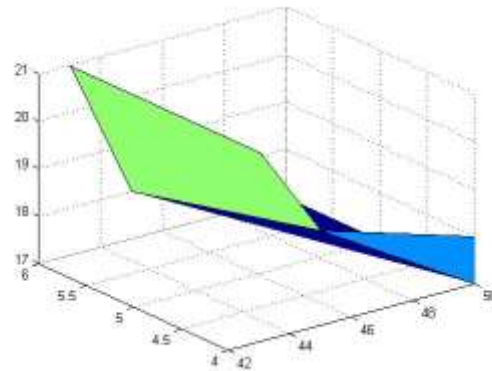
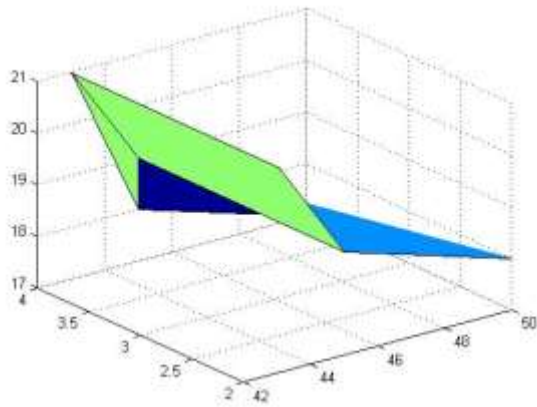
Combined Effect of Pulley Diameter and Projection Angle

The Projection angle and Pulley Diameter were changed and the shot peening process was repeated several times. The projection angle was varied from 41 Degrees to 53 Degrees and the two pulleys diameters were changed from 2 inches to 6 inches and the peening time for complete shot peening was measured. The motor attached with Pulley A is of 5 HP and that with Pulley B is 7.5 HP. The data measured is tabulated in the table below:

S.no	Projection Angle	Dia Pulley A (inch)	Dia Pulley B (inch)	Peening Time
1	50	2	4	18
2	45	2	4	19
3	43	2	4	21
4	50	4	4	17
5	45	4	4	19
6	43	4	4	21
7	50	4	6	17
8	45	4	6	18
9	43	4	6	21

From the above analysis the minimum peening time is 15 min and the optimum combination is at Projection Angle = 50 and Pulley Dia A= 4 inch and Pulley Dia B =6 inch

From the above analysis the maximum peening time is 21 min and the combination is at Projection Angle = 43 mm and Pulley Dia A= 2 inch and Pulley Dia B =4 inch



Peening Time V/s Projection angle and Pulley Dia A) (Peening Time V/s Projection angle and Pulley Dia B)

CONCLUSION

In this project the parameters Projection Angles and Pulley Diameters of the shot peening or the shot blasting process are varied to reduce the cycle time of the process. Results are calculated by the changing the above mentioned parameters and the time of the process are measured with the help of time measuring instrument. Thus reduction in the cycle time will be achieved by varying the projection angles and pulley diameters. The minimum Peening time comes out to be **15 Minutes** and the maximum peening time comes out to be **21 min.**

Thus a reduction of maximum **5 to 6 minutes** can be achieved by proper selection of above parameters. In future work there is a possibility of reducing the cycle time of other processes which are involved in the spring manufacturing process. Thus a lot of scope lies in reducing the overall cycle time of the spring manufacturing process.

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