Critical Analysis of Chip Breaking for Mild Steel in Turning Operation of Production System

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***Abstract*— In a modern automatic manufacturing system the reliability of machining operations is an essential requirement of the industrial sector. But in the turning operation the chip of unbroken is the major barrier of the automatic system. The characteristic of chip breaker for mild steel with respect to depth of cut, cutting speed and feed were analyzed from the result of the experiment.**

The chip breaking phenomenon was related to the mechanical properties of composites by a chip breaking criterion. In particular, effective chip control is necessary for a CNC machine or automatic production system because any failure in chip control can cause the lowering in productivity, but taken discontinuous chip obtaining by using the grooved type chip breaker.

Keywords-* *Chip breaker; CNC machine; MATLAB software.

I. INTRODUCTION

In the mild steel is the major role in industry, it is a important material which used more than 50 to 60% as automobile parts in automobile factories. When the disposal of chips is an important factor of factory due to the continuous cutting operation which will be improves the safety of worker and saving the cost. The better cutting techniques the quality of cutting tools has been improved continuously. When the better control of long continuous chips which is the factor of performance of the work piece by the method of chip are being generated less time. Therefore the purpose of this analysis is to solve the problem of continuous chip and constructed the basis of improved factory automation by using chip breakers of the attached obstruction type, which represent to control the method of factory automation.

Chip breakers are provided to control the continuous ribbon like chips that are formed at high cutting speed. Continuous chip are dangerous to the operator of the machine. When the chip breaker deflects the chip at sharp angle and causes it to break into small pieces. So that they are easily removed by various methods.

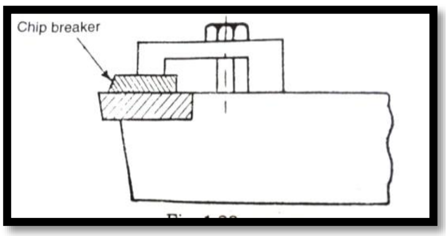

Fig 1: Obstruction type chip breaker

The chip breaker pattern affects chip breakability. In this chip breakability was predicted with shape elements depth, breadth, radius of the chip play an important role.

There are basically two types of chip breaker

1) Groove type (in built type)
2) Obstruction type (clamped type)

II. LITERATURE REVIEW

J.D.Kim et.al [1], the function of nose radius, cutting speed, inclined angle and curvature of work piece is the characteristics of chip flow. It indicated that thickness of chip is inversely proportional to shear angle and directly proportional to the feed rate. But better breaking condition low and medium cutting speeds lead simultaneously.

S.S. Joshi et.al [2], in developing appropriate cutting tool geometry, breaking of the chips is necessary for compaction of the chips in constrained environment (flutes of drill, tooth cavity in broaches, taps, etc. Curled and continuous chips not only occupy more volume but also creates difficulties in chip disposal system. The understanding of chip curling and breaking will thus help in developing better tools for composite materials.

L.-J. Xie et.al [3], in order to improve the estimate result and realize tool wear estimate in quantity, more efforts should be made in several aspects more reasonable friction modelling further mesh control and refinement at chip outside surface in chip formation analysis, consistency in simulation, experiment and characteristic equation of tool wear, for example, development of wear., characteristic equation and material model for the material used in tool wear experiment, etc.

Hong-Gyoo Kim et.al [4], performance of chip breaking was excellent at the finishing area, as the depth increases and the width decreased. Also the chip breakability was excellent at the roughing area as the depth decreased and the width increased.

K.P.Maity et.al [5], the optimum position of the chip breaker is around 13-14 times the uncut chip-thickness, with step - height equal to four times the uncut chip thickness, since the cutting forces becomes minimum at these positions. There is no chip breaking effect. When the chip breaker position is more than 28.8 times the uncut thickness, the minimum position of the chip-breaker is around 17 times the uncut chip thickness for all possible modes of deformation.

R.M.D Mesquite et.al [6], it shows that commercially available chip breaker geometries fail to control chip form in finishing machining when light cuts are required. For advanced carbide tool with form chip breaker, increasing the feed causes an increasing the shear angle. For light cuts the depth of cut also plays in important role in determining shear angle. Cutting speed has been found to have significant effect on the chip breaking area, increasing minimum feed for chip breaking by 30% when the cutting speed increasing 50%.

Jeong-du Kim and Eun-sang Lee et.al [7], its paper is a study on the phenomenon of chip breaking by computer analysis. He concluded that a finite element model for simulating chip breaking in the orthogonal cutting mode was developed and discussed. When the increase in chip radius and decrease in chip thickness cause decrease in the force acting on the chip breaker. The effect of chip breaking varies with chip thickness.

K.H.W. Seah et.al [8], has dealt with a three-dimensional model of chip flow, chip curl and chip breaking, taking into account the geometrical, the kinetic, as well as the mechanical features. For all these, a set of equivalent characteristic parameters was defined and a relationship was developed between these and the actual machining parameters.

G.P.Zou et.al [9], presented a paper on a new approach to the modeling of oblique cutting processes. Finally the authors point out that the model makes it relatively simple to add considerations of work hardening to both the force equilibrium constraints and the energy formulation. Such changes are embodied directly in the value of ratio.

N.Srinivas et.al [10], shows the paper evaluation of chip breaker using flank wear on EN-8 steel and optimization of machining parameters for maximum tool life and minimum chip length using RMS methodology. The final result was to analyze the effect of flank wear on response parameters and increasing the chip life.

III. PROBLEM IDENTIFICATION

It has been noted that the handling and disposal problem the turning operation produced the continous chips. So that the strong material like a mild steel which is insert the carbide or cermic tool, so the metal removal rate is high with high velocity.

For improve the mchinability, chip breaking is done proper way and reduced the cutting force also wear of the cutting tool. The purpose of the analysis is that to solve the problem of continuous chip by using the obstruction type chip breaker. So it is better control of the chip and reduced the chip thickess to best automation in the advanced technology system

IV. METHODOLOGY

Step-1**:** When this project the procedure will follow to calculated the result of response surface methodology by using the MATLAB software. So that the parameter like a chip thickness, chip diameter, chip length can be find out by using tool makers microscope. The next step is that the experiments will performed in a TIPL- 4 lathe machine. During the cutting operation chip length, chip thickness, chip diameter and the chip reduction coefficient can be carried out. By using the termite inner gas welding, the chip breaker should be welded properly.

Step 2**:** In the turning operation, the experiments were carried out by using the tool high speed steel inserts in a TIPL-4 lathe machine. The grade of high speed steels are listed below on Table. The machining operation were performed with depth of cut of (t) 0.3, 0.4, 0.5 mm and feed (f) of 0.3, 0.35, 0.4 mm/rev with cutting speeds (Vc) 100, 135, 180 m/min in atmosphere condition. The material should be used for present work in mild steel, its diameter is 90 mm and 280 mm length

TABLE I - DETAIL OF CUTTING TOOL

S.NO	Cutting Tool	ISO Grade and Specification.
1.	High speed steel(HSS) Insert	KT300 CNMA 120412

TABLE II- MECHANICAL PROPERTIES OF MILD STEEL

Mechanical properties	Values
Ultimate tensile strength (Mpa)	510
Yield strength (Mpa)	300
Elongation percentage (mm)	14
Rockwell Hardness	B64.30

TABLE-III EXPERIMENTAL READING.

Run No	Depth Of Cut (mm)	Feed (mm /rev)	Speed (m/min)	Chip Thickness (mm)	Chip Diameter (mm)	Chip Length (mm)	Chip Reduction Coefficient (ξ)
1	0.3	0.3	100	0.410	4.352	35.375	1.36
2	0.3	0.35	135	0.434	5.967	28.545	1.44
3	0.3	0.4	180	0.462	4.120	24.786	1.54
4	0.3	0.3	100	0.360	3.758	75.865	1.2
5	0.3	0.35	135	0.476	4.576	86.896	1.58
6	0.3	0.4	180	0.403	5.231	78.945	1.34
7	0.3	0.3	100	0.494	4.123	95.245	1.64
8	0.3	0.35	135	0.451	4.821	79.805	1.50
9	0.3	0.4	180	0.384	4.984	78.056	1.28
10	0.4	0.3	100	0.510	5.603	45.875	1.27
11	0.4	0.35	135	0.534	5.980	35.675	1.33
12	0.4	0.4	180	0.756	7.972	27.435	1.89
13	0.4	0.3	100	0.596	6.110	37.892	1.49
14	0.4	0.35	135	0.565	6.452	71.925	1.41
15	0.4	0.4	180	0.687	6.875	68.345	1.71
16	0.4	0.3	100	0.503	8.857	49.235	1.25
17	0.4	0.35	135	0.556	6.342	28.234	1.39
18	0.4	0.4	180	0.810	6.794	57.647	2.77
19	0.5	0.3	100	0.698	4.625	67.231	1.39
20	0.5	0.35	135	0.650	4.765	52.673	1.3
21	0.5	0.4	180	0.960	5.576	70.612	1.92
22	0.5	0.3	100	0.697	4.675	29.341	1.39
23	0.5	0.35	135	0.601	4.769	63.785	1.202
24	0.5	0.4	180	0.610	5.820	70.235	1.22
25	0.5	0.3	100	0.710	5.310	30.721	1.42
26	0.5	0.35	135	0.658	5.245	84.392	1.31
27	0.5	0.4	180	0.870	5.250		

V. RESULTS AND DISCUSSION

From the below figure is the photographs of the chip for the cutting speed 100,135 and 180 m/min at feed of 0.3, 0.35 and 0.4 mm/revolution

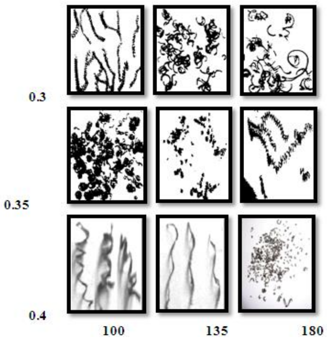

Fig. 2: For various Feed and Speed the chip produced at Depth of cut 0.3 mm

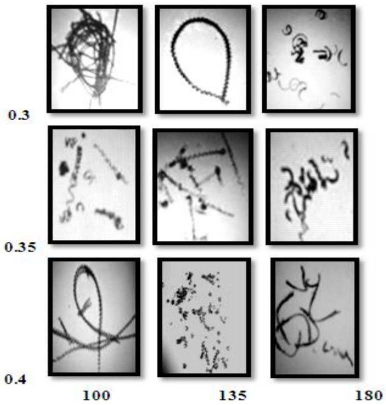

Fig 3: For various Feed and Speed the chip produced at Depth of cut 0.35 mm.

RESPONSE SURFACE METHODOLOGY FOR CHIP REDUCTION COEFFICIENT

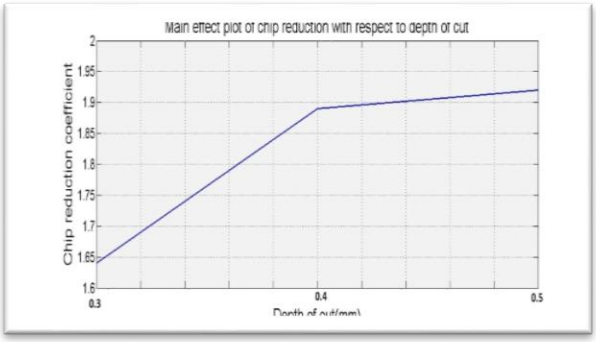

Figure 4: Main effect plot for the Means of chip reduction coefficient with respect to depth of cut.

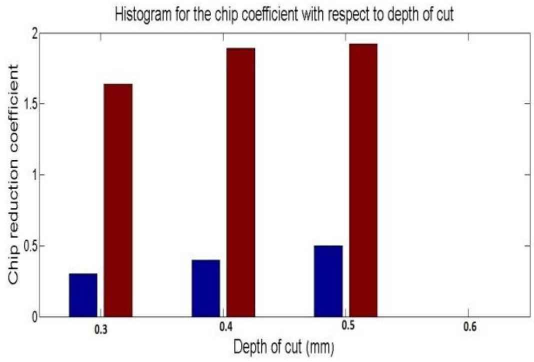

Fig 5: Histogram for chip reduction coefficient with respect to depth of cut.

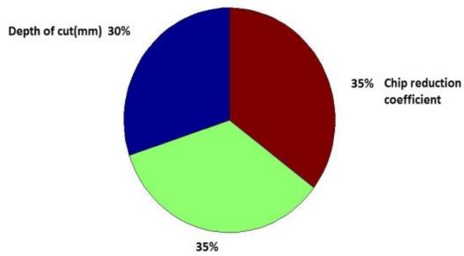

Fig 6: Pie chart of chip reduction coefficient with respect to Depth of cut

RESPONSE SURFACE METHODOLOGY FOR CHIP LENGTH

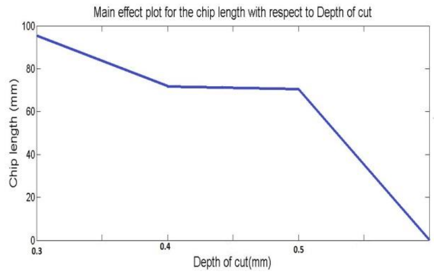

Fig 6: Main effect plot for chip length with respect to Depth of cut

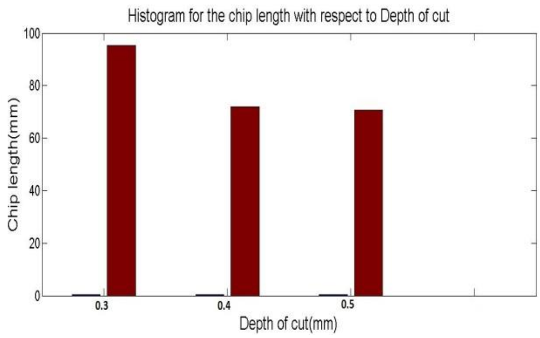

Fig 7: Histogram for the chip length with respect to Depth of cut

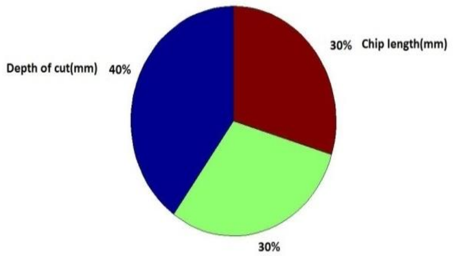

Figure 8: Pie chart of chip length with respect to Depth of cut

RESPONSE SURFACE METHODOLOGY FOR CHIP DIAMETER

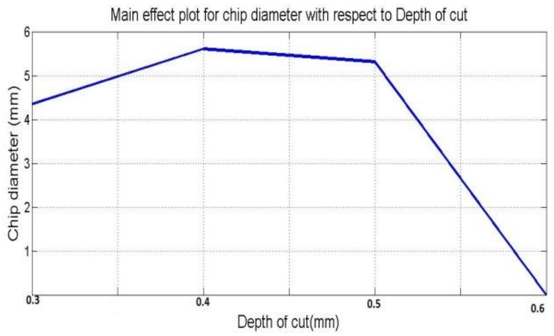

Fig 9: Main effect plot for chip diameter with respect to Depth of cut

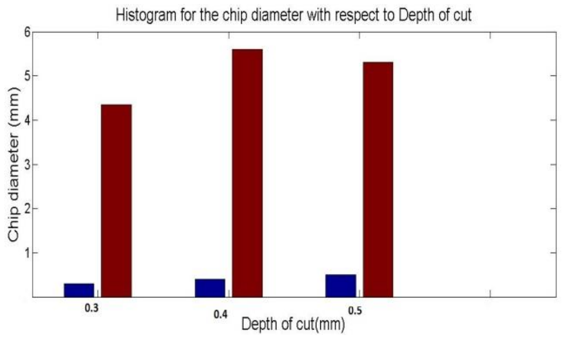

Fig 10. Histogram for the chip Diameter with respect to Depth of cut

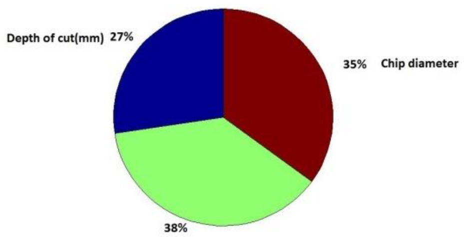

Fig 11. Pie chart of chip Diameter with respect to Depth of cut

VI. CONCLUSION

When the experiment is completed, it has concluded that the machine parameter like depth of cut, feed, cutting speed, chip length and chip thickness will be effected. The main object of the study was to analyze on the response parameter effect of tool flank wear. For the chip breakability, the cutting speed, depth of cut and feed is important role in cutting performance of the mild steel material.

For better control and good result, the cutting speed and depth of is more important factor.

In further work the composite material may be used to analysis of the chip breaker but taken standard grade of the specimen with design parameter.

The work may be carried out by change chip breaker depth with less than 1 mm with new design of chip in turning operation.

Angle parameter may be change and analysis may be done.

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