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OPTIMIZATION OF THE CUTTING FORCE & POWER CONSUMPTION OF SHAPER MACHINE BY VARYING DIFFERENT PARAMETRES DURING CUTTING OPERATION USING COMPUTER INTERFACE

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ABSTRACT

Shaper machine is used for shaping operation on the work piece .It works on the principle of Quick Return Mechanism in which forward stroke is cutting while return stroke is idle. In cutting operation large amount of Power is consumed which can be reduced. Previously Force Analysis was done on turning operation to analysis cutting force on tool and work piece. This paper develops a methodology to find out cutting force and power required by the tool to perform shaping operation on work piece. The cutting force is calculated by using load cell based dynamometer. By increasing the rake angle of tool cutting force and hence power consumption get reduced. In future these Load cell based tool dynamometer can be used to Stress and temperature distribution on tool and Work piece.

Keyword: Cutting force.

INTRODUCTION

Shaper Machine works on small work piece for shaping operation. The Mechanism which is used to perform cutting operation on shaper machine are based on quick return mechanism in which forward stroke is cutting stroke while return stroke is idle. As the depth of cut in the work piece increases cutting force will increase & hence the power consumption. Many researchers spent effort to determine optimum tool cross-sections and their ideal rake angles to withstand cutting forces. To Analyses the forces on shaper machine at first Ernst and Merchant[1],focused on plotting all the forces on a circle by considering single shear plane with no built up edge, by calculating cutting force & thrust force we can calculate all the value of forces, but assumption of merchant circle i.e single shear plane model ,no built up edge consideration where resolved by Okushima & hithomi model[2], assumed that rather than along a single shear plane, the shearing should fulfill a transitional region. Lee-Shaffer Model [3] gave us knowledge about Built Up Edge Consideration by considering angle Ɵ which is the angle b/w Shear force & Normal reaction. There have been many studies concerning the effect of cutting parameters and rake angle on the cutting forces, Satyanarayana et al [4] has made an attempt to study the effect of rake angle and feed rate on the cutting forces in an orthogonal cutting process. A.K. Baldoukas et al[5] experimentally Analyses the influence of cutting depth, tool rake angle and work piece material type on the main cutting force . The surface along which the chip flows is the rake face of the tool [6], the angle between the rake face and a line perpendicular to the machined surface is called rake angle α.The angle between the rake face and the flank face is the wedge angle β.The angle between the flank face of the tool and the work piece is called clearance angle gamma .The sum of the three angles Is 90. Astakhov [7] summarized that the major drawback of the single shear plane model as being the infinite strain rate & the perfectly sharp cutting edge of the tool and the fact that there is no contact on the tool flank surface that are not realistic for common practice.Deepak Bhardwaj & Lakhwal [8] give us idea that if the side cutting slope downward from a point Rake angle is positive,and is negative if the slope of side cutting edge is reverse.Mustafa Gunay et al[9] designed a special dynamometer to measure the forces for this purpose. Two strain gauge based load cell were placed in the proper position onto machine tool and cutting tool. Replacements of the tool caused by cutting forces were sensed by these proper placements.

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METHODOLOGY

Analysis is the base of Research, after reviewing the previous work we used two load cell for Analysis of different forces on shaper machine. We use base of Merchant Circle to analyses the forces, but we come to a point that if we have to analyses different forces on shaper then we have to calculate two forces trust force & cutting force. To calculate cutting force we use a load cell of 500 kg to calculate thrust force we use a load cell of 200 kg because cutting force increase as depth of cut increases and also when harder material is used. To collect the data in computer we designed Printed circuit Board which collect the load apply on load cell and take it as an input data and convert it from Analog to Digital signal so that data can be easily Display on computer screen. After collecting these data's of cutting and thrust force we apply it on Merchant Circle to analyses different forces. To resolve Assumption of Merchant's circle i.e. single shear plane and No built up edge where resolved by okushima - hithomi model & Lee-Shaffer model. Calculations of all the values give us result of power consumption during operations on Shaper Machine under varying Rake angle.

OBSERVATIONS:TABLE 1 Cutting & thrust force calculation on 0o rake angle

ALPHA (degree)	$T_{1(}$mm$_{)}$	F_c(N)	F_t(N)	Beta (deg.)	F_{s1}(N)	F_{s2}(N)	N(N)	F(N)	Φ_1 (deg)	Φ_2 (deg)	POWER (Watt)
0	0.2	200	50	14	181	170	200	50	15	18	5600
0	0.5	300	98	18	202	192	300	98	32	35	8400
0	1	550	200	20	376	342	550	168	30	33	15400
0	1.5	900	300	18	628	574	900	300	31	35	25200

TABLE 2 Cutting & thrust force calculation on 6o rake angle

ALPHA(degree)	$T_{1(}$mm$_{)}$	F_c(N)	F_t(N)	Beta (deg.)	F_{s1}(N)	F_{s2}(N)	N(N)	F(N)	Φ_1 (deg)	Φ_2 (deg)	POWER (Watt)
6	0.2	190	48	20.1	120	100	184	68	38	42	5320
6	0.5	280	70	20	181.49	161.24	271.15	98	39	44	7840
6	1	500	97	17	341	307	487	198	37	42	14000
6	1.5	600	150	22.7	358	316	481.5	340	30	36	16800

TABLE 3 Cutting & thrust force calculation on 12o rake angle

ALPHA(degree)	$T_{1(}$mm$_{)}$	F_c(N)	F_t(N)	Beta (deg.)	F_{s1}(N)	F_{s2}(N)	N(N)	F(N)	Φ_1 (deg)	Φ_2 (deg)	POWER (Watt)
12	0.2	180	50	27.5	118	105	166	86	35	38	5040
12	0.5	290	110	32.7	183	161	261	168	33	37	8120
12	1	470	160	30.8	300	257	426.4	254.2	34	37	13160
12	1.5	500	233	30.4	429	386	636.3	373.44	36	41	14000

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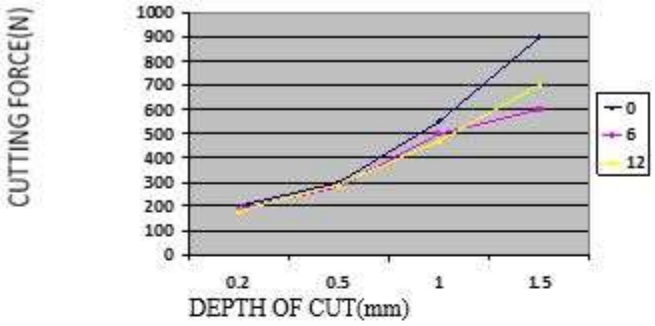
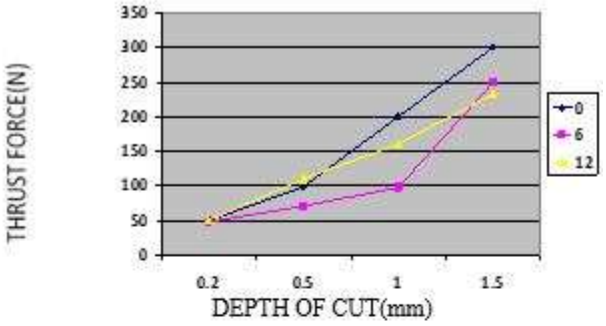
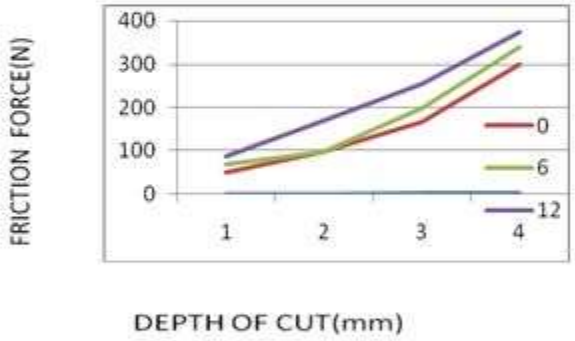
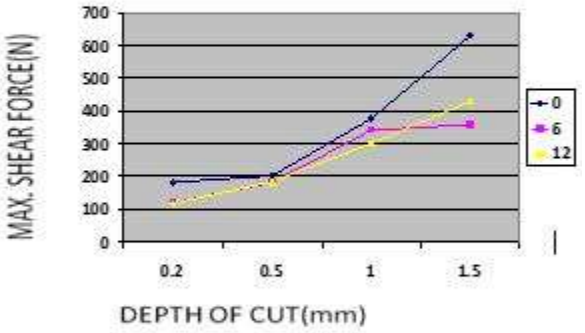
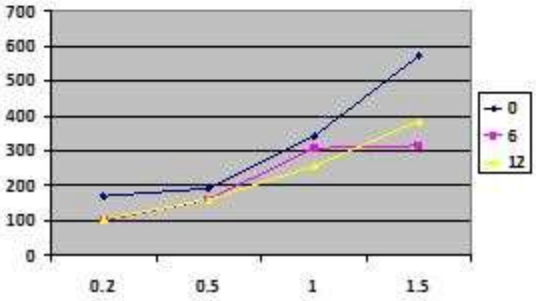
CHART BETWEEN DEPTH OF CUT AND RAKE ANGLE [0^0,6^0,12^0]:

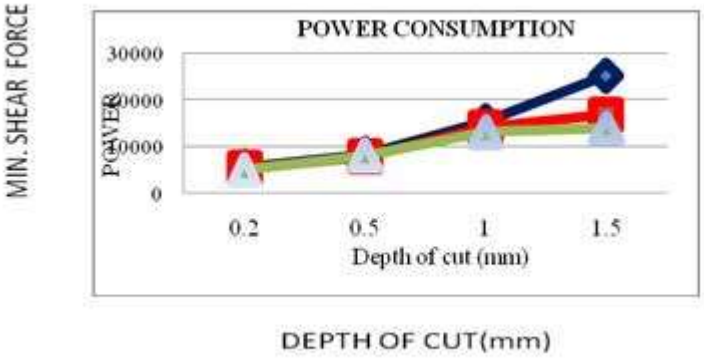












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RESULT

When we use this set up to Measure forces on Shaper machine we come to a discussion that when we increase Rake Angle then Cutting force reduces & hence Power Consumption Reduced. We get optimum Value of power consumption for .5 mm depth of cut is at 6^0. Friction Force which Resist Motion & hence increase cutting force its optimum value where it is minimum is at 6^0. As we increase depth of cut (mm) cutting force & hence power consumption increases.

CONCLUSION

Load cell is used to analyses forces on shaper machine, by the use of this load cell we can analyses forces acting on the tool and the work piece which is used further to analyses power consumption by the tool to cut the work piece. When we analyses all these parameters we come to a point that as we increase depth of cut, cutting & thrust force increases and with increase in Rake Angle, friction force will also increase .

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