Experimental study of single point incremental forming of SS316

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Abstract

There are many forming processes used in the industry for a long time. Many conventional sheets forming processes are deadly, time taking in development and design as well. In order to solve these problems Single Point Incremental Forming (SPIF) is presented which is a modern method for metal sheet forming for prototyping purpose, where parts can be formed without the use of dies.in this present work spif process is carried out on SS316 sheet of 1 mm thickness and hemispherical tool of 16mm is used for the forming process at three different wall angle and find the optimum value of surface finish and thickness distribution.

Key word: incremental forming, surface finish, thickness distribution

Introduction

This process can be performed on CNC or VMC machine in which single forming tool is used to deform sheet metal in z direction for getting desired shape, SPIF has ability to form complex part and main advantages of this process is it is completely die less process and reducing the lead time for tool set up and very economic process. Spif process can be carried out on aluminium, titanium, stainless steel, polymer and composite material according to application.

Literature review

Ham and Jeswiet (2008), Ham and Jeswiet (2006) highlight the various parameters which influence formability during incremental forming. The effect of step size, wall angle, the feed rate and the spindle rotation speed on formability were analysed

Filice et al. (2002) researched on the forming limit diagram for the incremental sheet forming process. They performed experiments for three different straining conditions which were pure uni axial stretching condition, bi-axial stretching and a new testing condition which was in between the uni-axial and bi-axial stretching condition

Duflou et al. performed experimental investigation on multi-step tool path strategy for SPIF with the findings that the thickness of multi-step cone was higher than that of the singlestep cone. Hussain et al, presented the method to test the thinning limit by forming a cone with increasing wall angle. Average forming limit angle obtained was 68.46° with a cone with circular generatrix radius of 115 mm. Hirt et al. applied multistage strategy to form 81□angle pyramid from a preformed pyramid having angle of 45□. Malhotra et al. proposed Multi-Pass SPIF strategy to form stepped feature with smoother component base. Manco et al. studied the effect of four different tool path influence on the thickness distribution in SPIF.

Experimental setup

In this present work stainless steel of grade AISI316 of 1 mm thickness is used as sheet metal and tool is made up from EN8 of 16 mm diameter.

Geometry of CONE is selected for trhe present study for that diameter of cone is taken as 100 mm and depth of the cone is 30 mm. following parameters are used for the study of SPIF.

Diameter of tool: 16mm

Feed of tool is 750 mm/min

Tool RPM: 1500 rpm

Depth of tool: 0.5 mm

Wall angle: 30 ,40 ,60 degree

Hear the wall angle is varying parameter and diameter of tool, feed of tool, tool rpm, depth of tool is varying parameters.

Sr no	Feed of tool	Depth of tool	Tool RPM	Wall angle
1	750	0.5	1500	30
2	750	0.5	1500	45
3	750	0.5	1500	60

Experiment is performed on the VMC milling machine and following is the specification of machine

Specification of machine

Make: Ace Manufacturing Systems, Bangalore

Model: mcv-950, Power = 5.5kW Controller: FANUC

Tool travel:

X-axis – 1000 mm Y-axis – 650 mm

Z-axis – 500 mm Table length: 510 mm

Table width: 1150 mm Groove width: 10 mm

Groove spacing: 300 mm

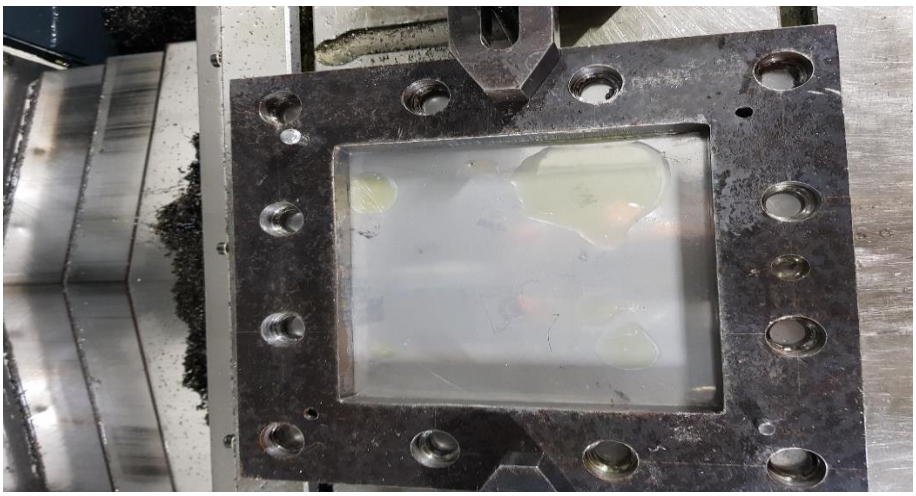

Figure: sheet metal set up

After performing experiment thickness and surface finish of the formed plate is to be measure

Observation table for surface finish. Surface finish is measured by use of roughness tester

Feed mm/min	Tool speed RPM	Depth of tool mm	wall angle degree	finish micron
750	1500	0.5	30	2.34
750	1500	0.5	45	2.96
750	1500	0.5	60	2.93

Observation table for thickness distribution

Feed mm/min	Tool speed RPM	Depth mm	wall angel degree	Thickness Mm
750	1500	0.5	30	0.88
750	1500	0.5	45	0.78
750	1500	0.5	60	0.62

After performing experiment, it is analysing that part which is at 60-degree wall angle it is going to be fail the 13 mm and it can not form at the depth of 30 mm

Figure – wall angle 60 degree

Conclusion

After performing this experiment, we can able to conclude optimum angle for the good surface finish and proper thickness distribution for AISI316, and also find that at the 60-degree the sheet get fail without fully formed so we can said that the 60-degree wall angle is the maximum wall angle limit at which SS316 can formed

Referances

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