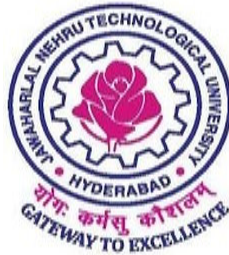


PARAMETRIC OPTIMIZATION OF NI201 DEEP DRAWN CONICAL CUPS

J. Nithin Sai

M. Tech (AMS), Roll No.:15011P0306, Department of Mechanical Engineering, JNTUH College of Engineering, Hyderabad



Under the Guidance of Dr. A. Chennakesava Reddy, Professor, JNT University Hyderabad

ABSTRACT

In this present work, the statistical approach based on Taguchi design of experiments and the finite element analysis were adopted to determine degree of each parameter i.e. punch velocity, coefficient of friction, blank thickness and displacement per step on the formability of conical cups drawn from Nickel 201 alloy using the deep drawing process. The damage of cups was lower when coefficient of friction was low. The major parameters that would influence the surface expansion ratio were the thickness of sheet and the coefficient of friction. Greater the coefficient of friction higher would be the surface expansion ratio. The cup height was higher when the coefficient of friction was 0.15 and blank thickness was greater than 1mm.

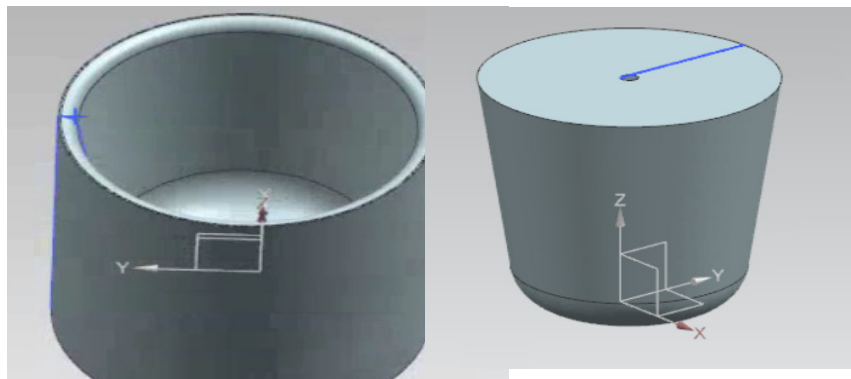


Fig 1: Modeled Die and punch in Siemens Nx (Unigraphics)

It is observed that the process parameters that has greater influence on the formability of deep drawing of conical cups of Nickel 201 are coefficient of friction and blank thickness. Damage of cups is lower when coefficient of friction is low. Major parameter that influence surface expansion ratio is thickness and coefficient of friction, more is coefficient of friction higher

will be the surface expansion ratio. Cup height is higher when coefficient of friction is 0.15 and blank thickness is greater than 1mm.

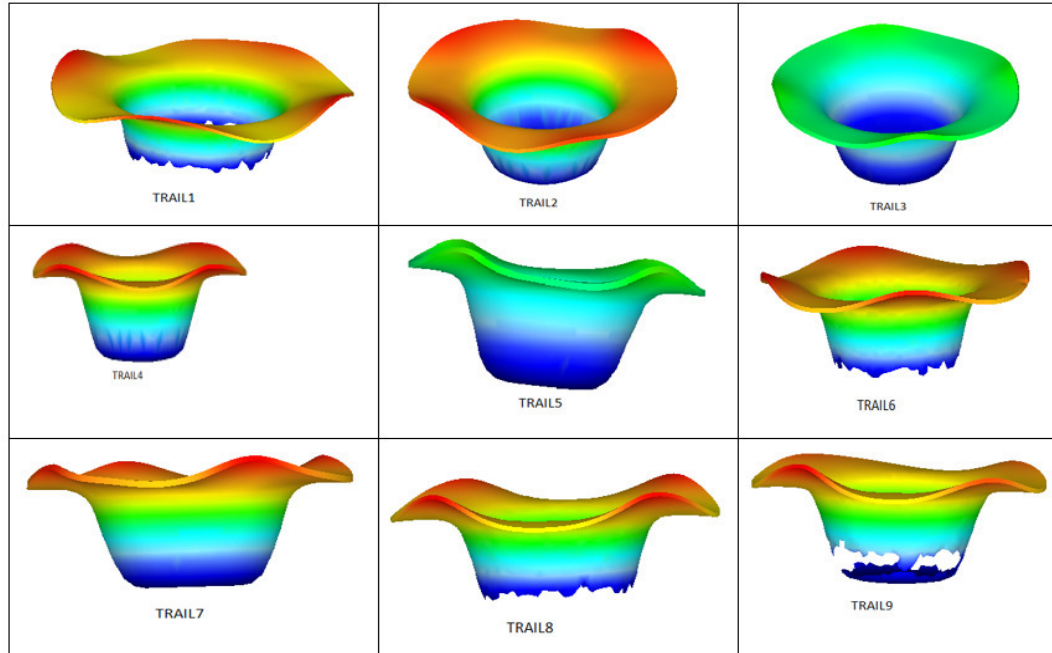


Fig 2: height of the conical cups under different trial conditions

REFERENCES

1. A.C. Reddy, Finite element analysis of reverse superplastic blow forming of Ti-Al-4V alloy for optimized control of thickness variation using ABAQUS, Journal of Manufacturing Engineering, vol.1, no.1, pp.6-9, 2006.
2. J.J.V. Jeyasingh, G. Kothandaraman, P.P.Sinha, B. Nageswara Rao, A.C.Reddy, Spherical dome formation by transformation of superplasticity of titanium alloys and titanium matrix composites, Materials Science and Engineering: A, vol.478, no.1&2, pp.397-401, 2008.
3. J.V.Jeysingh, B. Nageswara Rao, A. C. Reddy, Investigation on failures of hydroforming deep drawing processes, Materials Science Research Journal, vol.2, no.3 & 4, pp.145-167, 2008.
4. J.J.V.Jeysingh, B. Nageswara Rao, A. C. Reddy, Development of a ductile fracture criterion in cold forming, Materials Science Research Journal, vol.2, no.3&4, pp.191-206, 2008.
5. J.V.Jeysingh, B. Nageswara Rao, A. C. Reddy, Gas pressure forming of spherical domes from Pb-Sn eutectic alloy superplastic sheet material, Materials Science Research Journal, vol.2, no.3&4, pp.241-258, 2008.
6. A. C. Reddy, Influence of strain rate and temperature on superplastic behavior of sinter forged Al6061/SiC metal matrix composites, International Journal of Engineering Research & Technology, vol.4, no.2, pp.189-198, 2011.

7. A. C. Reddy, T. Kishen Kumar Reddy, M. Vidya Sagar, Experimental characterization of warm deep drawing process for EDD steel, *International Journal of Multidisciplinary Research & Advances in Engineering*, vol.4, no.3, pp.53-62, 2012.
8. A. C. Reddy, Simulation analysis of four-pass shape roll forming of I-sections, *International Journal of Mechanical and Production Engineering Research and Development*, vol.5, no.1, pp.35-44, 2015.
9. Kothapalli Chandini, A. C. Reddy, Parametric Importance of Warm Deep Drawing Process for 1070A Aluminium Alloy: Validation through FEA, *International Journal of Scientific & Engineering Research*, vol.6, no.4, pp.399-407, 2015.
10. Balla Yamuna, A. C. Reddy, Parametric Merit of Warm Deep Drawing Process for 1080A Aluminium Alloy: Validation through FEA, *International Journal of Scientific & Engineering Research*, vol.6, no.4, pp.416-424, 2015.
11. Thirunagari Srinivas, A. C. Reddy, Parametric Optimization of Warm Deep Drawing Process of 1100 Aluminum Alloy: Validation through FEA, *International Journal of Scientific & Engineering Research*, vol.6, no.4, pp.425-433, 2015.
12. A. C. Reddy, Homogenization and Parametric Consequence of Warm Deep Drawing Process for 1050A Aluminum Alloy: Validation through FEA, *International Journal of Science and Research*, vol.4, no.4, pp.2034-2042, 2015.
13. A. C. Reddy, Parametric Optimization of Warm Deep Drawing Process of 2014T6 Aluminum Alloy Using FEA, *International Journal of Scientific & Engineering Research*, vol.6, no.5, pp.1016-1024, 2015.
14. A. C. Reddy, Finite Element Analysis of Warm Deep Drawing Process for 2017T4 Aluminum Alloy: Parametric Significance Using Taguchi Technique, *International Journal of Advanced Research*, vol.3, no.5, pp.1247-1255, 2015.
15. A. C. Reddy, Parametric Significance of Warm Drawing Process for 2024T4 Aluminum Alloy through FEA, *International Journal of Science and Research*, vol.4, no.5, pp.2345-2351, 2015.
16. Balla Yamuna, A. C. Reddy, Finite Element Analysis of Warm Deep Drawing Process for Conical Cup of AA1080 Aluminum Alloy, *International Journal of Advanced Research*, vol.3, no.6, pp.1309-1317, 2015.
17. Kothapalli Chandini, A. C. Reddy, Finite Element Analysis of Warm Deep Drawing Process for Pyramidal Cup of AA1070 Aluminum Alloy, *International Journal of Advanced Research*, vol.3, no.6, pp.1325-1334, 2015.
18. Thirunagari Srinivas, A. C. Reddy, Finite Element Analysis of Warm Deep Drawing Process for Rectangular Cup of AA1100 Aluminum Alloy, *International Journal of Advanced Research*, vol.3, no.6, pp.1383-1391, 2015.
19. A. C. Reddy, Formability of Warm Deep Drawing Process for AA1050-H18 Pyramidal Cups, *International Journal of Science and Research*, vol.4, no.7, pp.2111-2119, 2015.
20. A. C. Reddy, Formability of Warm Deep Drawing Process for AA1050-H18 Rectangular Cups, *International Journal of Mechanical and Production Engineering Research and Development*, vol.5, no.4, pp.85-97, 2015.
21. A. C. Reddy, Formability of superplastic deep drawing process with moving blank holder for AA1050-H18 conical cups, *International Journal of Research in Engineering and Technology*, vol.4, no.8, pp.124-132, 2015.
22. A. C. Reddy, Formability of High Temperature and High Strain Rate Superplastic Deep Drawing Process for AA2219 Cylindrical Cups, *International Journal of Advanced Research*, vol.3, no.10, pp.1016-1024, 2015.
23. C. R. Alavala, High temperature and high strain rate superplastic deep drawing process for AA2618 alloy cylindrical cups, *International Journal of Scientific Engineering and Applied Science*, vol.2, no.2, pp.35-41, 2016.

24. C. R. Alavala, Practicability of High Temperature and High Strain Rate Superplastic Deep Drawing Process for AA3003 Alloy Cylindrical Cups, *International Journal of Engineering Inventions*, vol.5, no.3, pp.16-23, 2016.
25. C. R. Alavala, High temperature and high strain rate superplastic deep drawing process for AA5049 alloy cylindrical cups, *International Journal of Engineering Sciences & Research Technology*, vol.5, no.2, pp.261-268, 2016.
26. V. Srija, A. C. Reddy, Single Point Incremental Forming of AA1050-H18 Alloy Frustum of Cone Cups, *International Journal of Science and Research*, vol.5, no.6, pp.1138-1143, 2016.
27. T. Santhosh Kumar, A. C. Reddy, Finite Element Analysis of Formability of Pyramid-al Cups Fabricated from AA1100-H18 Alloy, *International Journal of Science and Research*, vol.5, no.6, pp.1172-1177, 2016.
28. A. Raviteja, A. C. Reddy, Finite Element Analysis of Single Point Incremental Deep Drawing Process for Truncated Pyramidal Cups from AA 1070 Alloy, *International Journal of Innovative Science, Engineering & Technology*, vol.3, no.6, pp.263-268, 2016.
29. V. Srija, A. C. Reddy, Numerical Simulation of Truncated Pyramidal Cups of AA1050-H18 Alloy Fabricated by Single Point Incremental Forming, *International Journal of Engineering Sciences & Research Technology*, vol.5, no.6, pp.741-749, 2016.
30. T. Santhosh Kumar, A. C. Reddy, Single Point Incremental Forming and Significance of Its Process Parameters on Formability of Conical Cups Fabricated from AA1100-H18 Alloy, *International Journal of Engineering Inventions*, vol.5, no.6, pp.10-18, 2016.
31. A. Raviteja, A. C. Reddy, Implication of Process Parameters of Single Point Incremental Forming for Conical Frustum Cups from AA1070 Using FEA, *International Journal of Research in Engineering and Technology*, vol.5, no.6, pp.124-129, 2016.
32. T. Santhosh Kumar, V. Srija, A. Ravi Teja, A. C. Reddy, Influence of Process Parameters of Single Point incremental Deep Drawing Process for Truncated Pyramidal Cups from 304 Stainless Steel using FEA, *International Journal of Scientific & Engineering Research*, vol.7, no.6, pp.100-105, 2016.
33. G. Devendar, A. A. C. Reddy, Study on Deep Drawing Process Parameters - A Review, *International Journal of Scientific & Engineering Research*, vol.7, no.6, pp.149-155, 2016.
34. C. R. Alavala, FEM Analysis of Single Point Incremental Forming Process and Validation with Grid-Based Experimental Deformation Analysis, *International Journal of Mechanical Engineering*, vol.5, no.5, pp.1-6, 2016.
35. C. R. Alavala, Validation of Single Point Incremental Forming Process for Deep Drawn Pyramidal Cups using Experimental Grid-Based Deformation, *International Journal of Engineering Sciences & Research Technology*, vol. 5, no.8, pp.481-488, 2016.
36. G. Devendar, A. C. Reddy, Formability Limit Diagrams of Cold Deep Drawing Process for Nickel 201 Cylindrical Cups, *International Journal of Science and Research*, vol.5, no.8, pp.1591-1598, 2016.
37. C. R. Alavala, Development of High Temperature and High Strain Rate Super Plastic Deep Drawing Process for 5656 Al Alloy Cylindrical Cups, *International Journal of Mechanical and Production Engineering*, vol.4, no.10, pp.187-193, 2016.
38. B. Navya Sri, A. C. Reddy, Formability Of Elliptical SS304 Cups in Single Point Incremental Forming Process by Finite Element Method, *International Journal of Research in Engineering & Technology*, vol.4, no.11, pp.9-16, 2016.
39. K. Sai Santosh Kumar, A. C. Reddy, Die Less Single Point Incremental Forming Process of AA6082 Sheet Metal to Draw Parabolic Cups using ABAQUS, *International Journal of Advanced Technology in Engineering and Science*, vol.4, no.11, pp.127-134, 2016.

40. T. Manohar Reddy, A. C. Reddy, Numerical Investigations on The Single Point Incremental Forming of 60-40 Brass to Fabricate Hyperbolic Cups, International Journal of Advance Research in Science and Engineering, vol.5, no.11, pp.161-170, 2016.
41. G. Soujanya, A. C. Reddy, Analysis of Single Point Incremental Forming Process to Fabricate Phosphorous Bronze Hemispherical Cups, International Journal of Innovative Science, Engineering & Technology, vol.3, no.11, pp.139-144, 2016.
42. A. C. Reddy, Numerical and Experimental Investigation of Single Point Incremental Forming Process for Phosphorus Bronze Hemispherical Cups, International Journal of Scientific & Engineering Research, vol.8, no.1, pp.957-963, 2017.
43. A. C. Reddy, Evaluation of Single Point Incremental Forming Process for Parabolic AA6082 Cups, International Journal of Scientific & Engineering Research, vol.8, no.1, pp.964-970, 2017.
44. A. C. Reddy, Experimental and Numerical Studies on Formability of Stainless Steel 304 in Incremental Sheet Metal Forming of Elliptical Cups, International Journal of Scientific & Engineering Research, vol.8, no.1, pp.971-976, 2017.
45. A. C. Reddy, Pilot Studies on Single Point Incremental Forming Process for Hyperbolic Brass Cups, International Journal of Scientific & Engineering Research, vol.8, no.1, pp.977-982, 2017.
46. A. C. Reddy, Effect of Recrystallization Temperature on Formability of Hot Deep Drawn Cylindrical Cups from 6082 Al Alloy, Indian Journal of Engineering, vol.14, no.36, pp.157-166, 2017.
47. A. C. Reddy, Formability Analysis of 6063 Al Alloy for Deep Drawn Cylindrical Cups with Constant and Progressive Blank Holding Force, SSRG International Journal of Mechanical Engineering, vol.4, no.5, pp.26-32, 2017.
48. Shashank Chagalamarri, G. Devendar, A. C. Reddy, Assessment of Strain and Stress – Based Formability Diagrams of Inconel 600 Hemispherical Cups Drawn by Single Point Incremental Forming Process using ABAQUS, International Journal of Advanced Technology in Engineering and Science, vol.5, no.5, pp.710-719, 2017.
49. B. Sumanth Kumar, G. Devendar, A. C. Reddy, Formability Analysis of Parabolic Cups Drawn from Ni201 using Single Point Incremental Forming Process, International Journal of Engineering Sciences & Research Technology, vol.6, no.5, pp.619-628, 2017.
50. A. C. Reddy, Formability of 5083 Al Alloy Hemi-Spherical Shells Using Hot Deep Drawing Process, International Journal of Mechanics and Solids, vol.9, no.3, pp.257-266, 2017.
51. A. C. Reddy, Evaluation of Formability Limit Diagrams of Arsenic Brass (70/30) Using Finite Element Analysis, International Journal of Mechanical Engineering and Information Technology, vol.5, no.6, pp.1651-1656, 2017.
52. A. C. Reddy, Impact of High Temperature and Beta-Phase on Formability of Cylindrical Cups from Cu-28%Zn and Cu-37%Zn Alloys, International Journal of Material Sciences and Technology, vol.7, no.1, pp.17-26, 2017.
53. M. Jaswanth Krishna, A. C. Reddy, Evaluation of Process Parameters of Conical Cups in Incremental Deep Drawing Process, International Journal of Science and Research, vol.7, no.6, pp.1350, 2018.
54. P. Kamesh, A. C. Reddy, Micromechanical Plastic Behavior of AA5454 Alloy used for Fabrication of Pyramidal Cups, International Journal of Science and Research, vol.7, no.6, pp.1225-1230, 2018.
55. Teniya Choppala, A. C. Reddy, Elastoplastic Behavior of AA2124 Alloy used to make Hemispherical Cups, International Journal of Science and Research, vol.7, no.6, pp.1295-1300, 2018.

56. T. Madhavi, A. C. Reddy, Manufacturing simulation and optimization of turbine blade die used in forging process, National Conference on Advances in Mechanical Engineering, Hyderabad, 13-14th May 2005, pp.127-131.
57. J. J. V. Jeyasingh, K. Dhananjayan, G. Kothandaraman, P. P. Sinha, B. Nageswara Rao, A. C. Reddy, Studies on the gas pressure formed Pb-Sn Eutectic alloy spherical domes, National Aerospace Manufacturing Seminar, Thiruvanthapuram, 22-23rd September 2005, pp.294-302.
58. J. J. V. Jeyasingh, K. Dhananjayan, G. Kothandaraman, P. P. Sinha, B. Nageswara Rao, A. C. Reddy, Spherical dome formation by transformation superplasticity of Titanium matrix composites, National Aerospace Manufacturing Seminar, Thiruvanthapuram, 22-23rd September 2005, pp.303-308.
59. M. Vidya Sagar, A. C. Reddy, Finite volume analysis of two-stage forging process for aluminium 7075 alloy, International Conference on Advanced Materials and Manufacturing Technologies, JNTUH Hyderabad, 18-20 December 2014, pp.228-238.
60. C.R. Alavala, Finite Element Methods: Basic Concepts and Applications, PHI Learning Pvt. Ltd., New Delhi, 2008.
61. C.R. Alavala, CAD/CAM: Concepts and Applications, PHI Learning Pvt. Ltd., New Delhi, 2008.