Key Engineering Materials *Online: 2014-09-26*
ISSN: 1662-9795, Vols. 622-623, pp 791-797
doi:10.4028/www.scientific.net/KEM.622-623.791

Analysis of Insulating Object Plastic Injection Forming of Bicycle Dynamo Hub Power Connector

Dyi-Cheng Chen[1*], Chih-Hsuan Jao[1], Chen-Kun Huang[1]

[1]Department of Industrial Education and Technology,

National Changhua University of Education, Changhua 500, Taiwan

*Corresponding author: E-mail: dcchen@cc.ncue.edu.tw

Keywords: Insulating object, Dynamo hub, Power connector, Moldflow forming

Abstract. Bicycle industry has been an international reputation as bicycle kingdom in Taiwan, but the problem of global warming green energy rise, the development of insulating object of hub dynamo and power output connector to bring new hope to bike industry. In this study connector power output to gather public opinion related to patent, basis of collected documents as basis for design, structural components in least drawn to power output with simple connector. The study objectives connector hoped at structure strongest, highest efficiency in output performance characteristics such as use computer-aided drawing software Solid works to establish power output connector parts of 3D model. A series of simulation analyses, in which the variables relied on Moldflow and ANSYS software forming, which were execution to investigate the effective stress, effective strain, weld line, injection time, injection pressure and filling state of insulating object plastic injection forming of insulating object of bicycle dynamo hub.

Introduction

Injection molding is the most popular method for producing plastic products because of its high productivity the manufacturability for making various complex shapes. Kamaruddin et al. [1] improve the quality characteristic of an injection moulding product (plastic tray) made from blends plastic (75% polypropylene (pp) blends with 25% low density polyethylene (LDPE)) by optimizing the injection moulding parameters using Taguchi method. Zhang et al. [2] The gap-caused flash monitoring (IGFM) system was developed by integrating the application of an accelerometer sensor. Fu. Et al. [3] found X-ray imaging is a promising method of non-destructive evaluation and quality control for metal injection moulding (MIM) parts. Fu et al. [4] designed a variotherm mold to produce 316L stainless steel microstructures by micro metal injection molding. A hot sprue, cavity pressure transducer, vacuum unit and rapid heating/cooling system were incorporated into the mold. Zhou and Li [5] studied residual stress accumulated during the post-filling and cooling stages will lead to warpage of parts after demolding.

Dang and Park [6] found the U-shape milled groove conformal cooling channels and proposes the design optimization process in order to obtain an optimal cooling channels' configuration and target mold temperature. Gan et al. [7] found to describes the use of artificial intelligence in the process planning of plastic injection mould bases. A mathematical model was successfully developed to predict the response (warpage) based on design of experiments (DOE) and CAE simulation by Guo et al. [8]. A non-dominated sorting genetic algorithm using runner size and moulding conditions as design parameters is presented to perform the multiple objectives optimization problem in injection moulding by Zhai et al. [9]. Banerjee et al. [10] present an approach to systematically identifying potential manufacturability problems that are unique to the multi-material molding processes and design rules. The study used a series of simulation analyses, in which the variables relied on Moldflow and ANSYS software forming, which were execution to investigate the effective stress, effective strain, weld line, injection time, injection pressure and filling state of insulating object plastic injection forming of insulating object of bicycle dynamo hub.

Process of analysis

Fig. 1 is the project picture of the insulating object. This main part that bicycle dynamo hub power connector is needing to cooperate with other parts. And the material adopts 66 plastics of nylon (PA 66). Fig. 2 shows design dimension illustration of insulating object. Fig. 3 shows illustration of assembly insulating object. The insulating object used stainless steel that Young's modulus 2930MPa, Poisson's ratio 0.35 and material density 0.00113.

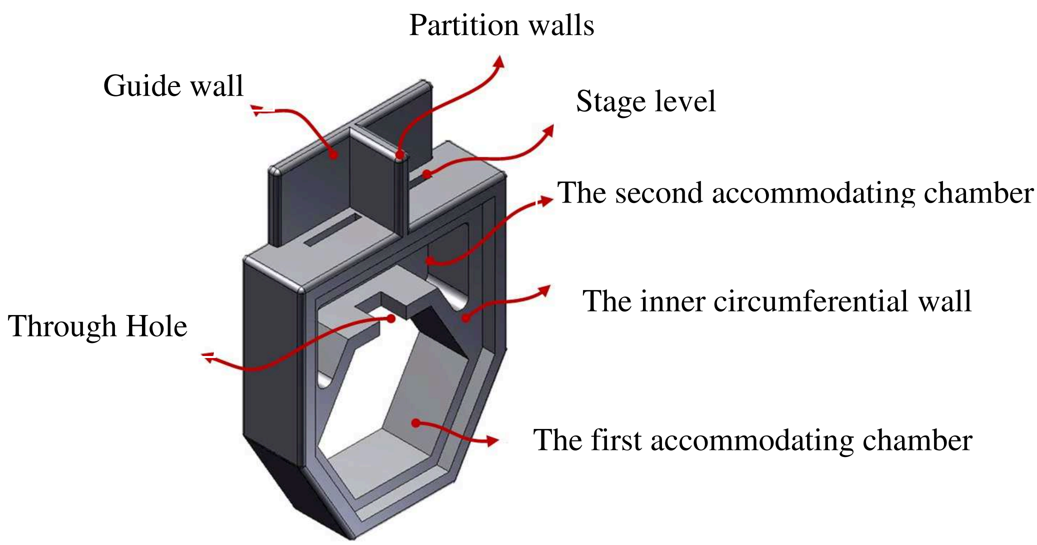

Fig. 1 Illustration of insulating object

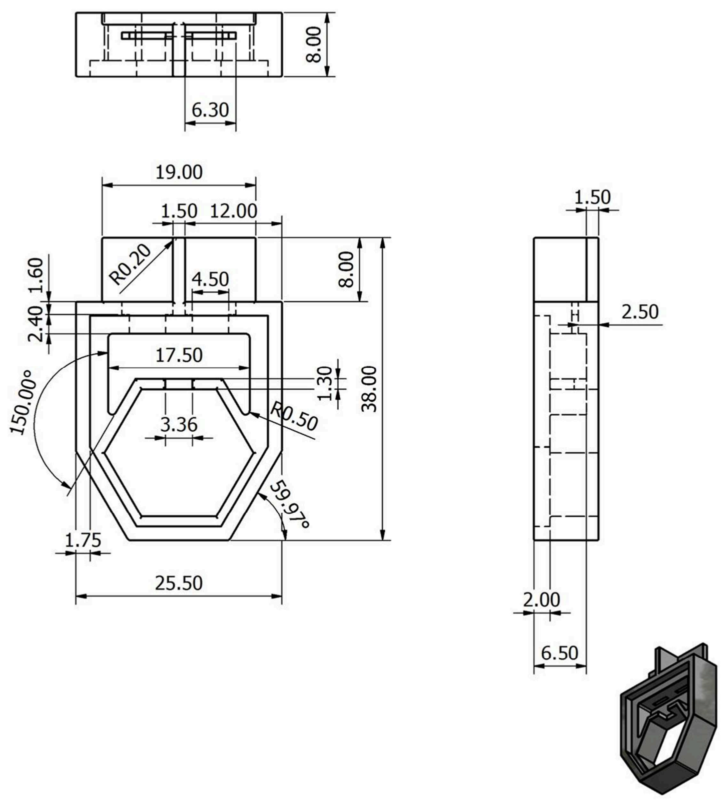

Fig. 2 Design illustration of insulating object

Fig. 3 Illustration of assemble insulating object

Results and discussion using Moldflow and ANYSYS

Fig. 4-6 shows 20%, 60% and 100% filling rate, separately. Because they can predict weld lines and fusing area (Fused) in relevant differences position. And can observe the changes of the pace and area size before relevant waves out and melt when the glue is kicked into the mould directly. Finally, the filling results can be observed whether if products short distance flow phenomenon.

Fig. 7 shows distributed result of weld line. It can be seen that weld line distributed short and not centralized in product important area that can add using products life. Fig. 8 presents distribution curve injection time, packing time and cooling time for plastic injection processing. It can be seen that the injection pressure is sound for forming machine.

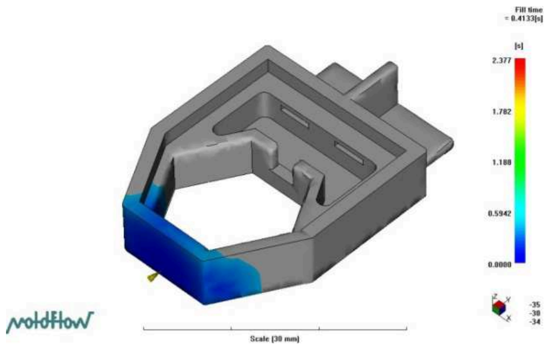

Fig. 4 Filling ratio 20% of the insulating object

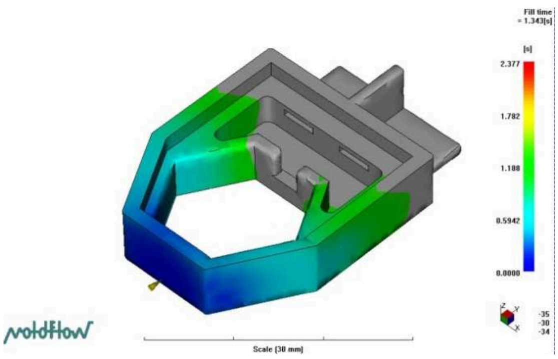

Fig. 5 Filling ratio 60% of the insulating object

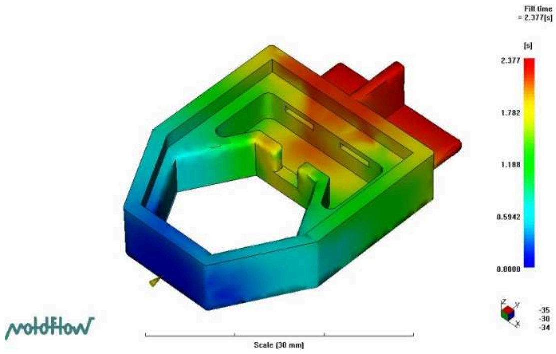

Fig. 6 Filling ratio 100% of the insulating object

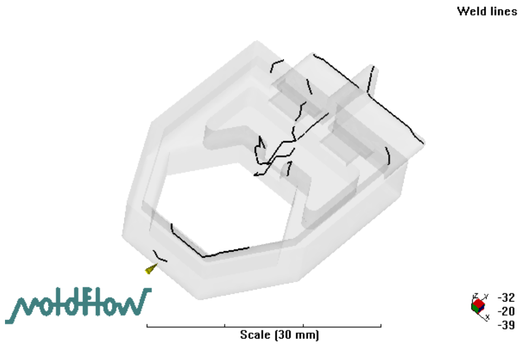

Fig. 7 Distributed result of weld line

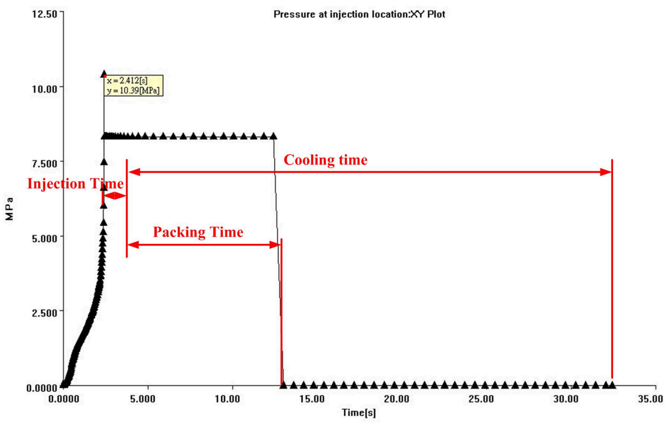

Fig. 8 Distribution curve injection time, packing time and cooling time

Fig. 9 shows temperature distribution of flow front that the low temperature district or volume temperature is close to the even area. It can be seen that plastic injection no obvious focus hot district. Fig. 10 presents pressure distribution of filling finished. It can be seen that the temperature maximum value 2.037 MPa, temperature minimum value is 0 MPa in different insulation object area.

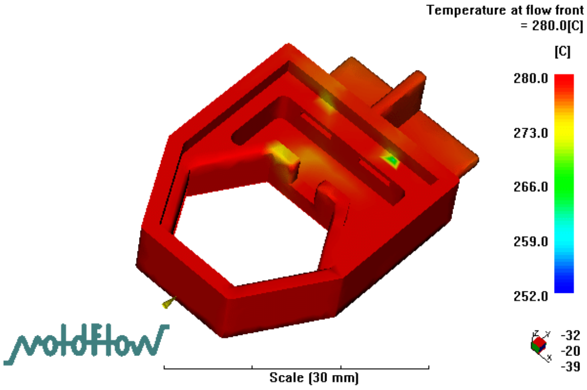

Fig. 9 Temperature distribution of flow front

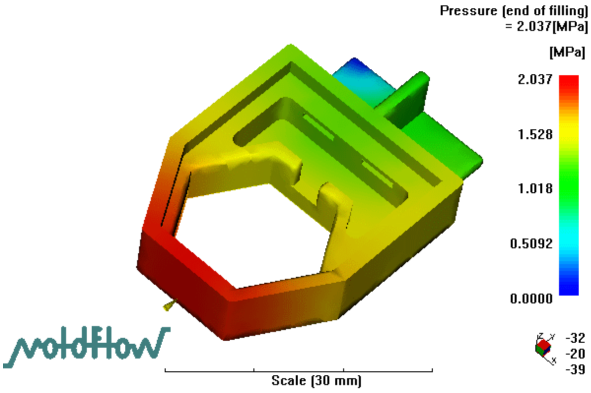

Fig. 10 Pressure distribution of filling finished

Fig. 11 shows ANSYS model constructed that using element elemental analysis to investigate into the structural characteristic before should format the structural body model network.

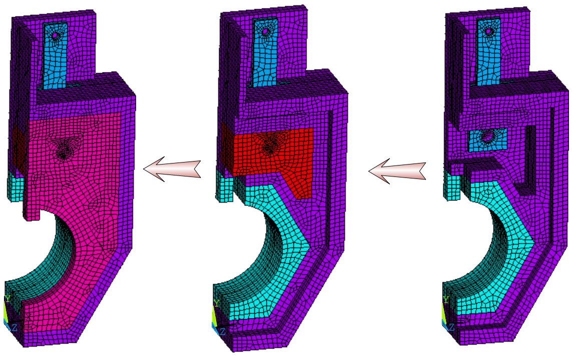

Fig. 11 ANSYS model constructed and network

Fig. 12 shows the effective stress distribution using ANSYS vibration analysis of dynamo hub power connector. It can be seen that the maximum is 0.0177MPa. Fig. 13 shows the effective strain distribution using ANSYS vibration analysis of dynamo hub power connector. It can be seen that the maximum is 3704. The centralized stress and strain should non- enough to influence insulating object of bicycle dynamo hub power connector.

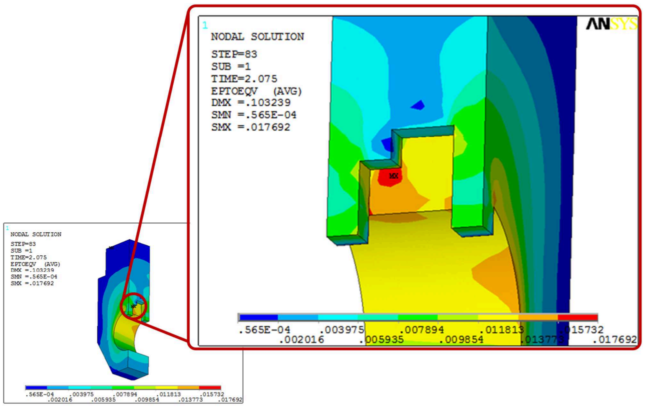

Fig. 12 Effective stress distribution using ANSYS analysis

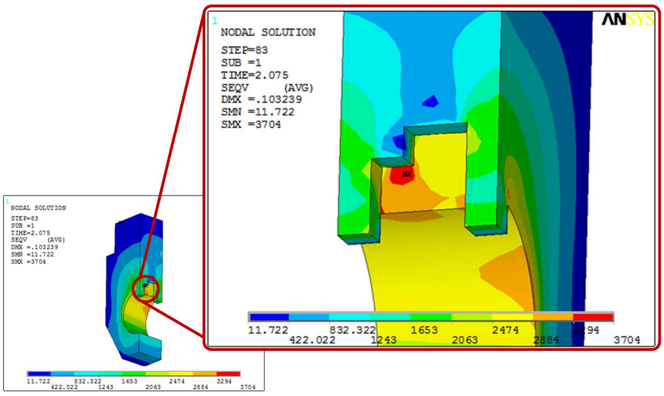

Fig. 13 Effective strain distribution using ANSYS analysis

Conclusions

This study has utilized the finite element code to investigate the effective stress, effective strain, weld line, injection time, injection pressure and filling state of insulating object plastic injection forming of insulating object of bicycle dynamo hub. The numerical results have shown that: (1) the temperature maximum value 2.037 MPa, temperature minimum value is 0 MPa in different insulation object area; (2) the effective stress distribution using ANSYS vibration analysis that the maximum is 0.0177MPa; and (3) the effective strain distribution using ANSYS vibration analysis that the maximum is 3704.

References

[1] S. Kamaruddin, Z.A. Khan, S.H. Foong, Quality characteristic improvement of an injection moulding product made from blends plastic by optimizing the injection moulding parameters using Taguchi method, Int J Plast Technol 14(2) (2010)152-166.
[2] Z. Zhang, J.C. Chen, J. Zhu, Development of an in-process, gap-caused flash monitoring system in injection molding processes, Int Adv Manuf Technol 26 (2005)1237-1245.
[3] Y.Q. Fu, C.H. JI, A.W. Batchelor, N.H. Loh, X-ray imaging of metal injection moulding parts, Journal of Materials Science Letters 16 (1997) 1873-1875.
[4] G. Fu, N.H. Loh, S.B. Tor, B.Y. Tay, Y. Murakoshi, R. Maeda, A variotherm mold for mocro metal injection molding, Microsyst Technol 11 (2005) 1267-1271.
[5] H. Zhou, D. Li, Residual stress analysis of the post-filling stage in injection moulding, Int J Adv Manuf Technol 25 (2005) 700-704.
[6] X.P. Dang, H.S. Park, Design of U-shape milled groove conformal cooling channels for plastic injection mold, International Journal of Precision Engineering and Manufacturing 12(1) (2011) 73-84.

[7] P.Y. Gan, K.S. Lee, Y.F. Zhang, A branch and bound algorithm based process-planning system for plastic injection mould bases, Int J Adv Manuf Technol 18 (2001) 624-632.
[8] W. Guo, L. Hua, H. Mao, Z. Meng, Prediction of warpage in plastic injection molding based on design of experiments, Journal of Mechanical Science and Technology 26(4) (2012) 1133-1139.
[9] M. Zhai, Y.C. Lam, C.K. Au, Runner sizing in multiple cavity injection mould by non-dominated sorting genetic algorithm, Engineering with Computers 25 (2009) 237-245.
[10] A.G. Banerjee, X. Li, G. Fowler, S.K. Gupta, Incorporating manufacturability considerations during design of injection molded multi-material objects. Res Eng Design 17 (2007) 207-231.