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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Manufacturing.

Signature : 

Name of supervisor : ASSOC. PROF. DR DEWAN MUHAMMAD NURUZZAMAN

Position : ASSOCIATE PROFESSOR

Date : 06-06-2017

DESIGN, FABRICATION AND PERFORMANCE TEST OF DIE-PUNCH SET FOR POWDER COMPACTION PROCESS

LOGATARSAN A/L CHANDRAN

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ABSTRACT

This study is mainly about the fabrication of die-punch set using two different metals; Tool Steel SKD61 and Hardened Steel SKD11. Powder compaction processes are well known in many industries nowadays and this process requires a die-punch set. Thus through this study, the performance comparison between both type of die-punch are also obtained. Hardened Steel SKD11 is commonly used in many industries. Thus, comparison between the two different types of die-punch is done to observe which die-punch has better performance. Fabrication of a die-punch set requires a proper design to be processed first. Once the design selection with a suitable dimension and tolerance are made, then the fabrication process can start. Few machining operations are done to ensure a successful fabrication of the die-punch set. The fittings of each part of the die-punch set are made aligned. Performance testing of the die-punch set is done by producing green compacts through powder compaction method. Before this green compacts are made, the metal powders are prepared and mixed well based on the compositions that needed in this research project. A total of three different metal powder compositions are tested. Once the compaction is done, the green compacts are sintered. Then, the sintered compacts are tested for their hardness. Hardness test is done to show which die-punch set can produce a metal ceramic compact with a better hardness.

ABSTRAK

Kajian ini adalah berkaitan tentang proses pembuatan "die-punch" menggunakan dua jenis besi; 'Tool Steel SKD61 dan "Hardened Steel SKD11". Proses pemampatan serbuk amat terkenal dalam kalangan industri pada masa kini dan proses ini memerlukan "die-punch". Oleh itu, melalui kajian ini, prestasi kedua-dua jenis "die" ini akan diuji. "Hardened Tell SKD11 digunakan di kebanyakkan industri. Oleh itu, perbandingan antara kedua jenis "die-punch" ini dapat diperhatikan dan produk mana yang dapat menunjukkan prestasi yang lebih baik dapat dikaji. Pembuatan "die-punch" ini harus dimulakan dengan membuat reka bentuk yang sesuai dahulu. Setelah reka bentuk tersebut selesai, dimensi dan toleransi yang sepatutunya perlu disertakan dan proses prmbuatan boleh dimulakan. Beberapa operasi pemesinan akan dibuat terhadap besi yang telah dipilih untuk menjayakan pembuatan "die-punch" tersebut. Pemasangan setiap bahagian harus sentiasa selari. Ujian prestasi ke atas "die-punch" dijalankan dengan membuat beberapa kepingan besi dengan cara pemampatan serbuk. Sebelum kepingan besi tersebut dibuat, serbuk besi dicampur mengikut komposisi yang telah ditetapkan untuk projek ini. Sebanyak tiga jenis komposisi serbuk besi telah disediakan untuk diuji. Setelah pemampatan selesai, kepinga besi tersebut akan dipanaskan. Selepas itu, kepingan besi akan di uji untuk ketahanannye. Ujian ketahanan dibuat untuk mengetahui "die-punch" mana yang dapat menghasilkan kepingan besi yang mempunyai ketahanan yang tinggi.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Metal composite compaction or stampings are important structural components of automobiles, computers, refrigerators, type writers, kitchen utensils, electrical, electronics and telecommunication equipment [1]. Metal composite compaction operations are conservative and brisk method for creating complicated, exact, solid and strong metal compactions in large amounts. Utilizations of these operations are expanding step by step because of their high efficiency, ease per part, and change in material quality, and least scrap material and vitality utilization. One of the critical assignments in the generation of metal composite compaction is the plan of press apparatuses and choice of materials for press instrument parts to suit the item highlights. The determination of a legitimate material for press instrument segments has turned out to be one of the imperative perspectives of press instrument outline on the grounds that long device life has ended up a need for accomplishing higher efficiency and decreasing expense of sheet metal parts. Thus, before proceeding in metal composite compactions, a die punch set should be fabricated as the press tool for the metal powder compaction process.

A die punch set consists of three parts; top punching die, bottom die and the die body. The concept designs were made via Catia V5R21 software. Total five concepts were generated based on their geometrical shapes. After that, the best design was chosen by doing the concept selection method. Then, the die punch set is been fabricated as per the design chosen. This die punch set also functions by the same principle, where firstly the

metal powder is filled into the cavity of the die body. Before filling the powder, a bottom die is placed where the die body would be fixed on top of it. This is to allow the filled powder to stay in a sealed environment thus it does not exit the cavity during compaction process. After the cavity of die body is filled with metal powder, the compaction process would start where the top die punching part will be used to compact the metal powder in the die body's cavity. Later, the finished specimen is ejected through the die bottom part. Overall, the production of this die punch set is to facilitate powder compaction process which we learnt in powder metallurgy.

Powder metallurgy is the process of fabrication of net shaped objects by the use of compacting force and temperature [2]. Usually only four steps would be involved in the powder metallurgy process. Firstly, powder preparation will be done. Certain percentage of different types of metal powders would be prepared then this metal powders are mixed till homogenous mixing is achieved. The third step is compacting and finally sintering is done to improve the mechanical property of the produced specimen. Applications of powder metallurgy was found in the aerospace, self-lubricated bearings, porous components, gears, implants, actuators, electronic and automotive industries [2]. At times metal specimens which processed by powder compaction will tend to crack. In certain cases, these cracks may not be visible till sintering is done. This is the reason where the fabricated die punch set plays an important role in powder compaction process. The inner wall of the cavity can cause friction between particles which can end up causing micro crack in the green compact.

As to this, this project is done to produce a die punch set to fabricate a green compact which can have better mechanical properties. The die punch would be tested to produce few green compacts and observed on its visible deformation.

1.2 PROBLEM STATEMENT

Industries nowadays choose to use the compacting process to fabricate any type of metal ceramic composite specimens. Even in forming a reinforced metal sheet, compaction process is most favorable. Thus, many sort of die punch had been produced to facilitate this compaction process. As we know compaction process involves a large amount of pressure exerted on the die punch to produce the specimens. Selecting a proper material that can be used as the die punch is very essential so that there would not be any mechanical failure on the die punch during compaction. Besides that, a proper tool should be also considered in machining the die punch which can reduce in tool wear and improper finishing. Once this is done, the performance test measures how well the die-punch is functioning. This is done by testing the specimens produced using those die-sets for hardness test. Thus, present study would be focusing in the fabrication of a well-functioning die punch set to perform compacting process on metal ceramic composite.

1.3 OBJECTIVE

The objectives of this project are:

- To design and fabrication of Die-Punch.
- To do performance test of the fabricated Die-Punch Set for metal ceramic composite structure.

REFERENCES

This thesis is prepared based on the following references;

[1] Kumar Shailendra,"An Intelligent System For Selection Of Materials For Press Tool Components" Jers/Vol.Ii/ Issue Ii/April-June, 2011/119-130

[2] Kamal Kumar Jangra, Tilak Raj, Neeraj Sharma, "Fabrication And Development Of Die For Powder Compaction Press" E-Issn: 2278-1684, P-Issn: 2320-334x. Pp 20-23

[3] Chiu L.-H., Yang C.-F. & Liu P.-M," Wear Resistance Of Jis Skd61 Tool Steels With Cr Based Coatings", Surface Engineering, 16:3, 257-261, Doi: 10.1179/026708400101517125 (2000)

[4] Huu-That Nguyen And Quang-Cherng Hsu,"Surface Roughness Analysis In The Hard Milling Of Jis Skd61 Alloy Steel" Department Of Mechanical Engineering, National Kaohsiung University Of Applied Sciences, Received: 17 April 2016; Accepted: 30 May 2016; Published: 8 June 2016

[5] Sung-Sil Jung, Je-Se Moon, Dae-Yeol Lee, Kuk-Tae Youna, Chun-Dal Parka And Jae-Sun Songa,"Fabrication And Characteristic Evaluation Of Hybrid Carbon Nanotubes Reinforced Skd11 Cold Work Tool Steel", (Received August 20, 2013; Accepted August 26, 2013)

[6] Ming Chen , Lu-Lu Jing & Xue-Kun Li (2007),"The Surface Integrity In Machining Hardened Steel Skd11 For Die And Mold", Machining Science And Technology, 11:1, 99-116, Doi: 10.1080/10910340601174574

[7] A.K.Kumaresh, B.Balaji, M. Raj Kumar,"Design And Analysis Of Punching Die", (Volume: 05 Issue: 04 | Apr-2016,)

[8] C.Parswajinana, B.Vijaya Ramnathb, M.Vetrivelc, A.Riyaz Ahmedd, A.S.A.Syed Mohamed Buharie, C.Muthukumaaranf, I.Anish Hilary,"Design And Fabrication Of Impact Die For Powder Metallurgy", Pmme 2016

[9] B.Tulasiramarao, Dr.K.Srinivas2, Dr. P Ram Reddy, A.Raveendra, Dr.B.V.R.Ravi Kumar,"Experimental Study On The Effect Of Cutting Parameters On Surface Finish Obtained In Cnc Turning Operation", Vol. 2, Issue 9, September 2013 Copyright To Ijirset Www.Ijirset.Com 4547

[10] Badru Doja And Dr.D.K.Singh,"Analysis And Effect Of Process Parameters On Surface Roughness And Tool Flank Wear In Facing Operation", Vol. 1 Issue 4, June – 2012

[11] K. Adarsh Kumar ,Ch.Ratnam, Bsn Murthy, B.Satish Ben, K. Raghu Ram Mohan Reddy,"Optimization Of Surface Roughness In Face Turning Operation In Machining Of En-8", Volume-2, Issue-4, 807 – 812

[12] Majid Tolouei-Rad, And Ankit Shah,"Development Of A Methodology For Processing Of Drilling Operations", Vol:6, No:12, 2012

[13] R.Maguteeswaran, M.Dineshkumar, R.Dineshkumar, K.Karthi, R.Sabariselvan,"Fabrication Of Multi Process Machine" Vol.2 Issue.2, February 2014.

[14] K. Mohammed Jasim Kadhim, Adil A. Alwan, Iman J. Abed,"Simulation Of Cold Die Compaction Alumina Powder" Volume 1, Issue 1, February, 2011, Pages 1-21.

[15] Mehdi Rahimiana, Naser Ehsania, Nader Parvinb, Hamid reza Baharvandic," The effect of particle size, sintering temperature and sintering time on the properties of Al–Al2O3 composites, made by powder metallurgy" Journal of Materials Processing Technology 209 (2009) 5387–5393, April 2009.