PREDICTION OF PUNCHING LIFE SPAN FOR PHOSPHOR BRONZE STAMPING OPERATION

MOHD FADZIL MUIN BIN HASHIM

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **PREDICTION OF PUNCHING LIFE SPAN FOR PHOSPHOR BRONZE STAMPING OPERATION**

SESI PENGAJIAN: _____

Saya **MOHD FADZIL MUIN BIN HASHIM**
(HURUF BESAR)

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah)* ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Kolej Universiti Teknologi Tun Hussein Onn.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

(TANDATANGAN PENULIS) (TANDATANGAN PENYELIA)

Alamat Tetap:
No 7 Jalan Wira 2 , Taman Wira, Pt
86400 Pt Raja ,
Batu Pahat, Johor

Tarikh: 26/08/2007

Nama Penyelia
Prof Dr Sulaiman Bin Hj Hassan

Tarikh: 26/08/2007

"I hereby declared that I have read this thesis and in my opinion this thesis in terms of contents and quality requirements fulfill the purpose for the award of the Master of Mechanical Engineering".

Signature : .....

Name of Supervisor : PROF. DR. SULAIMAN BIN HASSAN

Date : 26/08/2007.

PREDICTION OF PUNCHING LIFE SPAN FOR PHOSPHOR BRONZE STAMPING OPERATION

MOHD FADZIL MUIN BIN HASHIM

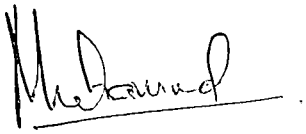
Thesis submitted in fulfillment of the requirements for the award of
Master of Mechanical Engineering

Faculty of Mechanical and Manufacturing
Universiti Tun Hussein Onn Malaysia

AUGUST 2007

Thesis submitted in fulfillment of the requirements
for the award of
Master of Mechanical Engineering.

"I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged"

Signature : 

Name of Student : MOHD FADZIL MUIN BIN HASHIM

Date : 26/08/07

To my dear wife, Zohaida, the most positive person I know and a constant source of encouragement. She believed in me before I believed in myself.

To my dear children Firdaus, Iman, Naeem, and Syifa. Also to my dear parents. They would have been pleased and proud to see the results of this undertaking.

Acknowledgements

Praise be to Him only, with His Grace and Mercy, He had given me the strength and courage to do and complete this project.

Firstly I want to thank my supervisor Prof. Dr Sulaiman Hj. Hassan from UTHM for his support and guidance during the project period.

Special thanks to Mr. Takahiro Yoshiike who is a stamping die designer and had supported me. Also special thanks to small group of skillful world class die maintenance technicians with dedicated production staffs and subordinates who had worked together with me to achieve these results.

I want to thank Vba programmers who have guided me to write a customized program for punch re-sharpening level using advanced Vba source codes world wide especially John Walken Bach (USA). In addition, thanks to Krueger from UK for the opens source Constrained Cubic Spline Vba subroutine. Finally, to countless friends, local and international who had guided me directly or indirectly.

ABSTRAK

Meramal hayat mata alat punch adalah kritikal untuk produk kerana ianya akan menyebabkan kualiti produk menjadi kurang baik, merendahkan kadar pengeluaran dan membazir masa bagi proses penajaman. Mata alat perlu diasah selepas digunakan beberapa kali kerana dimensinya akan merosot dan ini menyebabkan ketidak tepatan yang akan menyebabkan dimensi produk tidak mengikut yang ditentukan. Salah satu kaedah yang digunakan bagi penentuan masa penajaman mata alat ialah melalui anggaran kasar mengunakan unit kshots. Selalunya anggaran ini tidak tepat dan ianya menyebabkan proses penajaman dan proses mencetak yang tidak ekonomi. Kajian ini dilakukan untuk mengatasi kelemahan ini. Mata alat yang digunakan dalam kajian ini adalah dari jenis Cementite Tungsten Carbide dan bahan kerja yang digunakan ialah Phosphor Bronze Strip. Darjah kekerasan relatif bahan adalah lebih kurang 6.3. Proses pencetakan yang digunakan ialah proses pencetakan progresif dan ianya dijalankan di sebuah kilang elektronik yang termuka. Untuk kadar kshots yang tertentu, profil kehausan mata alat diukur dan ketidak tepatan dimensi produk dikaji. Peningkatan burr pada produk juga dikaji pada setiap 4000 unit produk. Hayat mata alat adalah ditentukan apabila produk yang dihasilkan rosak. Semasa ini, mata alat akan membulat, kehausan dapat dikenalpasti dan kerekahan pada hujung mata alat dilihat. Dapatan dari kajian ini ialah hubungan kadar kehausan berkadar terus kepada kshots dan ini memudahkan algorithma bagi penentuan hayat mata alat dibuat. Model simulasi dicipta dengan mengunakan 'Constraint Cubic Spline algorithm', pengkaji telah dapat meramal ketumpulan dan kehausan mata alat dengan lebih tepat. Walau bagaimanapun bentuk dan bahan mata alat serta kekerasan relatif akan mempengaruhi algorithma ini. Kajian ini menjimatkan kos proses pencetakan melalui mengurangkan ketidak tepatan ramalan kehausan dan hayat mata alat yang seterusnya mengurangkan kerosakan produk, mengurangkan burr dan membolehkan penajaman dibuat dengan lebih tepat. Secara keseluruhan, algorithma yang didapati dapat menambah baik kecekapan dan menambah produktiviti.

ABSTRACT

Predictions of punching life span for stamping process is critical since affect the quality of product, the production rate and cause waste in time and cost. The punch need to be sharpened correctly after a number of punches since its dimensional accuracy will deteriorate and cause inaccuracy in the dimensions of the product and thus do not satisfy the quality requirements. One of the method that are normally used to determine the point where re-sharpening should be carried out is through estimating the number of shots or unit kshots that will produce products that are dimensionally inaccurate and the occurrence of burr on the product. The research was carried out to overcome this problem. The punch that was used is made of Cementite Tungsten Carbide and the work piece is Phosphor Bronze Strip. The relative hardness is about 6.3. The stamping process is a progressive stamping process carried out in a well known electronic factory. The profile of the wear of the punch is measured and the error in product dimension is identified. The increase presence of burr is also studied and identified for every 4000 product. The end of punch life span is determined when there is a dimensional inaccuracy on the product and the product is rejected. This research found that at this point punch is rounded, wear is present and cracks occurred at the cutting edge of the tool. As a result of this research, relation between the punch wear and kshots are found to be proportionate and this enable an algorithm to be formulated. Simulation model is built to enable more accurate algorithm is developed. The simulation model used 'Constraint Cubic Spline algorithm'. The researcher is able to forecast a more accurately the kshots that relates to punch wear and thus save products dimensional inaccuracy and product rejects. An improved sharpening process is also possible and this provide accurate re-sharpening work. The accuracy of the sharpening prediction also reduce burr and have enhance the efficiency of the resharpening process. In conclusion, the algorithm has improved productivity and save cost to the company.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

A	-	Area loss due to wear at the punch cutting edge
H	-	Hardness
V	-	Volume loss due to wear at the punch cutting edge
W	-	Wear rate of a punch (mm^2/Mshots)
Wsp	-	Specific Wear Rate (mm2/m/N)
R^2	-	Coefficient of determination.
spm	-	Unit of stamping velocity in strokes per minute.
K	-	Wear rate (mm^2/m)
K	-	Archard wear coefficient
L	-	Life of a punch before next re-sharpening
Mshots		The unit of punch hits through the stock material.

LIST OF DEFINITIONS

Abrasion	A process where hard particles are forced against and moved along a solid surface.
Abrasive wear	It is a displacement of material, due to hard particles or hard protuberances. A hard body plastically deforms (with or without removal of matter) a softer body.
Adhesion	(1) The attractive force between adjacent surfaces in a frictional contact; (2) the state in which interfacial forces hold two surfaces together.
Adhesive wear	At a certain moment, the force applied to the contact is supported by the existing junctions. An adhesive junction is produced. It is either hardly resistant at all and the two bodies separate with no change, or the junctions is relatively resistant, and a crack forms in the less resistant body.
Blank	The piece of sheet or strip metal produced in cutting dies. The produced pieces are discrete and have no material carrier.
Blanking	The process of cutting out a flat piece of the size and shape necessary to produced the desired part.

Bolster plate	The static plate attached to the top of the bed of a press.
Burr	A rough ridge, edge, protuberance, or area such as that left on metal after cutting, drilling, punching, etc. In stamping it occurs in cutting dies because of the clearance between punch and die.
Burr side	This term is refers to the side or face of a blank or other stamping which comes in direct contact with punch in a blanking operation, and the side or face of a blank or other stamping which comes in direct contact with the die in a punching operation.
Capacity of a press	The related capacity of a press is the pressure, in tons, which the slide will safely exert at the bottom of the stroke in doing work within the range of the press.
Clearance	In punching and shearing dies, the gap between the die and the punch.
Crank press	A mechanical press the slide of which is actuated by a crankshaft.
Die set	A tool holder held in alignment by guideposts and bushings and consisting of a lower shoe, upper shoe or punch holder, guideposts and bushings.
Die shoe	A plate or blocks which die holder is mounted. A die shoe functions primarily as a base for the complete die assembly and, when used, is bolted or clamped to the bolster plate or face of slide.

Elastic limits	The maximum stress to which a material or body can be subjected and still return to its original shape and dimension.
Flank of punch	The position at the horizontal plane of punch where it will shear the stock material.
Metal	A group of substance that can conduct electricity and heat and can be hammered into shape or draw out in sheets.
Progression	The precise linear travel of the stock strip at each press stroke and is equal to the inter-station distance. Also called pitch, advance, or feed.
Progressive die	A die with two or more stations arranged in line for performing two or more operations on a part one operation usually being performed at each station. The parts are connected by a carrier strip until final parting or cutoff operation.
Punch	i) The male part of the die, as distinguish the female part called the die. The punch is the upper member of the complete die and is mounted on the slide. ii) The act of piercing or punching a hole. Also referred to as *punching*
Punching	The die shearing of a closed contour in which the sheared out sheet metal part is scrap.