

DEWAXING OF ABS RAPID PROTOTYPE PATTERN FOR CERAMIC INVESTMENT
CASTING OF PROXIMAL HUMERUS

SOUDEH IRANMANESH

A project report submitted in partial fulfilment of the requirement
for the award of the degree of Master of Engineering
(Mechanical-Advanced Manufacturing Technology)

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

SEPTEMBER 2014

Most importantly; I would like to thank God and dedication this thesis to my sweet parents, Azam Nabizadeh and Mohhamad Iranmanesh for their patience and praying. Also my appreciation dedicated to my beloved husband, Alireza Esmailzadeh for his sincere patience, sacrifice, inspiration, understanding and constant help and encouragement. Also my appreciation dedicated to my lovely sisters Saideh and Somayeh and my brother Amir for their patience, invaluable supporting, encouragement and praying for me, as well as Dr.Khoshnezhad for valuable helping and encouragement. Also I want to dedication to my husband's family for their constant support and encouragement. I could not have done it without you! Thank you for your love, support, great expectation and patience while I finished this project...

“This Is Our Success”

ACKNOWLEDGEMENT

I Thank GOD the Almighty with whose blessings I have completed the whole of my final year project and this thesis. I would like to express my sincere appreciations to my Husband for his encouragements, advices and support during my studies. I was in contact with many people, academicians and practitioners. They have contributed towards my understanding and thoughts.

In particular, I wish to express my sincere appreciation to my supervisor, Prof.Dr.Mohd Hasbullah Bin Hj. Idris for his encouragement, guidance, advices and motivation. Without his continued support and interest, this thesis would not have been the same as presented here.

I also want to express my appreciations to technicians and lab assistants especially thank Cast Metal Lab technicians Mr. Wan Mazian and Mr. Mohd Saleem for their ideas, guidance, cooperation and help me to experiments using all the available facilities. I also thank Mr.Sukari Mamat of Production Department, for his help and contribution.

Last but not least, I would like to thank my parents, family members and friends for their assistants and encouragement in completing this thesis.

ABSTRACT

Orthopedic implants can be defined as medical devices used to replace or provide fixation of bone or to replace articulating surfaces of a joint. Many proximal humerus bone cases require almost immediate/short lead time surgery. Thus rapid response from the manufacturer is very crucial. The manufacture of surgical implant often requires the use of machining process. Current trend shows that preform either from casting or forging is preferred to reduce machining cost and time. It is expected that by employing rapid manufacture using rapid prototyping and investment casting process could expedite the manufacturer to surgery time. The objective of this project is to evaluate the effect of dewaxing time on collapsibility characteristic of solid and hollow constructed rapid prototyped proximal humerus ABS pattern. FDM2000 machine was used to build the ABS patterns. Acrylonitrile Butadiene Styrene (ABS) P400 was used for pattern material in this study. Output responses investigated were collapsibility, expansion defects. ABS hollow and solid pattern are prepared and are subjected to dewaxing in different time and temperature. The ABS hollow and solid pattern were compared based on the dewaxing process results, ceramic shell defects. The best pattern material according to the optimum time and temperature was chosen based on the results and compared with the reference process. This study is expected to assist the investment caster to estimate the decomposition temperature and allowance required in preparing a mould from ABS pattern as well as in the initial CAD drawings to produce a final casting with minimal dimensional inaccuracy. It is hoped that the outcome of this study will assist the casting industries especially in biomedical in using the advanced product support tools using CAD and RP technology for higher productivity and quality products.

ABSTRAK

Implan ortopedik boleh didefinisikan sebagai peranti perubatan yang digunakan sebagai pelekapan pada tulang atau gantian pada permukaan artikulat sendi. Kebanyakan kes tulang humerus proksimal memerlukan pembedahan yang serta merta/masa pendulu pendek. Oleh itu, respon yang pantas daripada pengilang pembuatan adalah amat penting. Pembuatan dalam pembedahan implan selalunya menggunakan proses pemesinan. Aliran semasa telah menunjukkan proses prabentuk samada daripada penuangan atau penempaan menjadi pilihan kerana dapat mengurangkan kos dan masa pemesinan. Justeru itu, pembuatan deras yang menggunakan prototaip deras dan proses penuangan lilin oleh pengilang berupaya menyegerakan masa pembedahan. Objektif kajian ini adalah untuk menilai kesan masa penyahlilinan pada sifat keboleh-runtuhan binaan prototaip deras bagi bentuk humerus proksimal ABS iaitu dalam keadaan pejal dan berongga. Mesin FDM2000 digunakan untuk membina bentuk ABS. Acrylonitrile Butadiene Styrene (ABS) P400 digunakan sebagai bahan bentuk dalam kajian ini. Respon output yang dikaji adalah keboleh-runtuhan dan kecacatan pengembangan. Bentuk ABS berongga dan pejal ini disediakan melalui penyahlilinan mengikut masa dan suhu yang berbeza. Bentuk ABS berongga dan pejal ini juga akan dibandingkan berdasarkan keputusan proses penyahlilinan dan kecacatan pada kelompok seramik. Bentuk yang terbaik pula ditentukan mengikut masa dan suhu optimum dan dipilih berdasarkan keputusan dan perbandingan melalui proses rujukan. Kajian ini dijangka dapat membantu pekerja tuangan lilin untuk menganggarkan suhu penguraian dan ruang kelegaan yang diperlukan dalam penyediaan acuan pembentuk daripada bentuk ABS dan juga didalam lukisan asal CAD. Oleh itu, tuangan dapat dilakukan mengikut ketepatan dimensi yang minimal. Selain daripada itu, hasil daripada kajian ini juga boleh membantu industri penuangan terutamanya dalam bio-perubatan yang menggunakan sokongan produk alatan termaju CAD dan juga teknologi pembuatan deras untuk meningkatkan produktiviti dan kualiti produk.