PRODUCT DEVELOPMENT: through MATERIAL and PROCESSES RESEARCH.

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Centre for Engineering and Industrial Design

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MATHEMATICAL MODELLING, SIMULATION AND MATERIALS TESTING.

MATERIALS MODELLING FOR IMPROVING KAYAK PADDLE-SHAFT SIMULATION PERFORMANCE.

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In this work computer aided design tools are used to build iconic, semi-iconic and analogue CAD models to represent the microstructure of fibre reinforced polymer composite materials suitable for finite element simulation. The analogue method was identified as th... efficient approach due to less complex geometries with reduced pre-processin... ...ced simulation time. The analogue method was then used to create virtu... ...osite kayak paddle-shafts that were 'tested' using a design ana... ...dulus values are required for design analysis previousl... ...els are used. Simulation results were compare... ...ting and it was concluded that the analog... ...regard to composite kayak paddl... ...design aids and are cons... ...s than ideal for sim... ...have made m...

Fig. 1 SEM micrograph section of PMC with layered ...

Reinforcement
Discrete layers
Matrix

PREDICTION OF THE FLEXURAL MODULUS OF COMPOSITE MATERIALS FOR SPORTING EQUIPMENT.

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...t: The use of fibre reinforced composite materials in the construction ...are and sporting equipment has increased enormously over the last dec... Although it can be considered cost effective for manufacturers of less ...plex sporting equipment to prototype their latest designs, verifying the de...gn by utilising mathematical models and computer simulation should still be considered.

When a kayak paddle is used to propel a kayak through the water the paddle is subject to external forces that cause the shaft and blades to f... ...is paper is to model the flexural modulus of fibre re...osites. The proposed model used simple beam theory to ...n with a variable number of layers. It is seen that as the ... model increase, the prediction approaches the isostrai... be expected as a greater numbers of layers within a fi...tively homogenises the composite material. ...l shows a reasonable approximation of flexural modulu... ...blade and other composite material combinations teste... ...layer curve. The limitations of this model are due to the ...as simple beam theory, perfect bonding between layers ...being isotropic and monolithic.

...xural modulus, Modelling, Kayak paddle

Using micro-mechanical modelling to predict short-fibre composite properties in computer-aided design of sporting equipment

Sports Engineering
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ADVANCED COMPOSITE MATERIALS FOR HIGH PERFORMANCE SPORTING EQUIPMENT.

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Abstract: *This report investigates advanced composite materials, and accepted theoretical and empirical methods, as related through current literature. The use of technological developments, initialised for the aerospace and aeronautical industries, has ensured that the sporting equipment of elite athletes is capable of enabling high performance results.*

In order to fully model these advanced materials and quantify advantages in the degrees of motion and loading they are subject to in competition it is often necessary to utilise computer processing capabilities to enable the complexities of three dimensional analyses to be resolved.

It is also evident that the sporting goods industry is often economically driven; this may be to the detriment of the industry as performance advantages are often gained only through adaptation of supportive research findings.

Key words: Composite, results, sporting, high performance.

ENCAPSULATION OF TITANIUM POWDERS DURING BINDER REMOVAL FROM A METAL INJECTION MOULDED PART

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ABSTRACT

Due mainly to cost, titanium usage is very low outside of aerospace industry, chemical industry and a small number of specialized parts for cellular phones and laptop computers. Although widely known for its outstanding corrosion resistance and specific strength at elevated temperatures it is also referred to as a metallic solvent. Metal injection molding (MIM), a low energy processing method, with sintering, for producing target parts of complex geometry should be a suitable process for reducing the cost of using titanium. The addition however of a binder, to encapsulate the fine titanium powders, enabling shape retention after molding, also provides a contaminant source for uptake during subsequent processing steps. This work investigates encapsulation of titanium fine powders for MIM and how particle/binder adhesion affects strength of debound part due to the residuals. Results show that differences in particle adhesion may not be significant with regard to contaminant retention within the debound part.

Research on Metal Injection Moulding of Titanium Alloy Powders; towards a Titanium Industry for New Zealand.

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Abstract:
As an established process, i... form plastics. From the 19... sacrificial binder and a met... used to produce metal parts injection moulding (MIM) ... very active. This paper revie... our own work with regard t... emerging titanium industry complexity were produced u... and palm wax and 70% o... solution (water based) debi... binder by 38%, and dual s... remaining binder in the brow...

Keywords: debinding, metal injec...

Metal injection moulding of titanium alloy powders; towards a titanium industry for New Zealand. A review supported by preliminary research findings.

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Abstract:

As an established process, injection moulding is widely used in New Zealand (NZ) and globally to form plastics. From the 1970s, the process of injection moulding a feedstock, of sacrificial binder and metal powder, followed by sintering, known as metal injection moulding (MIM), has increasingly been used to produce metal parts with complex geometries. A very small fraction of such parts (<1%) are produced utilising titanium alloy powders. Nevertheless, the research on MIM is very active.

This paper reviews recent investigations and reports findings with regard to MIM of titanium alloy

APPLIED RESEARCH AND COMMERCIALISATION.

Figure 6: Powder particles modelled to show conventional consolidation of binder encapsulated particles with entrapped binder and corrected model with ideal smart encapsulation giving clean intimate surfaces.

Metal Powder Injection Moulding, Research and Industry.

A review and assessment of MIM as a commercial process and barriers to successful fabrication.

A report presented as condition of the Trade and Investment Research Scholarship 2010.

Research lead and authored by: Paul D. Ewart

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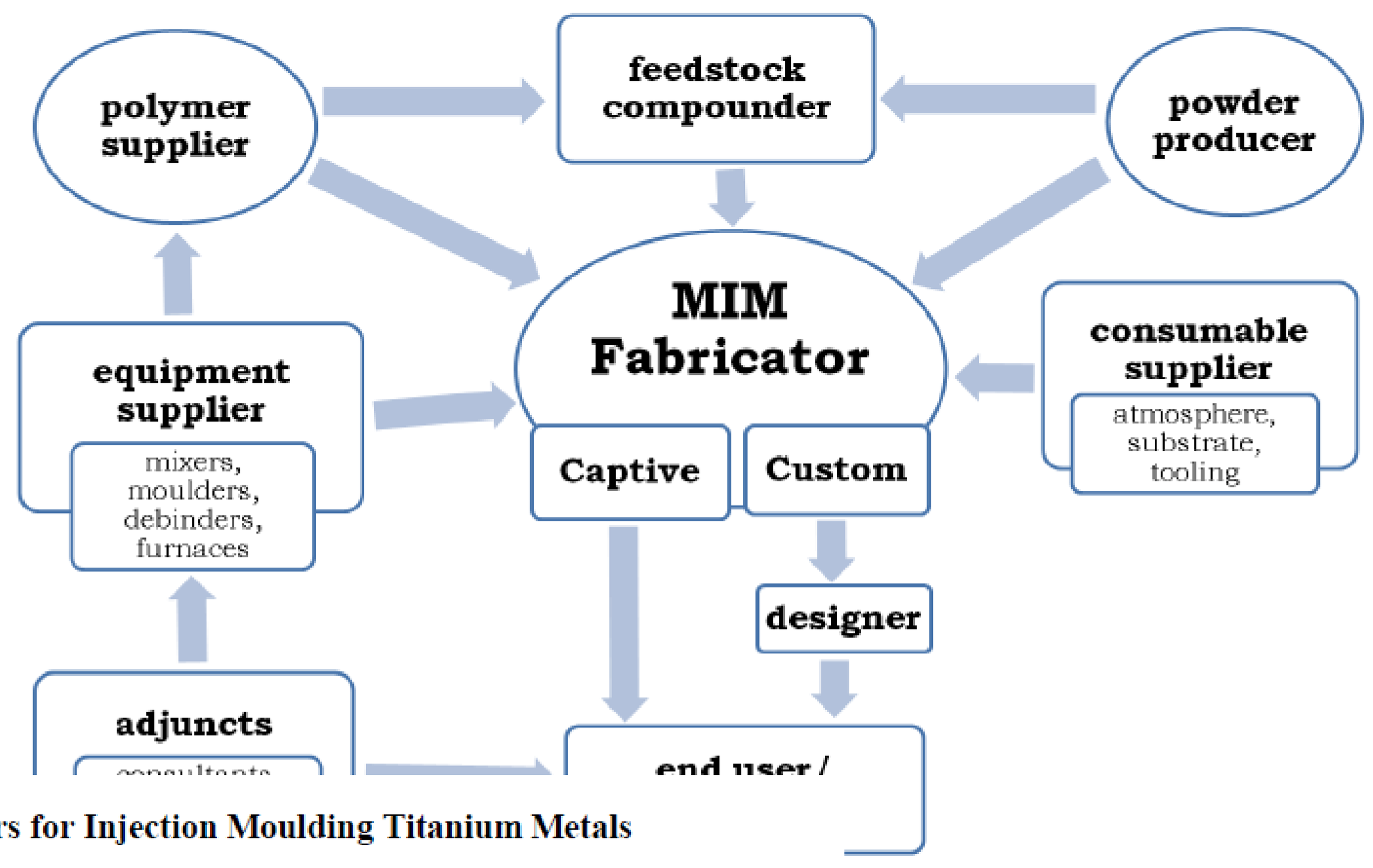
In conjunction ...

The Mechanical Engineering Dep...
Engineering Seminar Series – Fall 201...
Date: Friday October 22, 2010 Time: 11:45 am – 12:35
Place: ENGR 3.249

High quality, high value titanium parts ... low energy manufacturing proc...

Paul Ewart
University of Waikato, the New Zealand

Combining polymer and metal powders to prod... feedstock for subsequent processing and manufacture does not mean the science is based on polymer comp... Although polymers provide a tough matrix to bind powders it is not an integral component with reg... integrity of a finished part. What is produced here shou... as a metallic blend: even then this is only an intermed... material changes during the processing throug... transformations.



...stent MIM production (reprinted

Identification of Key Parameters for Injection Moulding Titanium Metals

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INTRODUCTION

Metal injection moulding (MIM) is an established fabrication process. Metal powders are mixed with a thermoplastic binder to form a feedstock that can be moulded into complex shapes (greenparts). Following moulding the binder is removed (debinding) and the powders are consolidated (sintered) to form the final metal part. As a scoping exercise a broad empirical investigation was made to span three of the four MIM process steps; moulding, debinding and sintering with respect to titanium (Ti) metal.

Greenparts moulded with correct geometry and visual acceptance did not ensure homogeneity through the part. Processing the greenparts with combined solvent (SD) and thermal (TD) debinding was more beneficial than by either treatment alone. A feedstock powder loading of between 0.6 and 0.7 by volume would likely reduce deformation and surface defects of the sintered part. Contamination of the final part by diffusion from the furnace atmosphere was greater than that due to binder residues. Contamination of the sintered parts was also greater in the static argon furnace than the vacuum

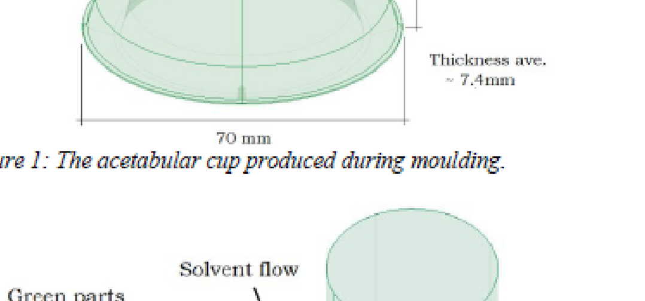

Figure 1: The acetabular cup produced during moulding.

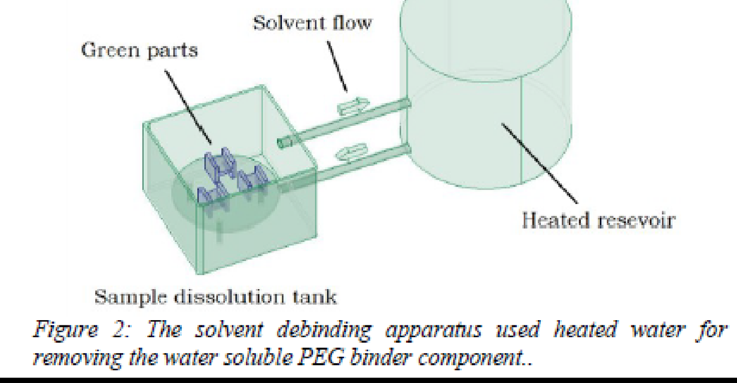

Figure 2: The solvent debinding apparatus used heated water for removing the water soluble PEG binder component..

... of the Flexural Modulus of ...nforced Thermoplastics as ...r Kayak Paddle Blades.

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SPORTS EQUIPMENT DEVELOPMENT; MATERIALS, DESIGN AND THE FUTURE.

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Abstract: *This paper reviews some sporting equipment with a focus on materials selection, design improvements and development of sporting goods suitable for young athletes. To get some perspective on the sporting industry in New Zealand the various levels of sporting participation are shown and equipment requirements at these levels discussed.*

Many sports create equipment for junior athletes. In general they are based on cut down full size equipment, of which the dimensions are dictated by an international body. The areas of sport where there is the greatest choice of equipment suitable for juniors within New Zealand are main stream sports that are practiced from a young age, fostered in the school system, and further developed within a club environment.

The birth of modern-day sports equipment was brought about with the composites revolution from the 1930's with the availability of modern resins and more importantly glass fibres. While materials development for sporting equipment over the last twenty years has been continuously innovative there appears to be no consideration of the effects they may have on junior athlete development.

Also discussed are several developments initiated on a national level, for kayak racing, to accommodate junior athletes into programs similar to those undertaken for NZ senior development paddlers. These initiatives are considered along with some investigations into the effects of sport equipment designed for and used by junior athletes.

Conclusions are reached in regard to the direction of canoe/kayak in New Zealand and how it may be possible to increase the attractiveness of the sport to junior athletes through development of equipment design, materials selection and strategic planning.

Key words: *Composite materials, junior athletes, kayaking, sporting equipment.*

Figure 1. Forces on the kayak paddle.

Figure 6: Aerospace defence parts by MIM, a) Ro... ...screw seal, produced in 1979 by Parmatech Inc...

PICK PM
A recognized green technology

Figure 9: Lifting the profile of MIM and a clear messag...

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