TiDA talk
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What is Powder Metallurgy?

Powder Metallurgy allows new products to be made which were not previously possible.

Powder Metallurgy was first developed over 75 years ago and now includes many different consolidation methods which allow extremely high-quality metal components to be manufactured with precision so there is little or no need for further machining.

Metal powders are usually produced by either chemical or mechanical means and are then consolidated into a desired shape or high performance coating using a wide variety of techniques. These consolidation methods include:

- Compacting/sintering
- Injection moulding
- Spray forming
- Laser deposition/laser sintering
- Hot isostatic pressing/cold isostatic pressing
- Foam structures
- Screen printing
- Coating (like PVD or Plasma Spray)
- Hot working processes ie extrusion, rolling and forging

Powder Metallurgy is now widely used by the automotive, electronics, military, medical and dental industries, as well as in the manufacture of power tools, household appliances and other machines.

It is particularly well-suited for complex geometry and miniaturised parts as computer aided design leads to quicker development times, cheaper development costs and more efficient and lightweight products.

Other advantages of Powder Metallurgy include superior material properties, over 98 per cent density, high production capacity and almost zero waste.

Since 1935 Powder Metallurgy has provided the ability to make alloys which could not be made in any other way. Certain metals and alloys – particularly those with very high melting points – are very difficult to produce by traditional melting and casting methods.

Powder Metallurgy is also a highly efficient process because labour costs have little impact. Instead the design and materials used are of greater importance.

As a result, new applications and products can now be made which were not previously possible, opening up exciting opportunities and a whole new world of technologies.

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TiDA
Titanium Industry Development Association Inc

Powder Injection Moulding

Producing complex shapes from metal and ceramics without the need for a large amount of machining

One exciting research project currently being carried out by PhD student Paul Ewart and other members of the titanium research team at the University of Waikato (led by Professor Deliang Zhang and Associate Professor Brian Gabbitas), involves building up industry knowledge about Powder Injection Moulding (PIM).
This consolidation technique is capable of producing metal, ceramic and metal-ceramic composite parts with complex shapes and good mechanical properties without the need for a large amount of machining.
Its main advantage over other Powder Metallurgy consolidation methods is its ability to make intricate shapes because it combines the advantages offered by plastic injection moulding.
Professor Zhang says the aim of the research is to define the process parameters for successfully producing titanium alloy parts via PIM for use by New Zealand industry, and later on develop a new binder material that will be especially suitable for titanium alloy powders.
PIM involves mixing metal, ceramic or metal-ceramic composite powder with polymer granules at a temperature high enough for those granules to melt. A homogenous slurry is then formed which can be extruded or left to cool down to form solid blocks. The extruded pieces or solid blocks are then granulated.
"Such granules are then reheated and injection moulded into components of desired shapes and dimensions in the same way as the plastic industry does for producing plastic products using plastic injection moulding," Professor Zhang explains.
Afterwards, the powder/polymer composite parts (which are called green compacts) are subjected to a debinding process to remove the polymer material, leaving mostly powder with a small fraction of residual polymer.
The parts are now called brown compacts and are sintered to turn the powder into solid parts with the desired microstructure and mechanical properties such as strength, ductility and fracture toughness.
"It should be noted that the polymer is used as a binder which is sacrificial and needs to be removed from the parts after injection moulding," Professor Zhang points out.
"In this sense, the amount of polymer needs to be sufficiently large to allow the slurry of powder/polymer mixture to be successfully moulded into desired shapes and dimensions of the parts, but it shouldn't be too large to compromise the process economy and cause the powder compacts to collapse when the polymer is removed from the injection moulded parts."
Normally the volume fraction of the polymer (or other type of binder) in the powder/polymer mixture is in the range of 25-40 per cent.
So far the titanium research team at Waikato has successfully moulded green parts of a trial component using a selected binder composition, gaining in-depth knowledge on the process of removing the polymer binder from the moulded parts.
"In the near future we aim to define the process parameters for successfully producing prototype parts of the selected component with desired microstructure and mechanical properties by powder injection moulding of titanium and titanium alloy powders. After this the research will be focused on developing a new binder with our own intellectual property and building up a knowledge base for making titanium alloy components using the PIM process."
For more information about how your company can access and benefit from PIM, contact TiDA Chief Executive Warwick Downing on (07) 577 3030 or email: info@tida.co.nz

Email: info@tida.co.nz and enter unsubscribe in to the subject line if you wish to discontinue receiving this newsletter

Powder Metallurgy Creates Innovation

One of New Zealand's most successful manufacturing companies, Triodent, is about to begin reaping the benefits that Powder Metallurgy has to offer.

In November last year the dental manufacturer, Triodent, purchased a titanium laser sintering machine from Germany – one of only 11 such machines in the world.
Triodent CEO and TiDA director, Dr Simon McDonald, says the new technology will give the company enormous flexibility. "We will be able to make things that we haven't even dreamed of yet."
Laser sintering, also known as Selective Laser Melting, involves laying down a layer of powder about 30 microns thick and then using a laser to selectively melt the powder to form a desired object.
Triodent's machine allows complex titanium parts to be manufactured for new and existing dental tools at great speed with virtually no waste.
"It's wonderful. An oral surgeon came to us recently with a new concept and within a week he had something he could try out. He was amazed."
Until now, Triodent has made its products by cutting shapes out of nickel titanium sheets – resulting in the waste of expensive materials. And prototypes were made out of plastic which in many cases meant they couldn't be used or tested properly.
"The advantage of laser sintering is that you can make a prototype really quickly and actually use it which is very powerful.
"It enables small scale manufacturing to get going and prove a concept rather than just relying on hypothetical market research that a new product would sell."
Dr McDonald says Triodent is now working on a range of new projects that will open up exciting export opportunities.
"I think many New Zealand companies have been held back up until now because they've had an idea but it hasn't been economical to try it out. I think Powder Metallurgy and laser sintering has got a lot of potential – people just need to open up their imaginations."
TiDA is a partner with Triodent for the laser sintering system and is able to help New Zealand companies develop prototypes on it. If you are interested in finding out more information contact TiDA chief executive Warwick Downing on (07) 577 3030 or email: info@tida.co.nz

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Metallurgists Needed

Currently NZ does not train metallurgists and TiDA believes this will constrain the developing powder metallurgy industry, in addition to the wider engineering sector.

As design and materials become increasingly important we need to ensure a workforce is available with the skills to meet the companies needs.
Over 2010 work will be done on the development of a qualification which will provide the necessary skills to bridge the knowledge gap. The Bay of Plenty Polytechnic is working with TIDA to provide this training in the new Engineering facility on the Windermere Campus in Tauranga by early 2011.
Industry Training Organisation Infra Train will lead the review and registration of a national qualification designed to meet the industry needs.
Further consultation will be required with the wider industry to support this development and gain Tertiary Education Commission approval to proceed. We need your input to ensure that the qualification is tailored to current and future industry need therefore you may be contacted within the next three months. We would like you to take a more active advisory role in this development, please send your comments to Malcolm Hardy, Head of School, Applied Technology, Bay of Plenty Polytechnic [email: Malcolm.Hardy@boppoly.ac.nz ; phone: 075440920].

Qualification – recommendations so far:
Entry – advanced trade qualification/ equivalent skills; National Diploma in Mechanical Engineering Level 6

Content – Process and Materials unit standards. Currently these are part of the National Diploma in Engineering (Process and Materials)

Delivery – one year fulltime programme; flexible options for those working in industry with employer support to attend regular day/evening classes and block courses.

Early consultation with companies has indicated the following components as a starting point for Infra Train and the Polytechnic

Essential

- ethics – to include calibration and compliance
- heat transfer
- process mass and energy balances
- corrosion
- select materials for manufacturing
- engineering materials failure analysis – (level 7)

Also needed

- fluid statics and dynamics
- chemical reaction calculations
- properties and measurement of particulate materials
- thermodynamic principles
- fluid particle dynamics
- principles of mass transfer
- chemical and phase equilibria

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