The Institute of Materials, Minerals and Mining

Schools Affiliate Scheme

Issue 14
Summer Term 2003

Its almost summer…

Another term, another newsletter and hasn't the time just flown by? We have been very busy indeed. The questionnaires for the Advanced level course should be winging their way to you very shortly so that there is time to complete them before the summer break.

Last term was a hectic one and despite loosing my voice temporarily I gave talks to over 1600 people. The UCAS fair season is now in full swing and we have already been to four events in Manchester, Keele, Cardiff and Newcastle. Still ahead are the events in Sheffield (1 & 2 July), Earls Court (4 July) and Aberdeen (sometime in early September).

World Materials Day will be taking place this year on the 5th November and we are running a competition for schools to celebrate this event. More details about the competition are included inside. Also in this issue, details of sports materials workshops in Birmingham, information on the FuTEC event for key stage 3 pupils and the usual careers and course information.

I know this term is busy with planning for next year. I am taking bookings for talks in the Autumn term and also don't forget about the Autumn Open Day programme, with events taking place in Materials departments around the country (further details enclosed as a separate leaflet).

Finally an administrative plea from myself and Susan Longstaffe. When you are returning payment for membership renewal please can you make sure that your finance department includes a copy of our payment request and that the payment is sent to us in the Doncaster office. A few payments seem to have been sent to the Stoke and London offices and have disappeared in to the system. The only way we can update our database with your payment is if we receive the cheques!

Well that it, hope you enjoy this edition and have a great summer holiday!

NEWS

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Career profile – Gerard Insley

Biomaterials is becoming an increasingly important field and more and more materials graduates are choosing to work in this area. Biomaterials courses are run at a number of universities around the country and new tissue engineering courses, such as the one at Sheffield, below are also available.

What did you study? BSc Materials Science (1992)

Where did you study? University of Limerick

Where do you work? Stryker Howmedica Osteonics, in Limerick as the Head of Applied Research.

What do you do? I run a group of four people involved in the development and application of new materials to the orthopaedic sector. The group is involved in direct research, technology transfer and manufacturing support. Our main specialisation involves the development of calcium phosphate based bone substitute materials.

Favourite projects? I am currently studying for a PhD part-time at Bath University and this is my favourite project at the moment. I am investigating the new ceramic bearing surfaces for orthopaedic applications.

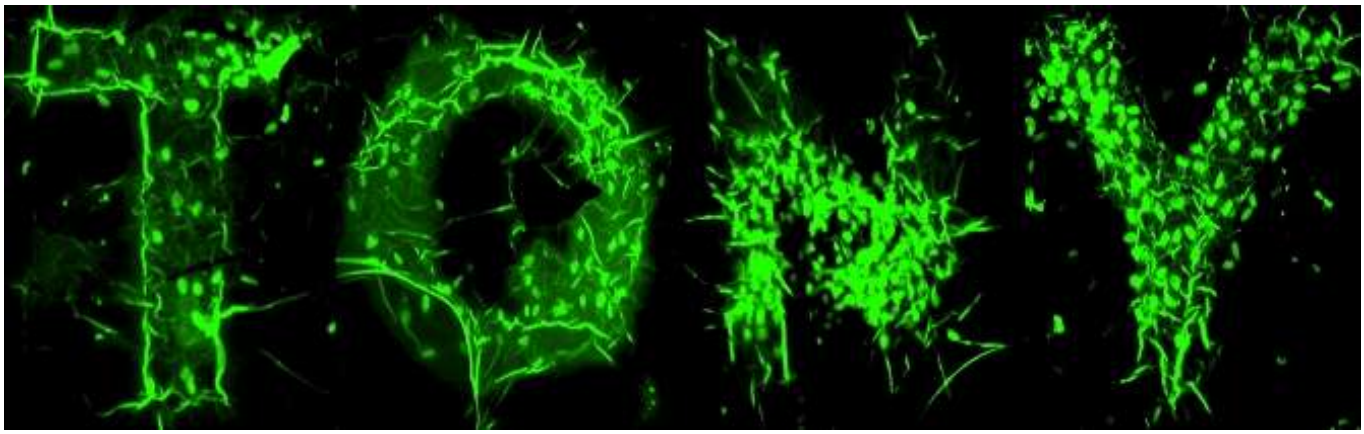
Who do you work with? I work directly with a metallurgist, mechanical test engineer and two research assistants. I also manage a number of university-based research contracts at Leeds and Limerick.

Why do you enjoy your job? Orthopaedics is all about giving people a better quality of life and being a small part of this is very rewarding.

Bioengineering at Sheffield University

The Department of Engineering Materials at the University of Sheffield offers two degrees in bioengineering: Biomaterial Science and Tissue Engineering and also Biomedical Engineering. Many of the problems in medicine and biology can be successfully addressed using an engineering approach. Biomedical Engineers work with doctors and nurses to design instruments, devices and software to solve clinical problems. A wide variety of materials are used in medicine, from the hard metal in an artificial hip to the soft polymers used in contact lenses. These 'biomaterials' have to meet engineering demands such as mechanical strength for the hip and both transparency and deformability for the contact lens. They also have to meet biological demands, as the human body is efficient in being able to recognise and react to foreign materials

Biomaterial science is the study of materials that are used in medicine and biology. Is it possible to avoid the problems of rejection by the body by growing replacement parts from the patients' own cells? Tissue engineering is addressing this issue and is an exciting, new and rapidly developing discipline. This topic was part of last year's Royal Institution Christmas Lecture by Professor Tony Ryan of the Department of Chemistry at the University of Sheffield. To help Tony out, staff at the Department of Engineering Materials took some of his own cells and got them to spell out his name on a specially engineered biomaterial:



If you are interested in finding out more about these subjects, please apply to come to the free residential summer school organised by Sheffield University's Faculty of Engineering on the 7th–10th July, or attend one of our Open Days. Details can be found on the Department of Engineering Materials homepage at http://www.shef.ac.uk/materials/.

Ivan-O – The Mean Materials Machine

Can you help to design a robot to beat off all the challenged in Robot Wars? The search is on!

Many of the robots that battle it our in the Robot Wars ring have a wide range of attack and defence systems and your job is to bring together the best mix of materials to help our robot, the mighty and mean Ivan-O to overcome all others.

The Institute is co-ordinating a competition to select the materials for our robot, Ivan-O. We have created the overall design and manufacturing drawings for the robot, which are supplied as a poster and separate booklet detailing the main structural parts. Your task is to choose the materials for a number of key components , including weapons and defence systems. The robot has a maximum weight of 95kg. The competition does not involve making the robot but instead researching and selecting the materials from which it could be made.

The competition is split into two age groups, under 16 and 16 to 19 and teams of up to five people may enter. The competition is not limited to schools, teams drawn from other youth groups (e.g. scouts or guides) may also enter. The deadline for entries is 19 September and special prizes will be awarded for each age group on 5 November 2003 in recognition of World Materials Day..

If you would like more information and an official entry form please contact me (Diane Talbot) on 01302 320486 or e-mail diane.talbot@iom3.org.

Do you have anything to contribute?

I am now starting to look for articles for the next issue of the newsletter, and indeed all future issues. If you have been to an event, have a cunning idea for how materials topics can be presented or have any other suggestions for articles in the newsletter please get in touch.

The deadlines for the publications for the 2003-2004 academic year are 1 August for the Autumn term, 1 December for the Spring issue and 1 April for the summer issue.

Diane's Diary

This term is much quieter than the previous ones but I'll still be out and about visiting the following:

29/04 Wellington College, Crowthorne
30/04 Kings of Wessex School, Cheddar
01/05 Teachers workshop, Cardiff
02/05 UCAS Convention, Cardiff
07/05 Monkseaton High School, Whitely Bay
08/05 & 09/05UCAS Convention, Newcastle
12/05 Spen Valley High School, Liversedge
04/06 Long Eaton School, Nottingham
05/06 Birkdale School, Sheffield
12/06 Burton College, Burton on Trent
12/06 Teachers workship, Gloucester
16/06 St Wilfrids Primary School
19/06 St Anthony's RC Girls School, Sunderland
20/06 Sutton Coldfield Grammar School for Girls
23/06 Napier Polymer Study Tour, Edinburgh
27/06 School workshop day, Winchester
30/06 Wiltsahire Polymer Study Tour, Trowbridge
01/07 & 02/07 UCAS Convention, Sheffield
03/07 Teachers workshop, Leicester
03/07 Manchester Polymer Study Tour
04/07 UCAS Convention, Earls Court

Don't forget that I am now taking bookings for the Autumn term. The diary has a tendancy to fill up fast so if you would like me to come and give a talk to your students or to a teachers or technicians group that you are involved in please get in touch. You can ring me on 01302 380913 or e-mail me at diane.talbot@iom3.org. I look forward to hearing from you!

Prosthetic limbs – where engineering, materials, and medicine meet

We are all familiar with the cartoon images of the pirate with the wooden leg and the parrot on his shoulder. Today artificial limbs are allowing amputees to tackle the challenges of everyday life head on. Modern materials, such as carbon fibre composites and titanium offer light weight flexible solutions to replace the traditional wooden leg prostheses.

The prosthetic limb must imitate the functions of the body part it is replacing as closely as possible and keep the wearer comfortable. The first point of consideration is how the prosthetic limb will be attached to the residual limb and this starts with a liner. The liner is made from silicone as it is soft and stretch y and easily fits to the geometry of the limb. The liner acts as a cushion between the skin and socket. The socket fits over the residual limb and the rest of the prosthesis attaches to this. Sockets can be moulded from either carbon fibre composites or glass fibres and polyester.

Sometimes artificial knee sections are required and these are generally hydraulic. They must allow the same range of movement as a natural knee and lock in the extended or bent position as required. Some knees are made from aluminium alloys and others from carbon fibre composites.

In order to have as natural a gait as possible the foot module must be flexible and absorb and release energy as your natural system would do. Carbon fibre composites make this possibility a reality as the material can be made stiff or flexible as required. Modern carbon fibre foot prostheses can provide a 95% energy return. Different types of modules are available for different levels of activity, from everyday feet to those used by sports men and women. Shock absorbance is also important for the overall health and comfort of the wearer and many models include metal and carbon fibre composite shock absorbers around the ankle.

The socket, knee, foot and adjoining sections often clip together using titanium components as these offer high strength and wear resistance combined with low weight..

There is no doubt that the field of prostheses has developed dramatically over recent years and it is likely that further improvements will be made. For more information have a look at www.ossur.com. This is the web-site of an Icelandic company specialising in up to the minute prosthetic lower limb components.

Slip, toilets and a lot of dirty washing!

(Whitewares Committee Visit to Weston Coyney Junior School)

As you may know the Institute is made up from a number of divisions, some of whom have an interest in Education matters. The Whitewares committee represents members from the traditional ceramics industry which produce tableware (plates, cups etc), sanitaryware (toilets, basins, baths) and decorative wall and floor tiles as well as the raw materials suppliers for these products. This is a huge and vital area of materials engineering but one which most of us take for granted. Did you know about 65 million toilets were cast in the UK last year!?

On the 23rd January this year, members of the Whitewares Committee visited Weston Coyney Junior School in Stoke on Trent as part of their annual "Industry Week" based on the theme of "Power over the Clay". They demonstrated a toilet production line complete with miniature toilet moulds to two groups of year 5 children.

Simon Warren, the Technical Sales Manager at Imerys Minerals showed the children how the clay is mixed with water to make a liquid mixture called "slip" which is then poured into the moulds to cast the toilets. He also managed to cover himself and some of the children when he turned the mixer on at full speed spraying liquid clay everywhere!

Brian Standbridge, UK Operations Director for American Standard (UK) Plumbing showed the children how the slip mixture is poured into the moulds to cast the toilets, exactly as it is in the real production process. The children were then given the chance to cast their own toilets. Brian then explained how the toilets are dried, fired and glazed to produce the final product. Each of the children were presented with their own miniature toilets to take home.

Everyone thoroughly enjoyed their day, although I'm not sure the parents of those children covered in clay were particularly impressed!!!.

The committee are very keen to develop the idea of a production line demonstration further and would be willing to visit interested schools to give the demonstration. For further details contact the Ceramic Industry Co-ordinator Jackie Butterfield on 01302 380906 or email Jackie.Butterfield@iom3.org.

Workshops on Physics and Materials Science in the Sporting World

There has recently been a huge advance in sports equipment and facilities. In athletics, obvious examples are running shoes and artificial track surfaces. In squash and tennis, the rackets themselves are almost unrecognisable from 20 years ago. This has been made possible through advances in engineering and materials science, which have provided many new materials such as composites plus novel ways of using established materials by changing equipment designs.

The University of Birmingham are running three one-day workshops in July for Year 10 students that investigate how science contributes to sporting performance and equipment design. The workshops have been designed to highlight the role of physics and materials science in the development of sporting equipment (e.g. vaulting poles, tennis rackets and baseball bats).

If you have students that you feel would benefit from studying science in a sporting context and, by doing so may become interested in taking their scientific studies further, please contact us to reserve places. The workshops include a series of fun hands-on activities and the chance to meet and work with undergraduates and research students from the Materials Engineering Department. Students will design and carry out investigative exercises in topics such as vibration, friction, bending stiffness and materials properties. Furthermore, the workshops shall take place on the University campus, which gives students the opportunity to use specialist university equipment and to get a feel for university life.

Ideally, we would like a broad mix of students from a variety of schools which is why we have suggested a limit of 5 students per school. However, if you would like to nominate more than 5 students or feel that you would need help with travel arrangements (expenses or logistics) please contact us.

The workshops will be taking place on the 7th, 9th, and 11th of July and if you would like more information or wish to reserve your spaces please contact Elizabeth Wilcock on 0121 414 5182 or email: e.wilcock@bham.ac.uk

Break-time Challenge

The answer to the question posed in the last issue is COBALT and as promised here is another brainteaser:

The word SILICON can be made up from the chemical symbols of several other elements. For example, Sulphur, Iodine, Lithium, Carbon, Oxygen, Nitrogen.

What is the lowest atomic number element that can be spelled out in this way?

Once again, the answer will be in the next issue.

Autumn Open Day Programme

We have now confirmed the dates with the universities and the flyer with all the details on should be enclosed with this newsletter. Hopefully more of you will be able to attend this year!

Please return any completed forms to me as soon as possible, or give me a call if you would like more information.

Future Transport Engineering Conference FuTEC 03/04

Do you want to get involved with a unique and rewarding experience?
Do you want the chance to win IT equipment for your School?

FuTEC 03/04 is a competition and conference for Key Stage 3 (ages 13 - 15), which is designed to provide students and teachers with an insight to the many and exciting career opportunities available in Science, Engineering and Technology (SET) particularly in the fields of road, rail, sea and air transportation.

How do you get involved?

- Complete the application form below and fax it off or visit http://www.futec.org.uk/
- Receive a free competition pack and CD-ROM containing competition outline and curriculum-linked activities and ideas
- Receive a Science Engineering Ambassador in the school to provide support and help with entries
- Submit teams of 8 pupils with their completed projects for judging by the end of December 2003

The winning teams are invited to attend the 2-day free FuTEC residential conference

What will you get from the residential conference?

- Further competition working with young engineers and other delegates in new teams
- Opportunity to research and examine the latest technology in use in transportation
- Winning teams to present their design and research to delegates and industry experts
- IT equipment awarded to 1st, 2nd & 3rd winning teams' schools and teachers
- Full programme of events to encourage academic and personal development
- Science, Engineering and Technology careers exhibition and advice from industry professionals.

For more information please contact Helen Sibbald - Projects Officer Campaign to Promote Engineering, 10 Maltravers Street London, WC2R 3EE or email info@cpe.org.uk

MERCURY

- Mercury is a silvery white metal and is rather unusual as it is one of only two elements which are liquid at room temperature (the other one being bromine).
- The name mercury originated from the name of the planet Mercury, however the chemical symbol, Hg, refers to the Latin word *hydrargyrum*, which means liquid silver
- Mercury rarely occurs in nature in its free form. The main ore is mercury II sulphide (HgS), which is also called cinnabar. The main sources of cinnabar are in Spain and Italy, with other sources in Russia and North America. One mine in Spain has been in continuous use for almost 2,500 years.
- The ancient Chinese and Hindu cultures knew of mercury and it has been found in Egyptian tombs dating back to 1500BC.
- Elemental mercury is obtained from cinnabar by heating the ore in air. At around 600°C the sulphide reacts with the oxygen in the air liberating liquid mercury and producing sulphur dioxide. The mercury is then washed with nitric acid to remove impurities and further purification is achieved by distillation at reduced pressure.
- Mercury can be readily recovered from scrap items and this is the principal source of mercury today.
- Mercury has an atomic number of 80 and atomic mass 200.59. It has a density of 1353.36 kgm^{-3}.
- Mercury easily forms alloys with other elements such as gold, silver, cadmium and zinc and these alloys are called amalgams. Zinc and cadmium mercury amalgams are used in dry cell batteries. Gold amalgams are used in the gold extraction process and silver amalgams are used in dentistry to make tooth fillings.
- Liquid mercury is used in measuring devices such as thermometers and barometers and also in diffusion pumps.
- In its gaseous state mercury vapour is used in streetlights, advertising signs and fluorescent lamps.
- Mercury is a fair electrical conductor and is used in some switches. It is a poor conductor of heat.
- Mercury in all forms is highly toxic and is a cumulative poison. It can be ingested through the skin, gastrointestinal tract, respiratory tract and through open wounds. Spillages must be handled with extreme care and small quantities can be cleaned up by the addition of sulphur powder.
- Mercury is incredibly volatile and air saturated with mercury vapour at 20°C contains a far higher concentration than the recommended maximum of 0.1mgm^{-3}.
- Mercury forms useful salts with a number of elements. Mercury II sulphide is a red pigment called vermilion which has been used to colour paint. Mercury I chloride and mercury II chloride have both been used to clean wounds as a disinfectant and antiseptic. Mercury II oxide is used to make batteries.
- Mercury is one of very few elements which forms compounds with the inert gases, neon, argon, krypton and xenon. When mercury vapour and the gas are exposed to an electrical discharge HgNe, HgAr, HgKr and HgXe are formed and these products are held together by Van der Waals forces.
- Mercury fulminate, $Hg(ONC)_2$ is a primary explosive commonly used in detonators. It is highly toxic and sensitive to shock, friction and static charges making it dangerous to handle. Its use as a detonator in blasting charges was patented in 1867 by Alfred Nobel.
- The phrase "Mad as a Hatter" originates from the use of mercury by hat makers in the 1800s. Mercury II nitrate was used to roughen rabbit or beaver fur fibres in order for them to matt. This was often referred to as carroting as it caused the fur to turn orange. The matted fur was shaved off the skin and turned into felt which was then steamed and ironed in to the shape of a top hat. As this process was often carried out in confined spaces with poor ventilation the workers inhaled mercury vapours leading to mercury poisoning. Symptoms of Mad Hatter Syndrome, as mercury poisoning became known, included shaking, loosening of teeth, loss of co-ordination, slurred speech, irritability, memory loss, anxiety and depression, finally leading to brain damage and kidney failure.

This newsletter is written and edited by Dr Diane Talbot, Education Co-ordinator.
If you have any comments or articles please contact Diane on 01302 380913,
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