



**The Institute of Materials, Minerals and Mining**

**Welcome to the Institute of Materials, Minerals and Mining**

Hello there, I hope you had a good summer holiday and have settled into the new academic year without too many hitches! As you may be aware from reading the last SAS Newsletter and recent issues of Materials World, the Institute of Materials and the Institution of Mining and Metallurgy have merged to form the Institute of Materials, Minerals and Mining. The new Institute was launched formally when it was granted its Royal Charter on 26 June 2002 and over the summer holidays there have been a few changes.

The Education Team, that is myself, Peter Davies (Education and Regional Support Manager) and Susan Longstaffe (Education Assistant) moved from our office in Sheffield to Doncaster at the end of July. It took a while to unpack but we are now settled in to our new home and functioning at full speed! Our new contact details are given below and our e-mail addresses have changed to <first name>.<surname>@iom3.org. Our main web-site has changed too and you can go to the new site at [www.iom3.org](http://www.iom3.org), the careers web-site address remains the same and you can access this at [www.materials-careers.org.uk](http://www.materials-careers.org.uk).

Since the merger our remit has widened to include the minerals and mining areas and in recognition of this Issue 12 has a minerals and mining theme. As you can see the layout of the newsletter has changed slightly too to include new regular features. As usual please let me know whether you do or don't like what you see. This is your newsletter! The next two issues of the newsletter will have a broad theme too with Issue 13 (spring 2003) having a careers focus and Issue 14 (Summer 2003) looking at materials in sport. If you have any articles, suggestions or comments please pass them on. My contact details are given below and on the back page.

I hope you enjoy this issue and continue to benefit from membership of the Schools Affiliate Scheme within the new organisation.

Best Wishes,

Diane Talbot, Education Co-ordinator

The Institute of Materials,  
Minerals and Mining  
1 Carlton House Terrace,  
London, SW1Y 3DB  
Tel 020 7451 7300  
Fax 020 7839 1702  
[www.iom3.org](http://www.iom3.org) and [www.materials-careers.org.uk](http://www.materials-careers.org.uk)

Doncaster Regional Office  
Education Team  
Danum House, South Parade  
Doncaster, DN1 2DY  
Tel 01302 320486  
Fax 01302 380900

Schools  
Affiliate  
Scheme  
Issue 12  
Autumn Term 2002

N

E

W

S

## Careers in Minerals and Mining

Rather than have one career profile in this slot I thought it might be a good idea to provide you with some information about careers in the Minerals and Mining sector, as this is the focus of this issue. Up until a few months ago I have to confess that I knew little about these fields other than what I had seen on the television news, and that didn't tend to be very positive. However these fields are thriving and offer exciting and challenging career options.

Mining is one of the oldest professions of which it has been said that "If it can't be grown it must be mined" and many of the ages of mankind have been named after the materials that were extracted: the stone age, bronze age, iron age and the silicon age. Career prospects are broad because of the diversity and geographical spread of the industry but what do Mining and Minerals experts actually do?



**Mining Engineers** evaluate and design mines to make best use of the ore deposits available. They develop open cast mines or underground workings where they are concerned with the strength of the rocks, ventilation, drilling and blasting, transportation of the product and are responsible for the equipment and people working on the operation.

**Mineral Engineers** are concerned with the extraction of the valuable metals and minerals from the raw ore. They develop processes which economically remove the product using chemical and physical techniques and to do this they need to know the physical and chemical properties of both the ore and the materials which they want to extract.

Minerals and Mining engineers work all over the world with a large number of different materials, which leads to many opportunities to travel whilst studying and work abroad once qualified. These fields are also concerned with the environmental impact of their operations and study pollution. Many old quarry and mine sites have been reclaimed and redeveloped in to areas for us all to enjoy.



Although only a few universities have minerals or mining departments those few offer a wide range of courses ranging from geology to quarry management and surveying to minerals engineering. A list of some of the courses available is given below:

**University of Exeter ([www.ex.ac.uk](http://www.ex.ac.uk)) (Camborne School of Mines)**

Mine and Quarry Engineering, Minerals Engineering, Minerals Surveying and Resource Management, Minerals Surveying and Resource Management with European Studies, Mining Engineering, Surveying and Environmental Engineering

**University of Glamorgan ([www.glamorgan.ac.uk](http://www.glamorgan.ac.uk))**

Geology and Minerals Surveying Science, Minerals Surveying with Resource Management, Minerals Surveying with Geology

**Imperial College ([www.ic.ac.uk](http://www.ic.ac.uk)) (Royal School of Mines)**

Petroleum Geoscience

**University of Leeds ([www.leeds.ac.uk](http://www.leeds.ac.uk))**

Chemical and Minerals Engineering, Mineral Engineering, Mining Engineering, Quarry Management

**University of Nottingham ([www.nottingham.ac.uk](http://www.nottingham.ac.uk))**

Mining Engineering

## **Materials A-level – the story so far**

You may remember reading in the last newsletter that we are currently undertaking a far reaching feasibility study to determine definitively whether there is a market for an advanced level course in materials.

Back in June we held three separate forum meetings, with groups of science teachers, technology teachers and representatives from the school senior management team, at which we presented out initial ideas for the course and a first draft of a proposed syllabus. These meetings were well represented and produced a great deal of feedback and food for thought, much of which I hasten to add was very positive. Comments came back on who would be teaching the course, who would have ownership and how it would be assessed.

These points were all taken on board and addressed for the second combined focus group meeting which we held in September. For this meeting the syllabus had been updated and an assessment strategy produced which gave the teachers more information to get their teeth into. Once again the group was very helpful, apologising for appearing to sound negative. However the outcome was not negative at all, everyone present thought the course would be a valuable addition to the existing courses available and simply came up with lots of ideas as to how we could improve the syllabus.

The constructive feedback was just what we were looking for to take the feasibility study to the next stage. We are now putting together a final draft syllabus and preparing a number of questionnaires for different groups with a vested interest in the course. Between now and next February we are planning to visit all of the accredited materials departments and other the other engineering, science and medicine departments within these universities, starting with a meeting in December. WE will also be speaking to colleges running further and higher education courses related to materials. This will allow us to make sure that our course does not overlap with the first year of materials degrees and ensures that the relevant departments will recognise the course as one suitable for entry on to all of their courses.

We are also hoping to survey science and technology teachers in 500 schools. For this we will be asking you, our SAS members, for your opinions, and with your co-operation, the opinions of school pupils. These questionnaires are currently in the process of being prepared and they should be with you in the near future. We would be extremely grateful for your help here as it is your opinions that really count – without the teachers happy to teach it and the students wanting to study it the Materials course will not work.

We will keep you updated with progress in the next newsletter however if you have any questions please do not hesitate to get in touch with me on 01302 380913 (or [diane.talbot@iom3.org](mailto:diane.talbot@iom3.org)). Finally a huge thank you to those of you who have already provided a great deal of help and support by attending the focus groups.

## **UK Materials Departments Autumn Open Day Programme**

This year for the first time the Institute has been working with fourteen of the accredited materials departments to organise a programme of open days designed to support the materials modules in the AS Physics courses (particularly Advancing Physics and the Salters Horners course). The open days were publicised to SAS members at the beginning of September and despite the short notice the uptake has been very good. The events were held in November and gave students the chance to experience mechanical testing, electron microscopy and modern materials first hand

Feedback on the events has so far been very positive and we hope to be running the same programme again next year bearing in mind the comments from this year. Although the visits were aimed at AS Physics this year, a number of schools studying Technology and AVCE courses also found the visits beneficial. Watch this space for information about events in 2003.

## Diane's Diary

As I spend a considerable amount of my time driving round the country meeting you and your students I thought it might be a good idea to include my diary in each issue, so here we go for the Autumn Term:

05/09 Carlton-le-Willows School, Nottingham  
19/09 Wellington College, Crowthorne  
20/09 Peter Symonds College, Winchester  
26/09 St Mary's College, Blackburn  
27/09 Birkdale School, Sheffield  
02/10 Sandbach School, Sandbach  
07/10 Brownedge St Mary's RC High School, Bamber Bridge  
15/10 The Crypt School, Gloucester  
16/10 Canon Slade School, Bolton  
24/10 Broadlands School, Bristol  
05/11 The King's School, Bruton  
21/11 Albany High School, Chorley\*  
26/11 Bristol Cathedral School, Bristol  
27/11 Lutterworth Grammar School, Lutterworth

\*This event has been organised in conjunction with the Lancashire Polymer and Rubber Group.

In addition to the above presentations in schools I have or will also be visiting the following:

12/09 & 13/09 UCAS Careers Fair, Aberdeen  
28/10 Stockport LEA teachers workshop day  
13/11 Manchester Polymer Group Young Persons Lecture  
14/11 East Riding Science Technicians group  
18/11 Sixth form Materials Day at the Royal Institution  
05/12 School visit and presentation to the Institute of Marine Engineers and Engineering Society, Isle of Man

There are still a few spaces left for presentations next term, if you would like to book me or discuss the type

## Living in a Material World

On Wednesday 13 November I shall be taking up my role as the Material Girl and giving the 36<sup>th</sup> Annual Young Persons Lecture for the Manchester Polymer Group. The lecture which is to be held at UMIST is the culmination of a day of activities which includes looking around the Manchester Materials Science Centre and experiencing polymer processing at Manchester Metropolitan University, and will be attended by around 350 pupils and their teachers.

As the title suggests the lecture focuses on the importance of materials in our everyday lives in shelter, transport, fashion, food and music. Here is an overview of the some of the topics covered...

### Materials for shelter...

It is one of our most basic needs: protection from our surroundings in the form of shelter. The types of materials used are dependent on those available at the location, for example wood, clay and stone.

Modern houses are made from a number of materials starting with clay pipes which are used for underground drainage. Clay pipes, like bricks are made from a mixture of shales, clays and fireclay. The desired balance of clays and shales are mixed together and then crushed and sieved before mixing with 14-17% water. This sloppy mixture is then extruded to the desired shape (brick, pipe, or tile), dried and fired (at about 1150°C). The final product has a water absorption of about 2.5%. The level of water absorption is affected by the amount of porosity and in clay pipes a special carbon core is incorporated in to the wall. This is done with very careful control of the firing cycle.

Once above ground there are a number of options available. Many modern buildings are made from breeze blocks. These are made from various types of aggregates, which are mixed with sand and cement, moulded to the desired shape and left to set at room temperature. It is immediately obvious that this is cheaper than producing bricks as the firing cycle is eliminated. Traditional breeze blocks are made from black ash with colliery shale or power station clinker, however these are very dense (2000kg/m<sup>3</sup>) and so heavy. Lighter breeze blocks with a density in the region of 350kg/m<sup>3</sup> can now be made using an expanded light clay aggregate. This is made by coating spheres of coke with a low vitrifying clay and then drying and firing them. The resulting balls of material have a texture similar to that of a Malteser! We would all agree that breeze blocks are not particularly attractive and so most buildings are clad with bricks to improve appearance. A space is left between the two layers for insulation purposes and this is filled with an expanding polymer foam. Finally felt is laid over a wooden roof structure and tiles are attached using steel nails.

### Materials for transport...

The advent of motorised transport has made it possible for us to travel large distances relatively easily and most of us rely on our car

more than we would care to admit (I know that certainly applies to me!). But how many times have you considered what your car is made from? Your car is made from a large number of different materials, all chosen for their specific properties, for example the rubber tyres which provide grip with the road surface and help to make the ride smooth. One major driving force (no pun intended) in the development of cars is the improvement of fuel efficiency and one way of doing this is to reduce the mass of the vehicle. This has led to an increase in the number of components made from polymers. One example of this is new composite body panels. These panels are made from a cloth woven from glass fibres which is impregnated with polypropylene. Complex contours can be made by vacuum forming and the resulting component is then cured in a furnace which melts the polymer producing a solid part. This material is currently used for wing panels in a number of cars and it offers the advantage that it is very flexible. I have recently acquired such a car wing from a company in Coalville (EPM Technology) who make components from this composite. You can stand on the wing and flatten it, but it will spring back to shape once the load is removed. This requires special properties of the paint so extra plasticisers are added to improve flexibility and prevent spalling and peeling. Car manufacturers are now having to seriously consider what happens to their products at the end of their life. Here the glass fibre / polypropylene composite offers an advantage over conventional composites which have a thermosetting plastic matrix. The panels can be heated up and reshaped since polypropylene is a thermosoftening polymer. This material is also used for under body protection and bumpers for rally cars as it offers better resistance to damage from grit and dirt than the traditional materials used.

Other areas covered by the presentation include smart materials for food preparation and jewellery, modern polymers for clothing and the development of new recording media for the enjoyment of music.

### **The Materials Scientist comes to town**

"So what exactly is Materials Science?" asked Dr Diane Talbot to a class of GCSE and A-level Design Technology students.

One Friday morning, much to our dubious surprise, our Electronics lesson was transformed into a lecture on the science of Materials. We were greeted not by our usual teacher but by Dr Diane Talbot, a Materials Engineer working for the Institute of Materials, Minerals and Mining. She presented to us various samples, including a blade from a Boeing 777 aeroengine, false limbs, single crystals of silicon and toothbrushes that change colour when you hold them. In addition to this she told us in more detail about what most of you have probably seen on the Specsavers advert, i.e. memory metal. The demonstration involved submerging a coil of wire in hot water and watching it expand. On extracting it, it would contract to its original size. Isn't science wonderful? The aim of the presentation was to introduce the art of Materials Science as a career, whilst making us aware of the wide and varied range of materials, including of course, smart materials. A member of the lower sixth says "I would seriously consider materials science as a career after this presentation." Another student complement this quote with "...it was very enlightening presentation on something I knew little about previously."

**Written by R Dickerson and J Duckworth, pupils at Birkdale School, Sheffield.**

*Thanks lads, glad to hear you enjoyed it, Diane.*

### **Web-site Review**

UK-Rocks.net is a useful web-site which looks at careers, work and training in the mining and minerals industries. The site is split into several sections:

- 'A day in the life of...' contains several career profiles of young people working in the industry and also gives details of salaries.
- The 'Programmes' section has details of courses in minerals and mining and has links to the relevant Universities.
- 'Find out more' does exactly what it says; it provides details of and links to other organisations involved in the industry
- The 'Resources' section has a good gallery of relevant images, a world map showing where the different minerals can be found, links to news and a very nice animation of a quarry blast.

If you get a spare minute why not pop along and have a look, you can find the site at [www.UK-rocks.net](http://www.UK-rocks.net).

If you know of a particularly good web-site that you have found useful why not write a short article for the newsletter? You can send them by e-mail to me at [diane.talbot@iom3.org](mailto:diane.talbot@iom3.org)

## A Smart new resource for 2003

Over the past twelve months I have received a large number of pleas for help from teachers asking for information and resources on smart materials. As a consequence of this the new resource for schools joining the scheme or renewing their membership in 2003 will be all about the world of Smart Materials.

The resource will consist of written information about shape memory metals, thermochromic polymers, and piezoelectric ceramics, including why and how they work, how they are made and where they are used. These notes will be supported by samples of these materials which you can use in school.

Also don't forget that I have a presentation specifically on smart materials that I would be happy to give to your students. It lasts about 30 minutes and was originally written for year 12 students.

## Another year, another ASE conference

Did you come and say hello to us at the ASE conference in Liverpool way back in January? No? Well come along and see us this year instead then.

We will be exhibiting for the full duration of the conference which is taking place on 3 to 5 January 2003 at the University of Birmingham. You can find us amongst all the other Institutes at stand number A45 where you will have the opportunity to see the new resource, pick up a copy of the new 'Takes you in all directions' careers booklet, book me for a presentation in your school and generally have a chat and tell us what you really think of the scheme.

The Metallurgy and Materials department at the University is also contributing by running a booked workshop on Friday afternoon during which you will have the chance to do some mechanical testing, other experiments and talk to the experts.

If you are still recovering from that New Year hang over and need some cheering up please pop along and see us. It would be great to put faces to the names!

## London Materials Society and the London Material World Tour

On 11 April 2002 the London Materials Society (LMS) hosted a 'whistle stop' tour of 'London's Material Word'. The event was aimed at pupils in year 10 upwards and it introduced various aspects of materials. The event started at the Science Museum where Dr Sue Mossman and her team guided the students



through the Challenge of Materials exhibit. The group of more than 70 pupils and their teachers moved on to the Royal Society where they were introduced to representatives from the materials departments at the London universities (North London University, Imperial College and Queen Mary, University of London). The departments gave presentations on ceramics, polymers and biomedical applications for materials and students were able to explore possibilities at the Materials in Action exhibit. The next LMS schools event is scheduled for 15 January 2003 and if you would like further information please contact Alicia Chrysostomou on 020 7753 3218.

## Local Societies and Schools

A number of our local societies are active in supporting materials in their local schools. LMS and the South East Polymer and Rubber Group both organise events for schools in the South East. The Manchester Polymer Group and Lancashire Polymer and Rubber Group have both organised lecture events in the North West and our Scottish societies have also been working with teachers. As members of IOM<sup>3</sup> you have an open invitation to attend the meetings of the local society nearest to you and diaries of events happening this year have been posted out. If you have not received one and would like to find out what is happening in your area give me a call and I'll send you the relevant information. Alternatively the diaries are available on our main web-site, [www.iom3.org](http://www.iom3.org)

## New Education Resources from CORUS

As you know CORUS are great supporters of our School Affiliate Scheme, providing new members with £25 of their own resources. Joe Eason, who works in Education and Development, wrote to me recently to tell me about their latest resources. The "Steel and the Motor Car" and "Steel and the Motorway" resources are being depleted and new resources introduced. Continuing along the steel and transport theme the new resource "Making Tracks" deals with rail and steel manufacture and links in to physics and design technology courses at KS 3 and KS 4 as well as the manufacturing GNVQ. This resource is wholly electronic and pupils and teachers are expected to run it directly from the CORUS Education web-site, [www.coruseducation.com](http://www.coruseducation.com). Also available on the web-site are "On your metal" and the "CORUS Virtual activity centre" which are aimed at KS 3 and the top end of KS 2 and "Minelifta", a mechanical de-mining machine which clears anti personnel mines aimed at KS 3 and KS 4. The web-site also has an excellent interactive description of the self-heating coffee can. Three other CORUS resources are available on the School Science web-site ([www.schoolscience.co.uk](http://www.schoolscience.co.uk)) which belongs to Industry Supports Education.

For many year CORUS have produced a series of posters covering topics such as "Making Steel", "Using Steel" and "Shaping Steel". Two new posters have recently been added covering "Coating Steel" and "Engineering Steels".

If you would like to find out more about CORUS resources you can view their catalogue at [www.coruseducation.com](http://www.coruseducation.com) or obtain a hard copy from CORUS Education Resources at Wetherby (phone 01937 845381 or e-mail [twoten.press.net](mailto:twoten.press.net)).

## Courses for Teachers

Over the past year, particularly over the summer, the Worshipful Company of Armourers and Brasiers have supported a number of courses for teachers which assist with the materials topics in chemistry and physics courses.

### *IOP Physics update at Cardiff*

Cheryl Anderson from the University of Wales, Swansea gave an excellent presentation to the teachers about materials in July.

### *RSC Summer Schools*

Also in July, 27 physics and chemistry teachers attended a summer school in Oxford which had a significant materials content. This was supplemented by an industrial tour later in the month.

### *Rolls Royce Masterclass*

At the beginning of September 14 teachers attended a two day residential course which gave them the chance to have a go at tensile and impact testing and learn more about the materials which are crucial to the aerospace industry. This was also supplemented by a tour of the Rolls Royce works in Derby.

It is anticipated that most of these events will run again next year. If you would like more information please get in touch for the relevant contact details.

## Minerals - A World Of Opportunity And Challenge

In order to celebrate the formation of the new Institute of Materials, Minerals and Mining, this issue of the newsletter is dedicated to the Minerals and Mining areas and we have some resources to give away!

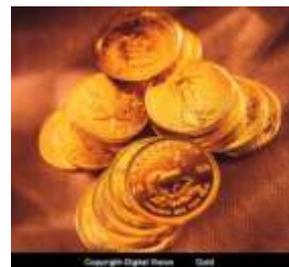
'Minerals - a world of opportunity and challenge' is a CD Rom containing 40 slides which explore the world of mineral and mining engineering in terms of career paths, areas of interest and its impact on our everyday lives. To view the CD you will need a PC and Microsoft Powerpoint or Internet Explorer.

We have 20 of these CDs to give away on a first come first served basis. If you would like to receive one, e-mail the answer to the following question to [diane.talbot@iom3.org](mailto:diane.talbot@iom3.org) along with your name, school and address: ***What are the two most abundant elements in the Earth's crust?*** Please include Newsletter 12 competition in the subject line.

## **GOLD, the substance of kings (and dentists and electronic engineers...)**

Gold has been one of the most highly valued metals since ancient times, here are a few interesting facts you might like to know...

- The word 'gold' is thought to derive from the Indo-European word for yellow, however its chemical symbol, Au, comes from the Latin word Aurum, meaning 'glowing dawn'.
- Gold has an atomic number of 79 and atomic mass of 196.9665. It melts at 1064°C and boils at 3080°C.
- Gold has a density of 19.3g/cm<sup>3</sup> so one tonne of gold would be equivalent to a cube of side length 37.27cm!
- Gold occurs naturally in its elemental state and is mined from extremely deep mines (3000m) in South Africa where two thirds of the worlds supply originates. The gold is refined to a purity of 99.5% using the Miller chlorination process. If purer gold is required, other platinum group contaminants can be removed using the Wohlhill electrolytic process to produce 99.9% pure gold. Since gold is such a rare and precious metal mine tailings can be treated with cyanide to remove the small amounts of gold present. A million tonnes of sea water contains 5-6g of gold, but as yet no economic process has been developed to extract it.
- Gold is soft and ductile and is the most malleable of all the metals. As a consequence of this it is often alloyed with silver and copper to improve strength and durability.
- The purity of gold alloys is measured in carats, which dates back to ancient times in the Middle East and Mediterranean. It is a unit of measurement based on the weight of a carob bean and pure gold is defined as 24 carat.
- Gold has been used as currency for many years in many cultures due to its enduring high value.
- The football World Cup trophy is made from solid 18 carat gold and is 32cm tall.
- Around 2573 tonnes of gold was mined in 2000, which accounts for about 65% of the total consumption. The remaining 35% comes from recycling.
- Around 300 tonnes of gold are used each year in industrial applications.
- One of the biggest uses of gold industrially, is in the electronics industry. Gold is the best conductor of electricity and so it is used to electroplate contacts in circuits.



- Fine gold wire or strip is used to join semiconductor devices as it is easily shaped
- Etruscans were the first to use gold for dental applications in the 7<sup>th</sup> century BC. They would make very fine gold wire and use it to fasten a loose tooth to a firm one, or indeed to hold a false tooth in place
- Gold has been used in dentistry to form crowns and false teeth and in leaf form to fill cavities, as it can easily be moulded to shape, is chemically inert and is non-toxic to the human body.
- The softness of gold does mean that in the pure form it will soon wear away when used in the mouth so it is commonly alloyed with platinum, copper and silver.
- Possibly the most well known use of gold is in jewellery, the earliest examples of which date from the Sumer civilisation (they lived between the Tigris and Euphrates rivers in south west Iraq) around 3000BC.
- Gold leaf has been used for many centuries to decorate buildings as it is chemically inert and so does not tarnish.
- Gold plated glass has been used as it is very reflective and it reflects heat in summer and helps retain heat during winter which reduces heating and cooling costs. This reflective property is also used for the space shuttle rocket engines, satellites and space suits where it is also used as a radiation shield.

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,  
e-mail [Diane.Talbot@iom3.org](mailto:Diane.Talbot@iom3.org) or write to her at the Doncaster address on the front cover