ANNUAL REVIEW

EXTRACTIVE INDUSTRY IRELAND 2015






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2015 - A year of Milestones

Every year, the Annual Review committee members from the council of the Irish Mining and Quarrying Society gather to discuss the content of the upcoming publication. We all sit around the table and review the events that have taken place within the industry since the last publication and look forward to scheduled events within the industry for the remainder of the year.

Ronan Griffin

Keith McGrath

Tony Killian

Siobhán Tinnelly

Sean Finlay

Earlier this year, while considering a theme for the Annual Review for 2015, the Editorial Team noticed a significant number of events that were pointing to 2015 as a particularly remarkable year for the extractive industry in Ireland.

With so many momentous anniversaries, noteworthy retirements, company announcements, new technologies and new regulations and guidance documents within the sector, it was decided to focus our Annual Review around these events and, hence, the theme of "2015 –A Year of Milestones" was agreed.

On the occasion of this our 17th publication, we note that this year marks the anniversary of a number of significant occasions including the 50th anniversary of the opening of Tynagh Mine (1965) and the anticipated first gas at the Corrib Gas Project (featured in last year's Annual Review). We would also like to acknowledge the 25th anniversary of the closure of the Arigna and Sliabh an Iarainn mines which ceased operations in 1990.

Employing nearly 400 people, The Lisheen Mine, which commenced production in Ireland in 1998, is due to close in late 2015. As such, there is a dedicated paper within this year's Review on the history and development of The Lisheen Mine since Chevron and Ivernia West Plc commenced exploration in the area in 1984.

The theme of "Milestones" also includes more than anniversaries and company closures and start ups. This Review includes papers on new technologies, accomplishments in the ever-challenging area of Health and Safety e.g. the European Mine Rescue Competition 2015 and the announcement of new statutory regulations and guidelines that will continue to influence our industry for many years to come.

Continuing with our "personal profile" feature of recent years, we have selected a number of noteworthy retirees from the Class of 2015 (Yvonne Scannell, Padraig Connaughton, Brendan O'Reilly, Eugene Hyland and John Grennen) who have contributed to the growth and advancement of the extractive industry in Ireland through their dedication and commitment to our sector.

Tony Killian, who continues to form the backbone of each Annual Review committee, has continued to provide a number of excellently researched articles which will undoubtedly ignite the imagination of our readers.

We thank our advertisers without whom this publication would not be possible; all of our feature writers and regular contributors and our publisher 4 Square Media, with the assistance of Darryl Magee, for their continuing support of the Irish Mining and Quarrying Society.

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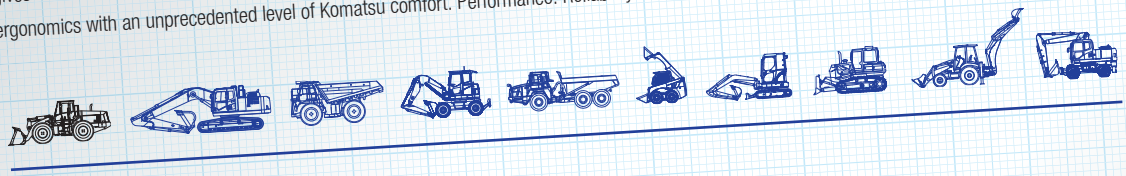

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IRISH MINING & QUARRYING SOCIETY

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Ministers Foreword

by Mr. Joe McHugh, T.D. Minister of State for Natural Resources

Following my appointment as Minister with responsibility for Natural Resources in July 2014, one of my first tasks was to contribute a foreword to the Irish Mining and Quarrying Society's Annual Review. I am very pleased to have been invited to do so once more this year.

Since my appointment I have become more familiar with the extractive industries and more aware of the importance of the sector to Ireland and its contribution to the economy. I have previously acknowledged the findings of the Indecon report published in 2013, which estimated the "economy-wide expenditure impact" of the sector in in the previous year at over €800 million and pointed to more than 3,300 full-time, jobs supported by the sector.

I am happy to note that, in 2014 our two underground Zinc-Lead mines accounted for 28% of European Zinc mine output and 10% of European Lead mine output. Output from Boliden Tara Mines Limited at Navan and Vedanta Resources Plc's Lisheen mine amounted to 2.1% of world mine production for Zinc and 0.8% for Lead.

According to data published by the UN's International Lead and Zinc Study Group, Ireland ranks 1st in Europe and 10th in the world for Zinc mine output and 3rd in Europe and 12th in the world in respect of Lead mine output.

In the non-metal mineral area, Irish Gypsum Ltd, continued production from its underground mine at Drummond, Co. Monaghan, production from the adjacent quarry at Knocknacran having ceased in September 2014. Approximately 300,000 tonnes of of gypsum was produced in 2014 which fed the company's production facility at Kingscourt, Co. Cavan.

Once again our administrative regime was ranked highly in the Annual Survey of Mining Companies conducted by the Fraser Institute of Canada. Ireland ranked first globally in the Policy Perception Index which ranks the attractiveness of Government mining policies to industry. Ireland scored 96.0 out of a possible 100 ahead of Finland (94.7), Alberta (94.7) and New Brunswick (89.8).

While Boliden Tara Mines continues to be the largest mine of its type in Europe, and will, I hope, carry on into the next decade, closure of the Galmoy and Lisheen mines will nevertheless impact on our place in the production tables in future years. Against that background, we need to ensure that the search continues for new resources. In this regard, I take comfort from the fact that minerals exploration is continuing with numbers of active prospecting licences currently standing at 581. Zinc and lead remain the principal targets of course, and the future of Glencore's Pallas Green project is of considerable interest. There is also interest in other minerals such as gold, silver, copper, iron, molybdenum, lithium and tungsten

The text of the long anticipated Minerals Development Bill was approved by Government and the Bill was published on 9 July 2015. This Bill will consolidate and update our statutory framework and, I hope, will provide greater clarity to investors while streamlining processes. I look forward to steering it through the Oireachtas for enactment in the autumn session.

IMQS membership and interests also include, of course, the non-minerals extractive sector, where, once again, with the economic upturn there are reasons to be optimistic. I was pleased to be present at Geoscience 2014 for the launch of the fourth edition of the Directory of Active Quarries and Pits in Ireland. This edition, published by the Geological Survey of Ireland (GSI), contains 209 entries and provides information on Crushed Rock, Sand and Gravel, and Dimension Stone operations throughout the country.

My Department is also working to encourage the exploration and mining sector through the provision of the latest data under the TELLUS Programme, managed by the GSI. Under this programme to date, all of Northern Ireland and nine other counties have been mapped with airborne geophysics and ground geochemistry, and this data is available free on line. In 2013 the North Midlands phase over Longford, Westmeath and Roscommon was completed. Announcing approval for the fourth phase of TELLUS in June 2015, I pointed out that this really is a highly significant development, not only in terms of Ireland's geology and natural resources, but in relation to our economy and environment as a whole. The data has the potential to lead to investment in areas such as mineral exploration and it can also help us better understand our landscape; enhance our land management skills; improve agricultural productivity and assess natural hazards such as radon on a region by region basis. It is my aim to have this established as a national programme, with a target of completing half of Ireland by 2017 and the entire country by 2023.

I am happy to reiterate my commitment and that of the Government to supporting a sustainable future for the mineral and non-mineral exploration and development sectors so that positive impacts for the local, regional and national economies can continue to be enjoyed in years to come.

I would like to thank the IMQS again for the opportunity to address its membership through this foreword and to acknowledge the important work of both the Society and its members in fostering sustainable development in the extractive industries. My Department and I both look forward to the continuation of and the future success of this important sector.

Message from IMQS President

by Siobhán Tinnelly MSc., PGeo IMQS President 2015 (& Associate Director with Tobin Consulting Engineers)

The theme for this year's Annual Review, "2015 –A Year of Milestones", reflects the fact that there are a number of significant events taking place in the extractive sector in Ireland this year. Anniversaries, retirements, industrial closures and project commissioning....the industry has reason to acknowledge and celebrate many business developments and also reflect on significant occasions relevant to our sector.

Our quarrying industry, in particular, has suffered badly in the last 7 years and we are happy to hear our members report a reasonable increase in orders and more consistent output levels than those reported in recent years.

Since 2014, a housing shortage in Dublin has led to an increase in house prices in the capital and a demand for provision of additional housing in Dublin and the surrounding areas. House prices have also risen nationwide during the last year.

According to the Central Statistics Office, in the year to June 2015, residential property prices increased nationally by 10.7%. This compares with an increase of 13.8% in May 2015 and an increase of 12.5% in the twelve months to June 2014. In Dublin, residential property prices fell by 0.4% in June 2015. Despite this fall, Dublin residential property prices were still 11.1% higher than in June 2014.

The most recent figures from the Ulster Bank Construction Purchasing Manager's Index (PMI) (July 13th 2015) report "growth of activity supported by a strong rise in new business and improved market confidence". The rate of job creation is accelerating and the rate of growth in the construction sector in June 2015 was the fastest reported since the survey record of November 2004.

As reported previously, the **mining sector** which remained buoyant during some of the most difficult years of the economic downturn has slowed down since 2012 and has experienced some challenges in the last two years including a decrease in metal prices and rising operational costs. A recent report in The Irish Independent by Andrew Critchlow (July 20th 2015) highlighted these challenges and, in particular, focused on the decline in iron ore and coal prices internationally which, coupled with the impact of large international mining companies restricting investment budgets has exposed the vulnerability of the often-cited booming exploration economy of countries such as Australia. Iron ore is now trading at around $50 per tonne, compared with a peak of around $180 per tonne in 2011.

The mining sector is vital to Ireland's economic growth and recovery. The Irish mining sector had sales of over €426 million in 2012. The overall value from the sector is estimated at €810 million, nearly double the direct production value. Exploration and mining companies contributed a total of €56 million in tax and other payments to the exchequer and to local authorities.

Following the announcement of the Minerals Bill in July 2015, **Minister Alex White said** that, in Ireland, "Over 3,000 people depend directly and indirectly on exploration and mining for their jobs and mining output earns almost half a billion Euro in foreign earnings."

The results of the **Fraser Institute's Survey** of Mining Companies 2014 (published in March 2015) confirm, once again, the international recognition of Ireland's value as a mining destination. The latest report ranks Ireland as 11th overall amongst 122 jurisdictions surveyed by the Institute. While this represents a slight fall in Ireland's position, the survey ranks Ireland in 1st place for policy and in 2nd place for investment attractiveness in Europe. A continuing downward trend in mineral exploration expenditure of 16% is noted among the companies surveyed. This represents a serious challenge in maintaining inward investment in mineral exploration for Ireland. The Exploration and Mining Division (EMD), GeoScience Ireland and the Geological Survey of Ireland (GSI), all associated with the Department of Communications, Energy and Natural Resources, have successfully used the annual PDAC Convention in Toronto, Canada for over 20 years in promoting Ireland as a destination for exploration and mining. 2015 was no exception, with EMD, GSI, Geoscience Ireland and the Geological Survey of Northern Ireland represented at the industry trade fair directed at over 25,000 delegates.

Mining operations in Ireland are in a similar state of contraction as reported in recent Reviews. As a result of the **recent closure of Galmoy Mine and the planned closure of The Lisheen Mine** in 2015, every effort should be made to encourage both continued operations and future exploration in Ireland. It is interesting to note that 2015 is the 25th anniversary of the closure of the Arigna and Sliabh an Iarainn mines which ceased operations in 1990. A special booklet on the mines and the 200 miners who worked them was launched in earlier this year. This year also marks the 50th anniversary of the opening of Tynagh Mine which commenced operations in 1965. There are a

number of events taking place during 2015 to mark both these occasions, including an industry event celebrating the discovery of Tynagh Mine which is due to take place at the end of October 2015. The very special "silver gavel and stand" that was made by Irish sculptor Edward Delaney from the treatment of the first shipment of lead-zinc-silver concentrates from the Tynagh Mine and presented to the IMQS in 1968 by Pat J. Hughes, Chairman of the Board of Irish Base Metals Limited, will be on display at this event and is featured on the front cover of this Review.

Boliden Tara Mines is continuing to operate in County Meath and is responsible for the direct and indirect employment of a significant number of mining and specialist professionals in Ireland and should be supported in all current and future operations to maintain this source of employment and also to provide stability in the supply of natural resources.

It is hoped that the recovery of the construction industry, and the housing market in particular, will have a continued positive impact on production and operations at **Irish Gypsum** (Saint Gobain). Following an extensive period of drilling and site investigation, further progress and a feasibility assessment for the **Pallas Green** facility is awaited. It is hoped that the recent cessation of drilling at this location is temporary, allowing for a full review of development options for this 40Mt+ zinc lead resource.

The IMQS is acutely aware of the pressing need for new discoveries to maintain output and employment and urges the Government to continue its policy of attracting new exploration investment to Ireland. This fact was acknowledged by **Minister of State, Mr. Joe McHugh T.D.,** who was a guest of honour at the IMQS dinner in November 2014 and who highlighted the importance of the sector for Ireland's economic recovery. The Minister also reiterates this message in his Foreword within this Review.

To date, 2015 has been a busy years in terms of new guidance documents, regulations and legislation for the industry. As detailed in "Highlights of the Year" within this Review and on www.imqs.ie (News and Events), the new regulations are relevant to both the mining and quarrying sectors and include:

Amendments to the Planning and Development Act – relevant for ongoing Substitute Consent Applications (S261A) and the Minerals Development Bill – which seeks to consolidate and modernise legislation on exploration and extraction of minerals replacing a number of pieces of legislation from 1940 through to 1999.

Irish Concrete Federation's (ICF) Product Traceability Scheme – a scheme for materials used in the construction supply chain which will enable suppliers to certify the origin of products and provide assurance as to compliance of products to Irish and European standards.

I would like to acknowledge the excellent work that is carried out on an annual basis by our colleagues in the GSI, GI, IGI, IAH and IAEG in informing the geosciences community about issues relevant to the extractive industry. Examples of this crossover between the various members of our associations can be seen by the weekly interactions and discussions on LinkedIn (Irish Mining and Quarrying Society Group) and the ongoing meeting of minds within the Irish Geoscience Network (IGN).

I wish to thank my fellow Council Members for their support during this my second term as President of the IMQS.

I also thank the individual and corporate members for their continuing support for the IMQS; across both the mining and quarrying sectors we have a loyal and enthusiastic membership who ensure that the Society continues to prosper.

Activities of the Society

May 2014 to June 2015

By Alan Dolan, Honorary Secretary 2015 – 2016

Current Membership	
209	Ordinary
3	Fellows
12	Hon. Fellows
7	Hon. Members
11	Corporate

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Dates of Council Meetings:

Since May 2014, the Council met on 8 occasions.

2014 –16th September, 14th October, 11th November.

2015 – 20th January, 24th February (AGM), 24th March, 28th April, 25th May.

Council Members:

In 2015, **Brendan O'Reilly** stepped down from the IMQS council. Brendan retired from Boliden Tara Mines in 2014. He had been a dedicated council member for a significant period and his vast knowledge and expertise on environmental matters proved invaluable to the society. At the AGM, Ciaran Greenan (Location Manager at Roadstone Ltd.) was voted onto the Council.

Siobhán Tinnelly will hold the position of IMQS President for a second consecutive year. Siobhán is an Associate Director at Tobin Consulting Engineers. The role of Vice President is filled by **Keith McGrath**. He is a director with McGrath's Limestone Works Ltd. **Les Sanderson**, our Honorary Treasurer, actively contributes to the society and is Director of Services for ECS Turbowash Ltd. **Alan Dolan** is Honorary Secretary and Ground Control Engineer at Boliden Tara Mines.

Other council members include: **Michael Lowther**, Manager of Mining at Boliden Tara Mines; **Mick Flynn**, Projects Manager at Boliden Tara Mines; **P.J. O'Donnell**, Director at Pat O'Donnell & Co. Ltd., **Sean Finlay**, Director of Business Development at Geoscience Ireland; **Ronan Griffin**, Property Manager at CRH Estates; **Peter Kinghan**, Chartered Mineral Surveyor at SLR Consulting; **Philip Morrissey**, Dan Morrissey (IRL) Ltd and **Ciaran Greenan**, Location Manager at Roadstone Ltd.

Carol Sanderson, our Executive Secretary, manages the society's communications and membership and maintains the web site, www.imqs.ie.

Thank you all for your dedication and commitment.

New Fellowship

At the council meeting on 11th November 2014, Mr. James Doody was proposed as an Honorary Fellow of the IMQS. James is a long-time supporter of the IMQS and has a significant depth of experience within the extractive industry. The announcement of James' fellowship was welcomed by all members.

The Extractive Industry Review 2014

The 16th annual publication was edited by Sean Finlay, Tony Killian, Siobhán Tinnelly, Ronan Griffin and Keith McGrath. As well as articles of technical and general interest, the theme of the review was "New Horizons". To coincide with the election of our first female president there was a dedicated section on women who are contributing to the recovery of the extractive industry in Ireland.

The 2014 and 2015 Review are available to download from the IMQS web site www.imqs.ie. The Review publishers were 4 Square Media.

Conferences / Seminars / Industry Events

Rusal Aughinish Alumina Refinery –Field Trip

The annual field trip took place on 5th September 2014. It was a fascinating insight into the handling, processing and waste management of Bauxite ore at the RUSAL Aughinish Alumina plant in Askeaton, Co Limerick. There was also stiff competition for the Perpetual Golf Trophy in Adare Manor Golf Course after the trip.

Boliden Tara Mines Visit

Prior to the council meeting held at Boliden Tara Mines on September 16th 2014, council members were invited on a brief tour of the facility. The tour included a visit to the Autogenous Grinding (AG) Mill in the Processing Plant and to the now completed, 4.5m diameter, 686m Return Air Raise drilling site.

CE Marking / Machinery Directive lecture - An Introduction to Machinery and Pressure Vessel Directives

On 1st October 2014, Mr. David Jenkins, RSA Engineering Inspection & Consultancy, held an evening seminar for IMQS members titled "An Introduction to Machinery and Pressure Vessel Directives". The talk was very well received and highlighted important certification issues for adapted machinery and pressure vessels.

IoQ-NI Stone Crushers Ball

The annual Institute of Quarrying (Northern Ireland) Stone Crushers Ball took place in the Europa Hotel, Belfast on 24th October 2014. IMQS council members, Siobhán Tinnelly and Alan Dolan, were invited as special guests and Siobhán presented a summary of the extractive industry in the Republic of Ireland. Council members P.J. O'Donnell, Sean Finlay and Phil Morrissey were also in attendance.

Africa Ireland Economic Forum

Held annually since 2011, the Africa Ireland Economic Forum (AIEF) is co-hosted by the Department of Foreign Affairs and Trade, the UCD Michael Smurfit Graduate Business School and the African Diplomatic Corps in Ireland. On 30th October 2014, Siobhán Tinnelly (representing the IMQS and Geoscience Ireland) presented an overview of Geoscience Ireland's objectives and collaborative approach to winning contracts as well as case histories of Geoscience Ireland's infrastructure development, water resource management and capacity building operations in Africa.

GSI/IMQS 4th Quarry Directory

TIn 2011, the IMQS and the GSI agreed to review and update the then out dated Quarry Directory. The IMQS provided support for this review and assisted with the data collection. The directory was launched by Minster of State Mr. Joe Mc Hugh T.D. on 5th November 2014 at the annual Geoscience Conference in Dublin Castle. Visit the DCENR web site (dcenr.maps.arcgis.com/home).

Geoscience 2014 Conference

Siobhán Tinnelly represented both the IMQS and Geoscience Ireland at the annual Geoscience Conference in Dublin Castle, on November 5th 2014. The conference was organised by the Geological Survey of Ireland (GSI).

All-Island Safety Seminar

The All-Island Safety Seminar was held on 19th November 2014 in Liffey Valley, Dublin. Siobhán Tinnelly chaired the morning session for this well attended event. Carol and Les Sanderson managed the IMQS information stand on the day.

Castlecomer Discovery Park Lecture: "Boliden Tara Mines - Europe's biggest underground zinc mine"

On Thursday 12th February 2015, as part of Engineers Week, staff from Boliden Tara Mines spoke about mine exploration, geology, planning and ore handling. IMQS members made presentations at this well attended event.

Evening Seminar: "The Lisheen Mine – From Discovery to Closure"

Following the AGM on February 24th 2015, our first evening seminar of the year was presented by Mr. Brendan Morris, Head of Mining & Technical Services, from The Lisheen Mine. It was titled "The Lisheen Mine – From Discovery to Closure". The talk dealt with all aspects of the mine's life from the orebody's discovery to its imminent closure and site rehabilitation in October 2015.

CQMS15

The 2015 Construction and Quarry Machinery Show, organized by Machinery Movers Magazine, was held in Tullamore on the 17th and 18th of April. Siobhán Tinnelly attended on behalf of the IMQS and a number of IMQS members were exhibiting at the show. It was a very successful event and the organisers have already started planning for 2017 (machinerymovers.ie/cqms).

Submissions

Exploration Drilling – Guidance on Discharge to Groundwater

A submission was made in June 2014 on the "Exploration Drilling – Guidance on Discharge to Groundwater" to the Exploration and Mining Division, Department of Communications, Energy and Natural Resources on behalf of IMQS members.

Representations

Irish GeoScience Network

The IMQS continues to represent its members on the committee of the Irish GeoScience Network. This committee aims to improve communications among the relatively small geoscience community and to review the issues of the day and any new legislation that may affect IMQS members. The most recent meeting was held on 11th February 2015.

EFEE (European Federation of Explosives Engineers)

EFEE was founded in 1988 and has 24 member nations. Its purpose is to provide a European forum for professionals working in the field of explosives techniques in rock. The IMQS represents Ireland as a member nation at EFEE council meetings. Alan Dolan represented the IMQS at the AGM and Council meeting, which coincided with the "EFEE 8th World Conference on Explosives and Blasting" in Lyon France from 26th to 28th April 2015 (www.efee2015.com).

QSCS and QSP steering committee representation)

The IMQS was represented on both the Quarry Skills Certification Scheme and the Quarry Safety Partnership steering groups by Les Sanderson, Ciaran Greenan and Philip Morrissey. Progress has been slow since the change from FÁS to SOLAS.

Annual Dinner Dance 2014

The annual IMQS Dinner Dance was held at the Ballsbridge Hotel on Saturday, 29th November 2014.

The presence of our special guest, Minister of State, Mr. Joe Mc Hugh T.D., was very much appreciated. In his entertaining, bilingual keynote speech, the Minister demonstrated a real understanding of the industry and his commitment to the sector (and the Irish language).

Overall, feedback from over 200 guests has been very positive. The intimate venue was very popular. The hotel management were attentive and provided a very satisfactory meal. The entertainment was provided by 'The Legends of Swing Band'. The sponsored photo booth, where attendees could take impromptu photographs, was a particular success (see the IMQS website for the photos). Thanks to the companies and individuals who sponsored the spot prizes, and, of course, to all the members of the IMQS Council who helped organise this well supported event.

Site Visit to the Sandvik plant, Co. Tyrone

The IMQS were delighted to be invited to the offices and factory of Sandvik, Ballygawley, Co.Tyrone, on May 21st 2015.

All the latest equipment was on display for our information and Q&As!

Annual Field Trip

This year's Field Trip was held at The Lisheen Mine, Moyne, Thurles, Co. Tipperary on Friday, 28th August 2015. Noel O'Dwyer took home the much sought after IMQS Golf Trophy! Details are available on www.imqs.ie.

Mine Rescue

European Mines Inspectors Conference

The European Mines Inspectors Conference was held on 10th October 2014 in City North. On 11th October, Boliden Tara Mines hosted the delegates for an underground trip.

European Mine Rescue Competition 2015

On the weekend of the 8th May 2015, Siobhán Tinnelly represented the IMQS at the European Mine Rescue Competition 2015. This year the 3 day event was held in Portugal at the Somincor Lundin owned Neves Corvo mine. Seven teams took part in the event and the Irish Mines were represented by Boliden Tara Mines and The Lisheen Mine.

Siobhán reported that, Lisheen were very unlucky not to take the title of "Best Search & Rescue" but that award did go to a worthy Boliden Tara Mines team, who were also deservedly awarded the title of "Best Overall Team" at the competition. Siobhán also presented the IMQS medal for the "Best Captain" on the day.

Many compliments were paid to Mike Lowther acknowledging his professionalism and dedication to the organisation.

The acknowledgement at Government level of the value of Mine Rescue training is very important for our industry, particularly with the closure of The Lisheen Mine later this year and the continuing underground operations at Gypsum Industries Ireland, Knocknacran, Co. Monaghan and Cavanacaw Gold Mine, Omagh, Co Tyrone. The IMQS are proud to be associated with the efforts of Mine Rescue in Ireland and abroad. A full summary of the activities of Mine Rescue are highlighted in this Review.

Future Events

Raw Materials Initiative.

A presentation will be given by Mr Tony Hand in late 2015. eit.europa.eu/eit-community/eit-raw-materials.

Annual Dinner Dance 2015

This year's annual dinner dance will be held in the Ballsbridge Hotel, Dublin 4 on 28th November 2015.

Heavy Machinery Exhaust Emissions

This event will be held in Autumn 2015.

Events are continually being organised so keep up-to-date at www.imqs.ie or at the Irish Mining and Quarrying Society page on LinkedIn.

IMQS Web Site

The IMQS website continues to have a high level of activity under the watchful eye of Carol Sanderson. As in 2013 - 2014, features that proved popular include the News & Events section where upcoming seminars, new regulations and legislation are posted and the Jobs section where vacancies, in Ireland and abroad, are advertised regularly. (Posting adverts is currently free of charge).

For the year ending 31st May 2015, a total of 4,771 visits were made to the website. Of the total number of visits, 2,864 of these were from Ireland. The IMQS website has a global audience with hits from Europe, Canada, USA,

South America, Australia, India, Mongolia, Russia and Africa. To help pay your subscription quickly and easily, just click 'Becoming a member' on the home page and follow the instructions. For those who prefer paper transactions, we still accept cash and cheques! See also the "Links" page on the website for other organisations related to the extraction industry.

Online Courses/ Flexible Learning for the Extractive Industry

A number of online courses are being run by the University of Derby, UK. Courses can be part-time, full time and online and range from individual modules to degree level qualifications. Further information can be found at either of the following: www.quarrying.org/education and/or www.derby.ac.uk

Media Coverage

IMQS members regularly provide updates and interviews to organisations and publications, including the QPANI Journal, IAEG Annual Review, Machinery Movers Magazine and Plant and Civil Engineer Magazine. The IMQS also got a mention in the Irish Independent following Siobhán's re-election as President http://www.independent.ie/business/the-punt/the-punt-a-rock-of-sense-at-society-31089065.html.

IMQS Communications/ Emails/Social Media

As well as keeping our members up to date with the latest news and events in the extractive industry, we also receive communications via email and social networking. The IMQS has an active group page on LinkedIn (Group: Irish Mining & Quarrying Society). The IMQS LinkedIn group currently has 251 members (at date of print) who have access to the latest industry news. If you are not already a group member, why not join and catch up with some colleagues or maybe connect with somebody in your area of business. All members of the Irish Mining & Quarrying Society are encouraged to contribute to this active group and join in the discussions. To help reduce our paper usage and postage costs, we are communicating with members, where possible, through our web site, email and other electronic means of social media. Email addresses continue to be sought and updated. If you have not received an email communication from us recently, please email info@imqs.ie to have your details updated and keep in touch!

Conclusion

I would like to express my sincere appreciation to our President Ms. Siobhán Tinnelly and Vice-President Mr. Keith Mc Grath for their leadership and dedication to the work of the Society. I also wish to thank our Treasurer Mr. Les Sanderson for maintaining the accounts over the past year and to the other current officers and members of the IMQS Council who often serve on several sub-committees to voice and protect the interests of our members. Finally, I would like to thank you, our members, for your patronage. The Society cannot exist without your continued support.

Alan Dolan

Honorary Secretary, Irish Mining & Quarrying Society

Alan Dolan is a Ground Control Engineer at New Boliden Tara Mines in Navan. He is a Chartered Engineer and has worked for many years in the Drill and Blast sector.

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Highlights of the Year

by Siobhán Tinnelly, IMQS President

Planning and Development Act (amendments) – Substitute Consent Applications (S261A)

A number of new regulations have been introduced as amendments to the Planning and Development Act and were signed by Alan Kelly T.D. in July 2015 and are relevant to quarry operators involved in ongoing Substitute Consent applications .

In summary, it will now be possible to apply for future quarry development at sites where a decision on a Substitute Consent Application is pending. From the date of publication of the planning amendment (July 14th 2015), the applicant has 6 months to submit a prospective application to An Bord Pleanála which will be considered alongside the pending Substitute Consent application. It is important that applicants inform the Board that they intend to submit a prospective application within 6 months of the publication date of the new planning amendment, in order for a decision on the relevant Substitute Consent application to be postponed until the prospective application is received.

In addition, further regulations were signed by the Minister on July 22nd 2015 and include rectification of permissions found deficient during the Section 261A process so as to allow a single application to ABP for retrospective substitute consent as well as prospective permission to finish out the previously authorised area (to extent of deficient permission). Additionally, the amendment contains measures for sites where outstanding issues under the original Section 261 process resulted in complications during the more recent Section 261A application process.

All documents are available on the "News and Events" page on www.imqs.ie

Minerals Development Bill

The Minerals Development Bill was published on July 11th 2015.

The Bill seeks to consolidate and modernise legislation on exploration and extraction of minerals replacing a number of pieces of legislation from 1940 through to 1999.

Minister Alex White and Minster of State Joe McHugh at the Department of Communications Energy and Natural Resources have both welcomed Government approval to the text of the new Bill. Minister Alex White, said "Over 3,000 people depend directly and indirectly on exploration and mining for their jobs and mining output earns almost half a billion Euro in foreign earnings. This Bill, when enacted, will modernize and update the statutory framework for exploration and mining."

The substantial Bill has over 250 sections and is likely to be one of the largest to be considered by the Oireachtas this year. The purpose of the legislation is to make better provision for prospecting and the development, management and control of mineral resources in the State.

Minister of State, Joe McHugh remarked "Ireland's diverse geology has good potential for the discovery of further economic mineral deposits and we have a comprehensive regulatory system for all stages from exploration to mine development, including planning for eventual mine closure and remediation. This is vitally important and gives reason for confidence in the sector. This new legislation consolidates and modernises that code into a single statute. Our commitment to keeping the regulatory code up to date is one of the main reasons international surveys consistently rank Ireland amongst the best in class.

"Ireland's natural resources are a vital part of our national potential. Since taking office we have renewed the commitment to their development in a way that is sustainable and that increases Ireland's international investment attractiveness. Offshore, new research such as the Atlantic Regional Seismic survey has been complemented by measures to revise upwards the fiscal take from the petroleum sector. Onshore, this Bill is a significant further step in both regulatory reform and supporting sectoral development, complemented by Government commitment of funding to the Geological Survey of Ireland's geophysical and geochemical survey of the country under the Tellus programme."

The Irish mining sector had sales of over €426 million in 2012. The overall value from the sector is estimated at €810 million, nearly double the direct production value. Exploration and mining companies contributed a total of €56 million in tax and other payments to the exchequer and to local authorities.

Ireland is Europe's largest producer of zinc metal in concentrate, and tenth largest in the world. Exploration continues in the search for new deposits of zinc and other minerals to ensure a future for this important sector in Ireland.

Concluding, Minister of State McHugh underlined that the legislation is not related to hydraulic fracturing (fracking) in any way. "There is a separate and very comprehensive piece of research looking at the question of hydraulic fracturing and no decisions on that issue will be made until that research is received and considered."

The text of the Bill and Explanatory Memorandum can be found on the Oireachtas website at the following links:

http://www.oireachtas.ie/viewdoc.asp?fn=/documents/bills28/bills/2015/6915/b6915s.pdf

http://www.oireachtas.ie/viewdoc.asp?fn=/documents/bills28/bills/2015/6915/b6915s-memo.pdf

Irish Concrete Federation's (ICF) Product Traceability Scheme

On July 1st 2015, the ICF launched a Product Traceability Scheme for materials used in the construction supply chain which will enable suppliers to certify the origin of products and provide assurance as to compliance of products to Irish and European standards.

Speaking at the Launch, Mr. Gerry Farrell, CEO of ICF, stated that the Scheme is in keeping with the requirement for building materials to carry the CE Mark and that changes in Building Control Regulations mean that builders, architects, engineers and surveyors who complete certificates of compliance with the new regulations, need the reassurance that materials are produced to the required standards and are traceable to their point of manufacture.

Minister of State at the Department of the Environment, Mr. Paudie Coffey, T.D., welcomed the ICF initiative at its launch. Following the event, IMQS President, Ms. Siobhan Tinnelly, joined the Minister in welcoming the ICF initiative and urged IMQS members to adopt and use the ICF Traceability Certificate for Aggregate and Concrete Products.

Construction Quarry Machinery Show (CQMS) 2015

In the weeks and months since the Construction Quarry Machinery Show (CQMS15), Ireland's first Construction and Quarry Machinery Show, the reaction received from all quarters has being universally positive.

Organised by Machinery Movers and sponsored by Close Brothers Commercial Finance (both members of IMQS), the show was held over two days in April 2015 at Molloy's Quarry, Tullamore. According to the organisers, the event attracted some 110 exhibitors and just over 5,000 visitors.

It is anticipated that a similar show (of even larger scale) will be held at the same venue in 2017, and will be announced in the coming months.

All Ireland and UK Mine Rescue Competition

and first European Mine Rescue Competition

By Mike Lowther, Chairman IMRC and Siobhán Tinnelly, IMQS President

The 2015 All Ireland and UK Mine Rescue Competition was hosted by Somincor Lundin's Neves-Corvo Mine, Portugal from May 7th to May 9th 2015.

This was also the first ever metalliferous mines European Mine Rescue Competition and Ireland was represented by specialist mine rescue teams from The Lisheen Mine and Boliden Tara Mines. (Lisheen and Tara competed in separate Iberian events in 2013 and 2014 respectively). There were four additional teams competing from Portugal and Spain.

The competition included the following events:

- Search & Rescue
- Bench Test and Knowledge Test
- First Aid
- Fitness

The award for "Best Search & Rescue Team" was presented to Boliden Tara Mines, who were also deservedly awarded the title of "Best Overall Team" at the competition! This was a huge achievement and was recognised by all present.

Joaquim Pereira, Competition Director.

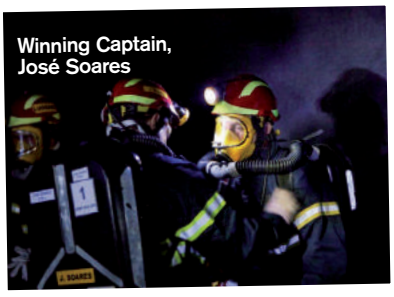
The IMQS award for "Best Captain" was awarded to José Soares, Neves Corvo 'C' Team.

All teams competed at a very high standard, and the bonds and respect between all competitors was clear to see.

The dedication and commitment of the individual team members, Mine Rescue Officers and management to Mine Rescue training at each facility, in parallel with day-to-day operations, is highly commendable.

For your information, the Guidelines for running the All Ireland and UK Mine Rescue Competition and the Irish Mine Rescue Standard are available on the IMQS website (www.imqs.ie). A special word of thanks to John Grennan (past Secretary Irish Mine Rescue Committee) who acted as a Search and Rescue Judge at the competition, and Aoife Tallon (Secretary IMRC), and Pat Griffin (Senior Inspector HSA) for their hard work and dedication in assisting with the 2015 competition.

Kieran Brassil (Tara Captain) at de-brief with S&R Judges Antonio Cruz, John Grennan, Armando Pereira



J.M. Lowther (I.M.R.C. Chairman), R. Cahill, J. Sheppard, D. Finnegan, G. Mc Donnell, K. Brassil, R. Russell, P. Smith Jnr, John Smyth, S. Tinnelly (IMQS President), J. Grennan (Search & Rescue Adjudicator).

Willie Bergin, Pierce Ryan, Eamonn Maher, Ian Kearsley, Ryan Owens, Ronnie Scott, Pat Hynes, Ian Johnstone.

An overiew of activities by the Institute of Geologists of Ireland (IGI)

by Marie Fleming, IGI President, Institute of Geologists of Ireland (IGI)

Marie Fleming IGI President

EurGeol Marie Fleming PGeo was elected President of the IGI in May 2015.

The Institute of Geologists of Ireland (IGI) was established in 1999 with the mission of promoting and advancing the science of geology and its professional application in all disciplines, especially the geosciences and to facilitate the exchange of information and ideas in relation thereto. IGI Members are required to uphold, develop and maintain the highest professional standards in the practise of their profession.

Since its formation, the IGI has gone from strength to strength. This ongoing development can be attributed to the IGI members who voluntarily represent the IGI not only at board level but through representation on various working groups, conferences and committees both nationally and internationally. The membership-led ethos of the IGI has created a close-knit community where there is always an IGI member available for consultation.

Professional Accreditation and CPD

The IGI provides accreditation for geoscientists in Ireland and promotes the interest of its members in Ireland and internationally. The IGI offers career-long support for geoscientists, with a member-in-training category for those working towards the PGeo title, the full PGeo Member category and membership for associate and retired geoscientists. Membership reflects the wide diversity of disciplines within the geosciences including geology, hydrogeology, mineral and petroleum exploration and development, engineering geology, environmental geology, geophysics and geochemistry.

The IGI also has six mutual recognition agreements (MRA) with:

- Australian Institute of Mining and Metallurgy – AusIMM (Australia).
- Geoscientists Canada – GC (Canada).
- European Association of Geoscientists and Engineers – EAGE (International).
- Southern Africa Institute of Mining and Metallurgy – SAIMM and the Geological, Society of South Africa – GSSA jointly sponsoring the SAMREC and SAMVAL, Committee – SSC (South Africa).
- Geological Society of London – GeolSoc (United Kingdom).
- American Institute of Professional Geologists – AIPG (USA).

The importance of maintaining these MRAs, based on continuing professional development (CPD) and ethically good professional practice cannot be overstated, given the international nature of geological practice and the mobility of IGI's membership.

The IGI's standing in the international geological community is very much dependant however on the rigor and completeness of our Continuing Professional Development process. Our CPD process has been closely scrutinised by all the professional bodies abroad with which we have MRAs. It was found to be sound, most recently through our successfully negotiated MRA with Geoscientists Canada which is the first MRA agreement facilitated by Geoscientists Canada (http://geoscientistscanada.ca/practice-in-canada/mobility/).

Professional membership of the IGI is open to all practising geoscientists who meet the required standards of qualification and experience. For information on how to apply, please visit www.igi.ie .

European Federation of Geologists (EFG)

The IGI also continues to be an active National Association Member, as well as a National Licensed Body Member, of the European Federation of Geologists (EFG). A significant milestone during 2014 was the decision taken by the EFG to lead and participate in the European Commission's Horizon 2020 (H2020) research

programme. The EFG were subsequently involved in a number of winning consortia.

Thanks to the collaboration of the EFG and its national association members the 'Geology for Society' report made by the Geological Society of London has been translated into various languages and was officially launched at the European Parliament on 2 June 2015. The report was presented to MEPs and EU policy makers to outline the importance of geology and qualified professionals to our society, covering areas such as energy, minerals, water, waste management, construction, land contamination and natural hazards. In turn it also aims to promote dialogue between policy makers and geoscientists at both a European and national level. The report has been translated into 14 European languages including Irish (with thanks to the translation services of the Geological Survey of Ireland and the Department of Communications, Energy and Natural Resources).

Irish Geoscience Network (IGN)

The Irish Geoscience Network (IGN), convened by the IGI, was formed in early 2012 to provide a forum for communication and sharing of ideas and resources for all bodies, organizations and departments involved in the Geosciences. The body has now grown to circa 32 such bodies and meets once a year.

Along with access to an exclusive Professional Indemnity (PI) insurance scheme for the IGI Members and affiliated organisations, the Geo-Calendar of Events http://www.igi.ie/events_calendar.htm is available to assist all members of the Network to plan and where possible to avoid conflicting dates in their events.

Geology for Society Report

Geology for Society Report Launch at the European Parliament June 2015 (L to R: IGI President Marie Fleming, Mairead McGuinness MEP, EFG President Vitor Correia)

Pan-European Reserves & Resources Reporting Committee (PERC)

The IGI has been a professional accreditation organisation of PERC since its inception. EurGeol David Dingemans PGeo of the IGI has prepared a summary guide to the PERC Reporting Standard (IGI Summary Guide to the PERC Reporting Standard). The Summary Guide has been prepared to explain some of the concepts behind the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves as defined by the PERC Reporting Standard for solid mineral raw materials.

Public Reporting, in the context of solid mineral raw materials, is any written or verbal communication concerning Mineral Projects. It is important not to mislead any member of the public, either intentionally or inadvertently, as to the presence or otherwise of solid mineral raw materials in or on the earth or of its value. With this in mind the Guide has been written primarily for geologists and geoscientists not familiar with, or not working in the minerals sector to explain the language commonly used in the reporting of Exploration Results, Mineral Resources and Mineral Reserves.

The Guide provides the key points and some associated definitions of the PERC Reporting Standard for ease of reference for both non-technical and professional users. Should any reader intend to prepare a Public Report on Exploration Results, Mineral Resources and/or Mineral Reserves then they must refer to the full text of the PERC Reporting Standard and should be a Competent Person as defined in the Standard to prepare such a report.

Medal of Honour 2015 Kevin Cullen (L to R : IGI President Marie Fleming, Gerry Stanley IGI past President, Kevin Cullen and Anne Cullen

IGI Medal of Honour 2015

The IGI was delighted to award the 2015 IGI Medal of Honour to EurGeol Kevin Cullen PGeo. Kevin has been a loyal and dedicated Member of the IGI as well as an ardent supporter of the EFG. He served on the IGI Board and was President from 2007 to 2009. He has contributed to many IGI projects including the IGI's EIS and Private Water Well Guidelines and to various workshops. He is always available to provide advice and volunteer for IGI activities and assists with interviews hosted by the Validation Committee.

The IGI acknowledges the continued support of our sponsoring bodies, the Irish Mining & Quarrying Society (IMQS), Geophysical Association of Ireland (GAI), Geotechnical Society of Ireland (GSI), Irish Association for Economic Geology (IAEG) and the International Association of Hydrogeologists (Irish Group, IAH).

Northern Ireland Infastructure:
False Dawn?

by Gordon Best, Regional Director QPANI

Last year I began my message with a greater sense of optimism than the previous number of years. However as I write this message for you that optimism and hope that our Northern Ireland Executive and political parties could act as cheer leaders and facilitators of economic prosperity and sustainable growth has sadly evaporated.

At the time of writing last year we had high hopes that Government action would help the speedy delivery of major economic infrastructure projects in the North. **We had hoped that following a number of high level infrastructure reports from the Strategic Investment Board and the CBI calling for a central delivery agency for major public sector construction projects that action would follow.** Instead what we got was procrastination and selfish political interests resulting in these proposals being frustrated and left on the shelf.

QPANI along with other construction and business organisations have been calling on our politicians in the North to reach an agreed decision on implementing the Stormont House Agreement that will enable the construction industry to build a modern infrastructure for an economically competitive Northern Ireland. The future of so many businesses and the hopes of our young people depends on our elected leaders reaching agreement on a future budget and on welfare reform. The current impasse is creating unequalled levels of uncertainty, growing numbers of redundancies and suspension of investment decisions within the construction supply chain. In fact a number of local contracting firms whose turnover in GB now exceeds that of their work in NI are now considering moving their main office facilities to Britain. It is sad that the innovation, skills and products of our construction material suppliers are in greater demand outside of these shores rather than at home. The responsibility for this lies fairly and squarely with those political parties who ignore the financial realities of life and put political interests ahead of supporting hard working people and businesses.

In May of this year QPANI supported the development of the **Cold Water Safety Strategy** which aims to tackle the issues of trespass and drownings in disused quarries and reservoirs. Following a number of deaths in disused quarries in Northern Ireland in the past number of years the Department of the Environment, led by the Environment Minister, asked district councils to investigate the number of disused quarries within their districts, assess their high risk features and consider what could be done to prevent further fatalities.

Following a comprehensive review of all aspects of disused quarries and the options available, an educational awareness campaign aimed at teenagers and young adults was considered to be the most appropriate way of highlighting the serious risks involved in swimming in disused quarries and open water and influencing behavioural change.

The Quarry Products

Association NI has worked for a number of months with the Departments of Environment and Justice and the Policing and Community Safety Partnerships (PCSPs) to put together an educational awareness campaign. The campaign, "Quarry water is a stone-cold killer. Stay out, stay alive" warns of the dangers of swimming in disused quarries and open water.

The team has designed a poster and informative leaflet that can be placed in schools, leisure centres, community centres and youth groups. This material will also be circulated on a number of social media sites, including Facebook and on websites, including NI Direct.

The leaflet, which has been specifically designed for social media channels, highlights how cold shock sets in after an initial plunge into cold water. It refers to the difficulties that an individual will have getting out of water as their fingers stiffen, coordination reduces and muscles weaken as the cold takes hold. If these reduced physical capabilities don't result in drowning, one is at risk of hypothermia. DOENI recently confirmed that the Safety Strategy face book page had received over 60,000 hits and was growing.

QPANI are also working with NI Water in a similar campaign to highlight the dangers of swimming in lakes, reservoirs and disused quarries.

Our annual Joint Industry Charity Golf Day on the 8th June was blessed with good weather and the sun shone on around 80 golfers from across the industry who took part at the Hilton Templepatrick. The event was well supported by Members and guests and a great day was had by all. Through sponsorship and the evening raffle the event managed to raise an impressive £3000 for the 2 nominated charities, Chest Heart and Stroke and the Children's Liver Disease Foundation.

On the training and skills front QPANI members recently attended **Extractives and Mineral Processing employer forums** with Southern Regional College and South West College to discuss apprenticeships and the delivery of qualifications within the industry. Discussions focused on how we as an industry can make ourselves more attractive as a potential career opportunity for young people in offering career paths, where the current skills needs are and agreeing a medium to long term strategy to address succession issues within the industry. The three areas that were highlighted are materials testing, health and safety/ quality/ environment and maintenance activities. Agreement was also reached on the need for a joined up strategy between QPANI and the two Colleges going forward. More meetings are being planned to take the strategy forward.

A major highlight of this year was the recent **RESTORE** conference that gave the local industry an opportunity to showcase some excellent environmental and restoration work. The event, which took place on Wednesday 27 May, was organised by the RESTORE project, with support from the Quarry Products Association Northern Ireland. RESTORE is a partnership project financed by the EU's Interreg IVB North West Europe fund, led by the RSPB, and aims to assist the restoration of mineral extraction sites into priority habitats in Northern Ireland, elsewhere across the UK and wider North West Europe. The key note address was given by **Environment Minister Mark H Durkan MLA** in which he recognised the important and positive contribution the aggregates sector can bring to the environment through quality restoration.

The growing influence of environmental and landscape matters is being manifested by increased opposition to proposed developments across Northern Ireland. QPANI has a key role, assisted by members of course, to educate and inform key stakeholders, neighbours and objectors alike about the impact the industry does have and the mitigation measures that can be taken to minimise or eradicate nuisance and environmental impact. At the time of writing QPANI are working with the Northern Ireland Environment Agency organising a number of pollution prevention and resource management workshops that will assist in raising standards within the Industry and also NIEA staff appreciation of the economic, social and environmental importance of our Industry.

The transfer of power to the new 11 local Councils in April of this year has created challenges and work for the Association. While we have developed close relationships with local Councils, particularly through the good offices of the Northern Ireland Local Government Association (NILGA), **the transfer of planning powers to local Councils will undoubtedly bring significant challenges** for everyone as the new system takes time to bed in. We intend to set up a working group with Planning Service and the new Council Chief Executives Group to assist in building capacity and knowledge within the new Council planning regime to ensure our members planning applications are dealt with and processed by knowledgeable and competent planning officials thus resulting in a faster and efficient service. QPANI have offered our assistance in helping local council planning teams as they write their Local Development Plans. Assessment of aggregate supply and demand and the need for Mineral Safeguarding in each Council area is high on the QPANI agenda.

The excellent work by our **Health and Safety Committee** has continued this year. The QPANI lost time incident statistics and positive reports from HSENI indicate standards are good and the industry is performing well and implementing good practice. It is sad to report though of two fatalities in the Industry this year and QPANI will intensify our work with HSENI to ensure incidents like these never happen again. Our sympathy and best wishes are with the families and friends of those who tragically lost their lives. This past two years QPANI have worked in a partnership with HSENI that has delivered significant improvement in the precast concrete sector and the number of safety workshops held at various industry sites during 2015.

As always I am honoured to be asked to pen this short article for the IMQS Journal and may I wish IMQS and all your members every success in 2015 and the coming years ahead.

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Industry Review

by Gerry Farrell, Chief Executive of the Irish Concrete Federation

Once again it gives me great pleasure, on behalf of the Irish Concrete Federation, to make our yearly contribution to the Annual Report of the Irish Mining and Quarrying Society. I would like to thank the Society's President, Ms. Siobhan Tinnelly, for offering me the opportunity to bring readers up to date with developments in the agenda of the Irish Concrete Federation and its members over the past year.

Having read my previous contributions to this highly regarded publication in preparing for this article, I find myself struggling to avoid repeating my comments of the past number of years. Without wishing to sound overly negative about developments since last year's report was published, I will simply say that unfortunately 2015 has not proven to be as buoyant as the members of the ICF had hoped. In fact for many of our members, 2015 has seen contraction in activity when compared to last year, particularly in rural areas. When reading the very welcome reports on Ireland's economic performance in recent times, one could be forgiven for believing that all sectors of the economy were on a steadily upward curve. However it is clear that while recovery is taking hold, the disparity between economic activity, particularly construction activity, in the greater Dublin area and rural Ireland has become more pronounced this year. Clearly investment has returned to our capital city, particularly in the industrial and commercial area. However this has not been the case in rural Ireland. Indeed, it will be a major challenge for the next Government to ensure that the very welcome improvement in Ireland's economic fortunes is felt by those who live and work outside of the greater Dublin area.

Taking a more positive perspective on current market conditions, it is fair to say that it was always predicted that when recovery would take place, construction would lag the general economic upturn. Furthermore it was always expected that construction activity would increase in urban centres before rural areas saw any

upturn. Therefore perhaps we are currently experiencing what had always been anticipated and that more prosperous times are on their way for all of our members.

Over recent years, ICF members, and no doubt members of the Irish Mining and Quarrying Society, have adapted to the current market environment and have developed new and innovative ways of managing their businesses. Therefore, despite the fact that the industry remains stubbornly at levels equivalent to one third of its size at the height of the 'Celtic Tiger', individual businesses and in particular our export sector continue to thrive. In this context, there has been a magnificent performance by our precast concrete exporters to the UK, with the value of exports this year predicted to reach €140 million from a figure of 0 in 2006. Clearly this tremendous performance is not easily achieved and great credit is due to those individual companies who, with the assistance of Enterprise Ireland, have successfully developed new markets across the Irish Sea for their products.

On the representational front, the ICF agenda remains extremely busy as the organisation continues to positively influence the business environment in which our members operate. Through our member committees, ICF formulates policy to influence decision making on our members' behalf while at the same time continuing to provide valuable services for members.

Of particular interest to Irish Mining & Quarrying Society members I am sure, are the developments with regard to quarry planning. ICF has spent the past two years seeking the introduction of new legislation to facilitate a speedier regularisation process for those of our members who have been required to seek substitute consent as a result of Section 261A of the Planning and Development Act. I am happy to report that the regulations have finally been signed by the Minister for the Environment, Community & Local Government for which we are grateful. The legislation will facilitate the introduction of a 'once-off' provision whereby operators can apply directly to An Bord Pleanála for permission for future development while awaiting a decision on a substitute consent application. ICF is hopeful that when Section 261A has finally worked its way through the entire industry, it will leave our quarries on a more sustainable and concrete

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footing for the future.

The ICF's Health and Safety Committee continues to work to promote safety in our members' quarries. Unfortunately 2015 has already seen two fatalities in quarries in this country, a stark reminder of the fact that quarrying by its nature is an extremely dangerous occupation and that everybody, both at company and individual level, should always place safety to the forefront of everything that they do. ICF was happy to work with the Irish Mining & Quarrying Society in the organisation of the All-Island Quarry Safety Seminar in November of last year and we will continue to work with the Health and Safety Authority to address all safety issues and improve the safety culture in our members' quarries.

Our Technical Committee remains extremely busy in assisting the National Standards Authority of Ireland, along with other stakeholders, on the development of revisions to guidance and standards for the products which our members produce. Compliance with standards is an issue of the utmost importance for ICF. On July 1st, the Irish Mining & Quarrying Society, along with other stakeholders in the construction sector, attended a launch by Minister of State at the Department of the Environment with Special Responsibility for Housing, Planning and Coordination of the Construction 2020 Strategy, Mr. Paudie Coffey TD, of an initiative by ICF to improve traceability and compliance with standards in our industry. Certification of the origin and compliance of our products with the required standards will become a central part of our industry's contribution towards improving the integrity of the entire construction supply chain in the future. While possibly increasing the burden of paperwork on our members, this is a positive development for those in our industry who are compliant with standards and are supportive of continuously 'raising the bar' and safeguarding our own industry's future.

Transport continues to form a central part of the federation's activity. In June of this year, the ICF held a major Driving for Work Seminar for members in consultation with the Road Safety Authority, An Garda Síochána and the Health and Safety Authority. The key point to note is that our members are no longer simply manufacturers of construction materials, they are also transport companies with the associated additional costs and legal responsibilities that all other transport companies have. It is clear that educating members on the constantly changing regulatory requirements in respect of their transport operations will be a key challenge for our new, young and energetic transport committee.

In recent years the constraint in resources available to all representative bodies like the ICF, and I am sure the Irish Mining & Quarrying Society, led to an unavoidable and necessary reduction in activity in particular areas. One area of the ICF agenda which has suffered greatly as a result of this constraint in resources was the marketing of our members' products. I am happy to say that the ICF and Cement Manufacturers Ireland have recently agreed to reform the Concrete Development Group with a view to identifying key communication objectives for our industry centred on the promotion and marketing of sustainable aggregates and concrete. I look forward to updating all Irish Mining & Quarrying Society members this time next year on the progress of this very important initiative.

I will sign off by once again thanking the IMQS for their support and assistance throughout the past year and I wish the Society and all of its members the best for the remainder of 2015 and the coming year.

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The Lisheen Mine – Discovery to Closure

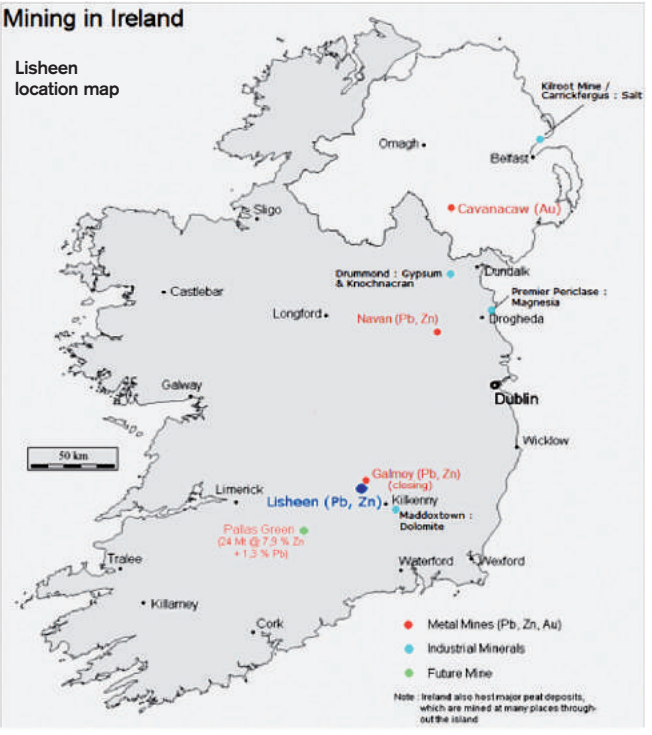
By Mr. Brendan Morris, Head of Mining & Technical, The Lisheen Mine

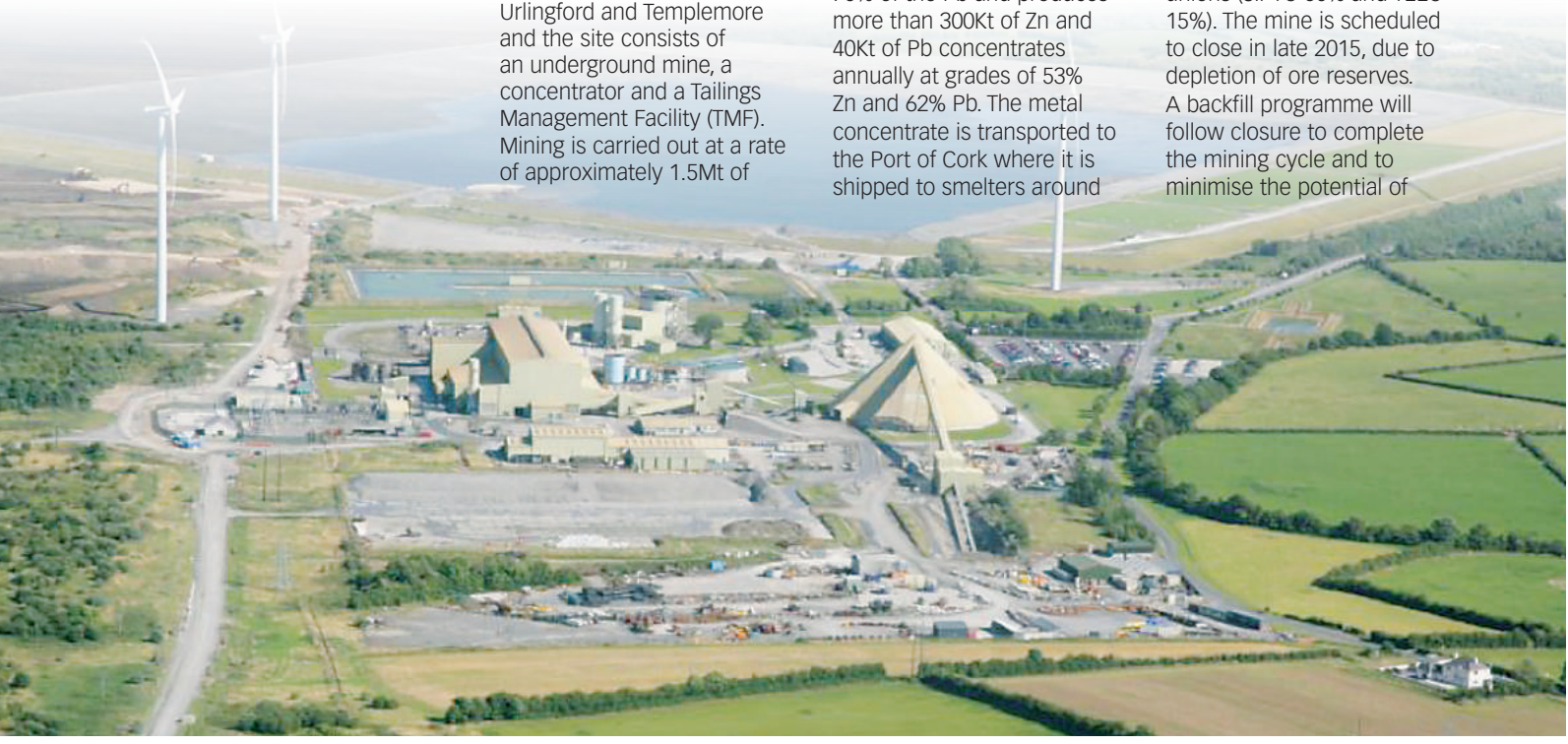
Lisheen is a mining/ mineral processing company wholly owned by Vedanta Limited, a company who is a London Stock Exchange listed, globally diversified natural resources major, with interests in Zinc, Lead, Silver, Copper, Iron Ore, Aluminium, Power and Oil & Gas.

The Lisheen Mine – Overview

Vedanta has mining operations in India, Africa, Australia and Ireland, with a strong organic growth pipeline of projects. Vedanta is committed to international standards for safety and sustainable development and works with stakeholders and local communities. Lisheen Mine consists of two distinct operating companies. The mining entity extracts zinc and lead ore from underground and the crushed ore from the mine is brought to surface via conveyor and stored in a surface stockpile ("Tepee"). The milling entity then takes the ore and conveys it via vibrating feeders onto a conveyor, which delivers it directly into the milling plant where it is processed into zinc and lead concentrates and sold to smelters and customers in Europe, North Africa and the USA.

Lisheen is located in County Tipperary between Thurles, Urlingford and Templemore and the site consists of an underground mine, a concentrator and a Tailings Management Facility (TMF). Mining is carried out at a rate of approximately 1.5Mt of ore per annum at an average grade of 11% Zinc (Zn) and 2% Lead (Pb). The concentrator recovers 90% of the Zn and 70% of the Pb and produces more than 300Kt of Zn and 40Kt of Pb concentrates annually at grades of 53% Zn and 62% Pb. The metal concentrate is transported to the Port of Cork where it is shipped to smelters around the world. Lisheen employs 374 people plus 26 permanent contractors and 65% of the employees belong to trade unions (SIPTU 50% and TEEU 15%). The mine is scheduled to close in late 2015, due to depletion of ore reserves. A backfill programme will follow closure to complete the mining cycle and to minimise the potential of





Lisheen mine site, with Tailings Management Facility

surface subsidence in the future. A fully funded 'mine closure' programme is in place and will continue for several years post-closure. Vedanta is intent on ensuring that the mine closure is carried out to a world class standard. Lisheen is currently one of the largest power consumers in Ireland, predominantly due to the large volumes of underground dewatering and the requirement to mill the ore material so finely.

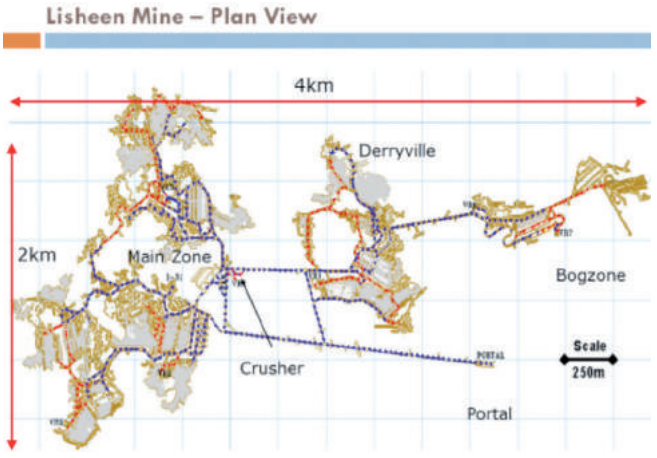
Lisheen is accredited with ISO 14001 (environmental systems - NSAI), OHSAS 18001 (occupational health and safety systems - NSAI) and with Excellence Through People (NSAI), where it holds a Gold Standard accreditation.

Lisheen operates under an Integrated Pollution Control Licence (IPCL) from the Environmental Protection Agency (EPA), which sets limits on discharges of noise, vibration, air emissions, water discharges, etc.

Discovery

In 1984, Chevron commenced exploration in Ireland and two years later the Galmoy orebody was discovered. In 1987, Chevron started prospecting around the general area and in 1990 signed a joint venture (JV) agreement with Ivernia West. Over the next few years two massive sulphide zones were intersected and drilled at the current Lisheen site and in 1993, Anglo American, a multi-national mining company took over Chevron's JV share.

A decision was then made to carry out an Environmental Impact Statement and following approval, construction started in 1997 on the Lisheen mine site. Production started in 1998 and soon after a major delay



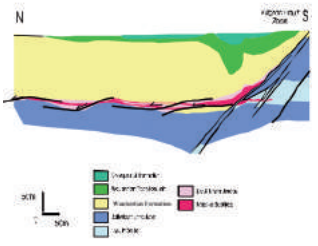
Plan view of the mine

was encountered when the decline intersected a major water feature at a distance of 500m from surface. This was to delay progress by almost a year. In 2003 Anglo American bought out the Ivernia share hold and the mine continued in production until 2010, when Anglo American sold Lisheen to Vedanta for US$308m. Vedanta also purchased other Anglo American zinc assets, including the Black Mountain mine in South Africa, the Skorpion mine in Namibia and a large zinc prospect at Gamsberg in South Africa. At that stage the Lisheen mine was due to close in 2013, but with the full support of the new owners, Lisheen was able to extend the life of mine and is now currently planned to cease operations in late 2015.

Safety and Environment

Lisheen has a comprehensive Safety Health and Environmental (SHE) policy in place. All major operational activities are controlled by procedures, which are continuously reviewed and briefed out to workers, supervisors and other stakeholders on a regular basis. Workers continually undergo training and reviews of the safety related systems.

Since the initial start-up of the mine, Lisheen has been on a continuous journey of safety improvement, with many initiatives, standards, training courses and other factors put in place. The core principle of safety is based around high quality risk assessment and risk management and ensuring that adequate layers of control are put in place.



Geological Cross Section

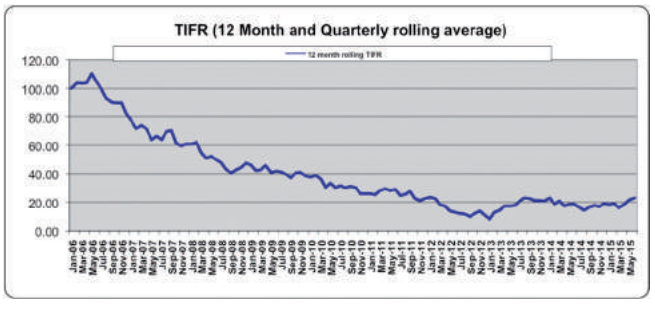
Geology

The Lisheen orebodies occur in a NE-SW trending belt of Carboniferous aged carbonate rocks, commonly termed the Rathdowney trend. The ore is largely hosted within fault associated hydrothermal breccias, known as the Black Matrix Breccia (BMB), which is developed at or proximal to the base of a massive, fine grained dolomitised limestone unit, termed the Waulsortian Formation. This unit is underlain by the Argillaceous Bioclastic Limestone (ABL), a dark shaly limestone which forms the lithological footwall to the mineralisation. Minor mineralisation may also be present in the ABL, usually associated with normal faulting developed at the ABL-Waulsortian contact.

Complex geometry and grade variability requires close-spaced drilling combined with significant grade control and mine geology effort to define the orebody adequately to a level suitable for productive mining. Strong and well understood geological controls restrict the extent of mineralisation and therefore the possibility of significant upside extension.

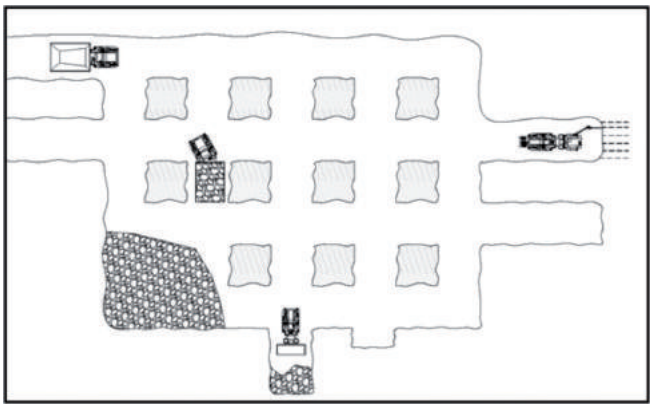
Lisheen Mine - Mining Process

Ore is produced from the development cycle (tunnelling within the orebody) and the production cycle (massive ore mining) within the mine. The ore is drilled using a variety of large drilling machines and then blasted using an ammonium nitrate based emulsion explosive and non-electric detonators. Using Load-Haul-Dump (LHD) machines, the ore is then loaded onto 40 and 50 tonne

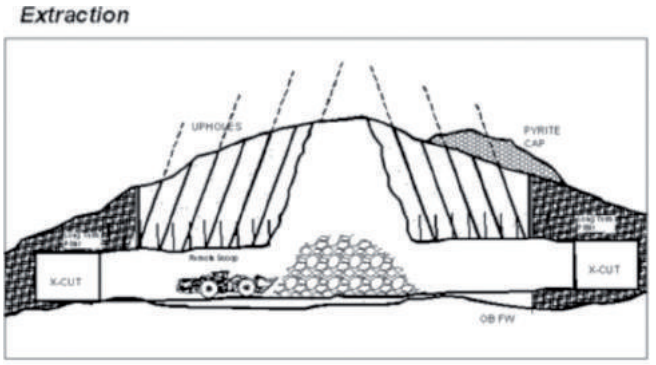


Total Injury Frequency Ratio (based on 1 million man hours per year)

LHD loading a truck



Room and Pillar Mining



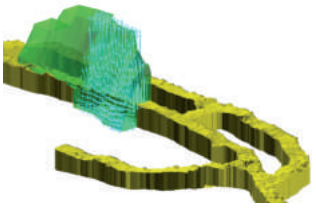
Open Stoping - (extraction)

trucks for transportation to the underground crusher, where it is crushed to <150mm and transported to the surface storage tepee via a conveyor system. The tepee has a live storage capacity of approximately 15,000 tonnes with a series of feed chutes located at its base and this enables the concentrator to operate on a continuous basis. The mine has produced between 1.35 and 1.5 million tonnes of ore per year with an average grade of 11% Zinc (Zn) and 2% Lead (Pb). The mine operates on a two shift basis, six days per week.

Mining Methods

Lisheen has utilised three different mining methods throughout the mining cycle.

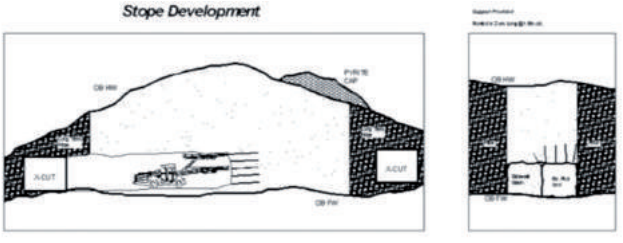
Room & Pillar (Figure7) mining is carried out in areas where the ore is less than 5 metres thick and where the local geometry is complex. This method provides flexibility as mining, geological and geotechnical conditions change. Rooms are cut between parallel drifts leaving pillars in place. On retreat, the pillars are extracted resulting in a high extraction ratio.



Longhole Open Stoping – 3-D view

Drift & Fill (8) mining is used in areas where the ore is 5-15m and when orebody complexity is low. Drifts are driven along the hangingwall, the roof is supported and then the lower bench is mined on the second pass.

Longhole Open Stope mining (Figures 9 & 10) is carried out where the ore is greater than 10 metres and up to 30 metres. Open stoping has predominantly been from uphole retreat style of mining from a single footwall drive. Several stopes with hanging wall and footwall access have also been mined successfully. The upper and lower accesses are required in stopes where the orebody is too thick for uphole retreat mining with the mobile equipment fleet (greater than 30m), or where the hanging wall of the orebody is anticipated to be poor.



Drift and Fill mining

Ventilation

The Lisheen mine is located at an average depth of 170m with no major geothermal gradient. Ventilating air is delivered using a negative pressure system, whereby fans are located at the exhaust raises. All fans are located underground in order to reduce noise, as part of the Integrated Pollution Control Licence. Air is supplied to and returned from the underground workings via 8 ventilation shafts which are connected to surface, and also via the main decline. Four of the shafts are used for exhausting return air to surface, and five of the shafts and the main decline are used to draw fresh air into the working areas. The mine utilises 4 major underground fans to achieve the required ventilation levels, with a total power requirement of 860kW, with the fans ranging in size from 2.5m to 3m in diameter. The mine has a volumetric air throughput of approximately

Underground Fan

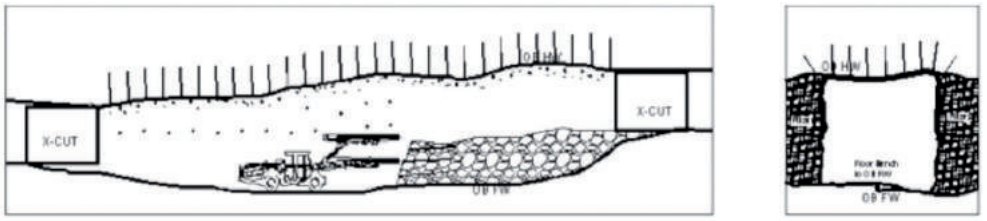
500m3/s, distributed between 4 major mining zones; Main Zone, Main Zone North, Derryville, and the Bog Zone.

Backfill

A system of backfill is used at Lisheen to fill voids which are made as a result of the extraction of ore from mining areas. Backfill is used to provide the necessary strength fill material to facilitate extraction of secondary and tertiary mining areas. Backfill also provides support to the overlying strata in order to prevent subsidence.

When a section has been mined, the area is sealed and backfill is pumped in a liquid state, filling the void. Backfill at Lisheen is made from the tailings (finely crushed rock with the economical metal removed), which comes from the concentrator. The

Backfill Plant



Open Stoping – (development)

Underground Water Pumping Station

tailings is mixed with a binder, which is made of Ground Granulated Blasting Slag and Ordinary Portland Cement. The backfill hardens over a period of 28 days to a strength of approximately 500kPa and at this stage the adjacent secondary or tertiary mining areas are available for mining. The concentrator produces more than 1Mt of tailings per annum and approximately 43% of the tailings material from the concentrator is pumped underground as backfill.

Water

Lisheen mine produces between 60-100 million litres of water per day. The water comes from natural aquifers in the region and enters the mine through a series geological fractures and faults. The water is classified a 'clean' or 'dirty' as it enters the mine and is pumped through separate systems to the surface. 'Dirty' water is water that has come into contact with mineralised rock and is likely to contain metal contaminants and suspended solids. The 'dirty' water is sent to a treatment plant on the surface where it is cleaned and then mixed with the 'clean' water before it is discharged into local rivers. Water discharge is carried out under very strict environmental conditions which are covered in the Integrated Pollution Control Licence, issued by the Environmaental Protection Agency.

Geotechnical

The experience gained in managing the ground conditions at Lisheen over the last 15 years has allowed a good understanding of the ground behavior and the development of support techniques and methodologies in order to manage the poor ground conditions.

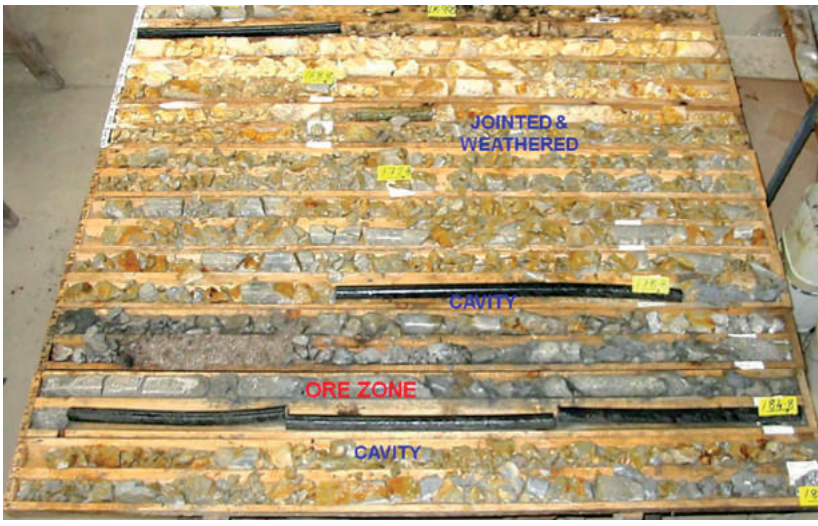
Face collapse, weathered sands/clays, with no cohesion and no strength

The ore body at a depth of between 70 and 230m is extensively faulted, with deep karstic weathering causing degradation of the strong limestone into sand and clays and eroding sections of the massive sulphide ore body. The occurrence of major water inflows along the faulting can create hazards such as pressure build up in sand filled features and the removal of cohesion from the intensely jointed rock mass.

The use of paste backfill and shotcrete to stabilise sidewalls and long bulbed cable bolts to pre-support the roofs has facilitated large spans allowed for longhole open stopes and aggressive pillar mining. Critical stope assessments incorporating modified stability graph techniques, span management, blasting control and strategic paste fill placement with robust risk evaluations, has resulted in large stopes in extremely poor ground being successfully mined.

In extremely poor ground, shotcrete arches and spiling bars are used during the development process. In some cases even this method is not sufficient to consolidate the ground and the use of spiling bars followed by pressure grouting allows both the consolidation and reinforcement of ground ahead of the face. This support technique combined with good blasting design has allowed the mine to access areas that previously were considered unmineable.

Water Control



Diamond drill core showing weathered jointed ground

EQUIPMENT	NO.	MAKE
Drill Rigs	4	Atlas Copco – twin boomed jumbo
	3	Tamrock/Atlas Copco – long hole rig
Load haul dump units	9	Tamrock (6m^3), remote controlled (6)
Dump trucks	10	Tamrock (40t & 50t capacity)
Roof bolters	3	Atlas Copco
Mechanical scalers	3	Jama
Shotcrete	1	1 Active & 1 backup (Normet)
Cable Bolters	1	Tamrock

Mobile Plant and Maintenance

The fleet of mobile equipment which operates underground is shown in the table below. Most of the maintenance work on underground equipment is carried out in a modern underground workshop where maintenance personnel work on both an extensive planned maintenance programme and unplanned breakdowns. The fleet of mining equipment includes the following units;

Mines Rescue Team

Lisheen has a mines rescue team consisting of 16 highly trained employees. The team carry out emergency drills, compete in international competitions and have a mutual assistance arrangement with Tara mine

Mine rescue training exercise with Air Corps helicopter

for emergency situations and with the Air Corps for transportation in the event of an emergency.

Lisheen Mine – Milling Process

The mining process ends with the delivery of ore to the surface stockpile. The milling process then commences with the concentrator plant receiving the crushed ore from the tepee storage where it is fed into the concentrator mill and is processed into zinc and lead concentrate on a 24 hour per day basis. The crushed ore is ground to 80% passing 75 micron in a semi-autogenous mill (SAG) and a ball mill. The ore is then mixed with reagents and passed through a lead flotation circuit followed by a zinc flotation circuit. In each circuit, the specific reagents cause the lead and zinc minerals to float. The floated product is then skimmed from the top, thickened and filtered, with the resultant concentrate fed to a storage outlet. The concentrate is then transported to the Port of Cork where it is loaded onto ships and sold to smelters across the globe.

The resultant waste product from the process is pumped to a Tailings Management Facility (TMF), which incorporates a backfill plant. When tailings are placed in the TMF they are stored in an environmentally secure entity.

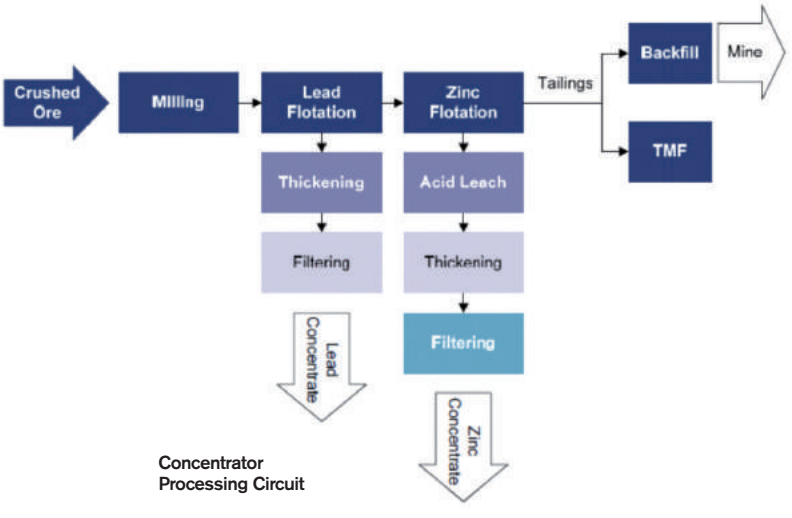
Environmental Management

Lisheen is highly regulated by the Integrated Pollution Control Licence which was issued by the Environmental Protection Agency. The key environmental aspects are

- Water discharges offsite
- Tailings management
- Mine Closure
- Dust
- Noise
- Blast vibration

There is a self-contained environmental laboratory on site to manage all of the key testing requirements. Compliance level >99% for all conditions of IPCL.

Concentrator Plant



Concentrator Processing Circuit

Water Treatment Ponds

On site laboratories

Vedanta Exploration

Vedanta Exploration Ireland Limited (VEIL) was established in July 2014 and currently has 3 full-time employees and 5 part-time/temporary employees, based at Lisheen Mine. VEIL is exploring on 30 prospecting licence areas in the Irish Midlands for carbonate hosted lead & zinc. Established with an initial budget of €2,000,000, the company has drilled more than 17,000m to date, and is intent on building a licence portfolio through applications and JV's. The dominant position for drilling is on the Rathdowney Trend which hosts the Galmoy and Lisheen ore bodies.

Exploration Drilling

Community Engagement

Lisheen has engaged in regular sponsorship of the local community's events and projects since 2008, with excess of €1.5 million spent on local community projects;

- Moyne Templetuohy GAA Stadium
- Moyne Indoor Athletics track
- Upgrade of Moyne hall
- Hurling Wall in Thurles
- Many other small projects

Over the past few years Lisheen has held an Annual Safety EXPO over a two day period at the mine site, where local community and employee families are invited. Up to 1,700 people have attended on a single day.

A Community Engagement Programme was formalised in 2007 and there have been very positive interactions and good relations since its inception. Employment at the mine provides more than €30 million per annum to the region and financial contributions to the Government and County Councils through royalties amount to more than €6.5 million per annum.

People and Closure

There is a significant redundancy package in place since 2010, when Vedanta acquired Lisheen from Anglo American. Redundancies started in

Moyne Templetouhy GAA Stadium

2014 and are continuing throughout 2015 and 2016 on a phased basis, as the operation slowly winds down.

An 'Outplacement Programme' has been put in place for all employees, part of which has been run in conjunction with SIPTU, one of the workers unions. The programme includes:

- Training grant to all employees
- CV preparation and interview skills
- Start your own business courses
- Train the Trainer courses
- Basic IT skills courses

Site Closure, Rehabilitation and Post-closure Initiatives.

There is a fund of circa. €25M in place to ensure that closure is completed responsibly and in line with best practice and a further circa. €3M is set aside for after-care for a 30 year period. If no other use is found for the site, then the wind farm will be retained on the site post closure, all other surface buildings will be demolished, all mine access & ventilation shafts will be plugged with concrete and backfilled and the mine site area will be landscaped and returned to a green field site.

A Task Force has been put in place with the intention of finding alternative solutions for the site post-closure. The Task Force includes members from the mine management team and semi-state bodies. A green energy hub is being promoted and there is currently significant interest from the industrial sector.

Vedanta are a multi-national mining and resources and there is a requirement within the group for mining and technical expertise and skilled human resources. The Lisheen team are currently in the process of establishing a new company which will provide mining and technical consultancy and mining contracting services to both Vedanta and other mining operations in India, Africa and Australia, following the closure of the mine in late 2015.

Both the Vedanta and Lisheen management teams are fully committed to closing the Lisheen operation to a world class standard utilising the 'best practice' available in the safest, most environmentally responsible manner possible. Lisheen would like to thank all of the stakeholders who have supported the mine from start-up to closure and particularly Vedanta who have been fully supportive of the many new initiatives since acquisition of the mine in 2010.

Brendan Morris is currently the Head of Mining and Technical at the Lisheen Mine and has been at Lisheen since 2005. Brendan has worked in the mining and quarrying industries for more than 35 years in Ireland, Canada, UK and the United Arab Emirates. Brendan holds a Mining Engineering degree from Camborne School of Mines and a Master's degree in Business Practice from University College Cork.

Tailings Management Facility

Post Closure Site Rehabilitation

Implementation of modern technology and Operational Management Systems at Boliden Tara Mines

by Mick Flynn, Alan Dolan, Tony Hand, James Dolby and Luke Penna

Compiled by Alan Dolan (Ground Control Engineer) with the assistance of Mick Flynn (Manager-Projects Dept.), Tony Hand (Planning Engineer), James Dolby and Luke Penna (Mining Engineering students, Camborne School of Mines).

Today, mining in Europe faces many challenges. To provide the raw materials for societal needs, mining companies must look to new and more efficient ways of operating. Rapidly disappearing are rich mineral deposits located close to surface. Companies must operate in increasingly dynamic environments and at greater depths if they wish to remain productive and competitive. As part of its corporate strategy, the Swedish metals company Boliden Mineral AB is increasing its automation processes within the group, especially at its mine sites. In parallel with significant initiatives in automation, the deployment and evolution of Mine Operations Control (MOC) at Boliden's mines facilitates centralized and effective scheduling of mining activities with improved utilization of machine resources at key workplaces. These improvements have a potential to increase productivity by up to 20 %.

At Boliden Tara Mines (Tara Mines), the planning department drafts long term mining plans where strategic mining areas are identified. Around this plan ancillary activities are identified and weekly and daily shift plans are drawn up. The shift plans are then compiled using the GANTT scheduler. During a shift, personnel report to MOC as they start and finish their activities. Any deviation from the shift plan during the shift, e.g. breakdown or delay, is reported to MOC. This real-time feedback is used to re-run GANTT updating current and future planned activities in real time.

A number of software packages are used to collect data for GANTT scheduling:

- MIST (Mine Information Systems Tara) gathers information on personnel attendance and equipment locations and working status at the start and end of shift.
- SES (Site Entry System) logs personnel as they enter and exit the mine site.
- Maximo facilitates the timely reporting and logging of equipment malfunction so the fault can be prioritised and rectified as soon as possible.
- Trail Blazer is a Radio Frequency Identification tracking system used to locate personnel in an emergency.
- Deswik is the main planning tool for the mine. It is used to plan reserves and determine mining sequences for life of mine.
- Leapfrog Geo is a 3D geological modelling tool used in conjunction with Deswik, to aid resource calculation and delineation.
- Ventsim simulates ventilation throughout the mine. Automated monitoring of airflow and air quality will be introduced in the near future.
- Scada is the remote monitoring and control of mine plant equipment.
- Eagle is the universal design, planning, survey and geological software used in the mine.

As MOC develops at Tara Mines, the information gathered is hastening the introduction of automated equipment and activities for autonomous, video-remote operated and robotic supported units similar to those already in use in other Boliden mines. These include:

- Operational use of autonomous drilling in tunnel advance, long-hole and open pit drills.
- Operational use of autonomous loaders.
- Development of robotic equipment primarily for charging and drill bit change.
- Automated ventilation control based on real time monitoring of the local work environment and the detected presence of equipment in the area.
- Real time positioning of personnel and equipment underground. This information is critical when planning a response in an emergency situation.

Autonomous Loading Project at Boliden Tara Mines

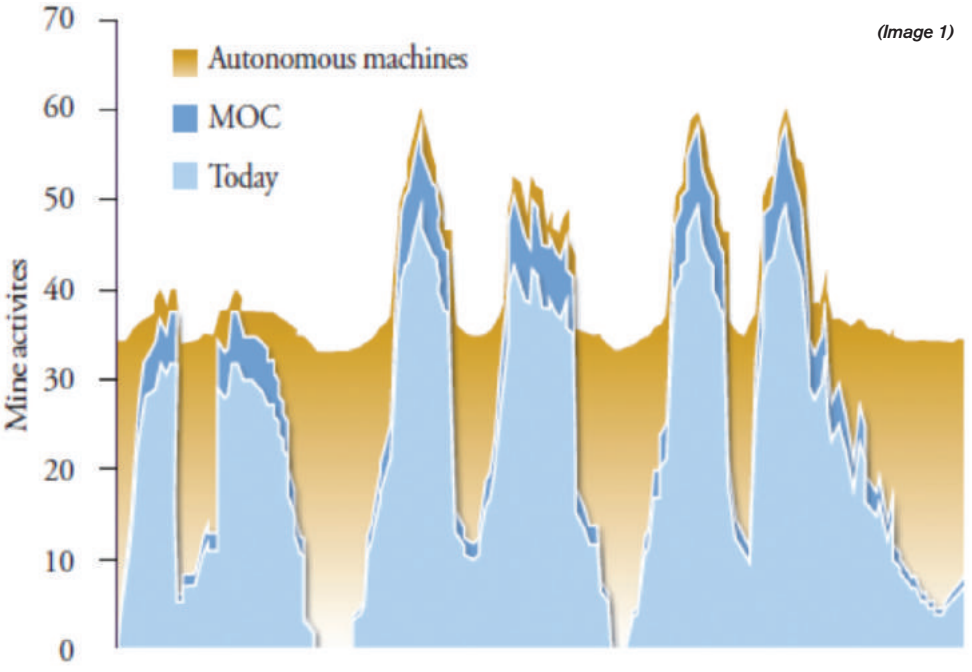
As part of Boliden's automation objectives, an autonomous loading project is underway at Tara Mines. In terms of mitigating problems and seizing opportunities, the goals of the project can be summarized as follows:-

- The alleviation of delays associated with mining at depths that affect the mine's ability to maximize production targets.
- The pursuance of autonomous loading

strategy to increase production rates.

- Surpassing current work time by operating automated loaders remotely from surface in key production areas between shifts.

Outlined is a concept chart based on the utilization of the inactive period during shift changes. The shaded brown area illustrates the potential for enhanced machine utilization by use of automation to supplement the gains already achieved using MOC. *(Image 1)*



(Image 1)

Expected Benefits

- Increased productivity during "lost hours" between shifts.
- Improved working conditions, ergonomically designed for operators, located away from the immediate work environment thereby preventing exposure to falling rock, dust, heat, exhaust fumes, moving machinery etc.
- Increased fleet utilization. Underground loaders have a high asset value requiring much higher utilization than other transport vehicles.
- Reduced loader impacts with sidewalls.
- Increased stope utilization.

Installation Project

Since June 2015, Sandvik Mining & Construction Ltd (SMC) has been contracted by Tara Mines to install their autonomous loading system AutoMine Lite. This is a single loader automation system that provides functionality for the operation and supervision of a semi-automated loader.

The project scope includes the retrospective fitting of a new LH517 loader at Tara Mines with the AutoMine Lite full component set. This system will provide semi-automated loading from one production stope to a nearby ore pass at a location approximately 1,000m below surface.

The scope also includes:-

- An Operator Station – Ergonomically designed tele-operations control located on surface, in the MOC.
- MineLAN communication systems – This provides the communications link between the semi-automated loader in the production area and the surface located Operator Station. The system is based on fibre optic cable links to surface and local IP based wireless communication systems.
- Access Control Systems – This fundamental safety concept provides an area for AutoMine Lite loading which is totally isolated from manually operated machines and personnel. Electronic barriers prevent unplanned loader exit from the autonomous operations area and restricts manually operated machines or persons accessing the area covered by Automine Lite loading.

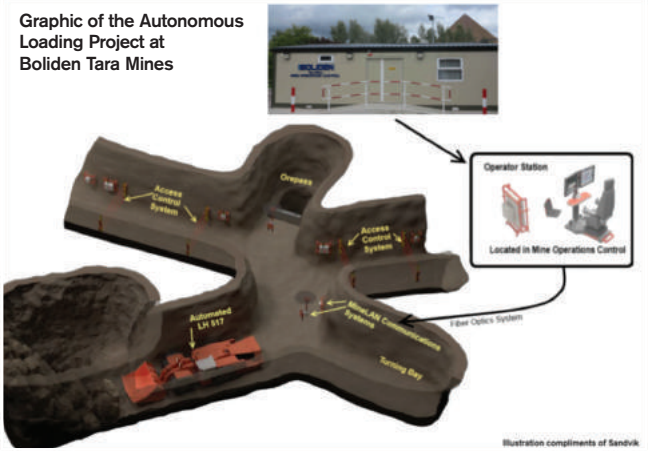
Training on and commissioning of AutoMine Lite will take place during the autumn. The system will be extended to other mining blocks thereafter and become an integral part of the operation.

In addition to autonomous equipment, the up-skilling of experienced and trainee operators using modern technology is being utilised. In the summer of 2013, Atlas Copco's Master Driller Program simulator was deployed on site. This simulator allowed the practical aspects of drill operation to be evaluated, while the theoretical aspects were assessed using an e-learning module.

During evaluation, the operator experiences sensations replicated by the simulator such as uneven terrain and external noise. The software can generate hazardous scenarios to test an operator's reaction without putting the operator or working machinery in danger. After successful completion of the theory and practical elements of the programme, participants are awarded certificates in bronze, silver and gold tiered levels.

Having run a very successful training programme in 2013, which doubled the number of production drillers, the simulator was back on site for further training in May and June of 2015.

This brief summary highlights some of the technological innovations and management systems being implemented at Tara Mines. Their continued implementation will not only lead to greater efficiencies and productivity, but will extend the life of mine well into the future.



Graphic of the Autonomous Loading Project at Boliden Tara Mines

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EIT Raw Materials

by Tony Hand, Mine Planning Engineer, Boliden Tara Mines

On the 9th December 2014 the European Institute of Innovation and Technology (EIT) announced the winners of the call for EIT Raw Materials.

The purpose of this call was to create an integrated European partnership triangle of higher education, business and research institutes with the specific aim to develop strategic partnerships to boost innovation and tackle raw materials challenges in Europe. Europe, with its long tradition of mining, now imports c80% of its raw materials and strategies are required to ensure a sustainable supply of raw materials to the European economy and make Europe a world leader in raw materials exploration, extraction, processing, recycling and substitution by the year 2020. There are many issues that are requisite to achieve these objectives and targets, including research and development along the value chain, raw materials knowledge, the exchange of best practices, revision of selected legislations, licensing steps, standardisation, and policy dialogues. There are many stakeholders to be considered in this strategy, therefore, it is envisaged that governments and their agencies, companies, researchers and NGOs, among others, will aim to foster technological and non-technological innovation in the whole raw materials value chain supported by the EIT.

The EIT is an independent EU body set up in 2008 to spur innovation and entrepreneurship across Europe to overcome some of its greatest challenges. It brings together leading universities, research labs and companies to form dynamic cross-border partnerships, known as Knowledge and Innovation Communities (KICs) that develop innovative products and services, start new companies, and train a new generation of entrepreneurs. It is envisaged that the winners of the EIT Raw Materials call will lead the way to economic growth, stimulating European competitiveness and reducing the import dependence of raw materials to the EU.

The winning consortia in EIT Raw Materials and their Co-location Centres (CLCs) titles consist of the following regional areas (their HQs in brackets):

Baltic Sea Co-location Centre *(Espoo, Finland)*

Central Co-location Centre *(Metz, France)*

Eastern Co-location Centre *(Wroclaw, Poland)*

Nordic Co-location Centre *(Luleå, Sweden)*

Southern Co-location Centre *(Rome, Italy)*

Western Co-location Centre *(Leuven, Belgium)*

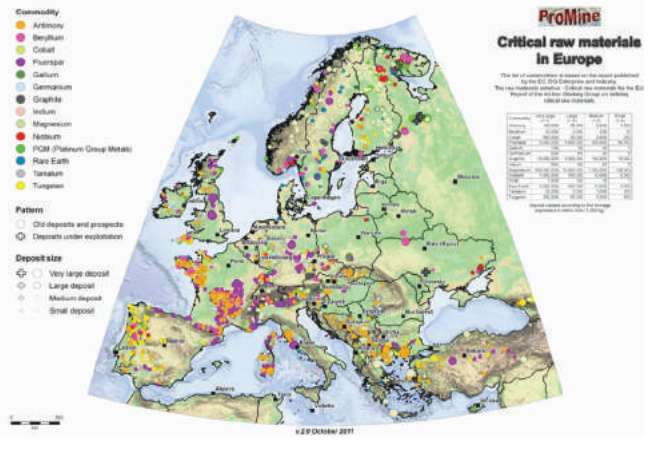
Core members from Ireland are Aughinish Alumina Ltd, Trinity College Dublin and University of Limerick. These organisations are part of the Nordic Co-location Centre (NCLC), which includes organisations from Sweden and Denmark. A core member of this CLC is New Boliden, the Swedish metals company and the parent company of Boliden Tara Mines, Co. Meath. It is felt that this is a natural position for the Irish members due to continuous cooperation on many projects between Ireland and Scandinavia over many years. There is an added strength to this CLC as it is the only one which covers the whole raw materials life cycle from exploration and mining to metal recycling and most points in between. But, what does all this mean for the raw materials industry in Ireland?

In a press release the Minister for Research and Innovation, Mr Damien English T.D., believes that great opportunities will exist throughout Europe for Irish SMEs by allowing them privileged access to their leading European counterparts. Not only will there be significant funding available, but it also allows Irish organisations to work together with the best in Europe on finding innovative solutions to the challenges facing the raw materials industry in Europe today.

But it's not only SMEs that can benefit. The KICs will support the development of a 'lab to market' structure by the developing, testing and the transfer to market of new technologies. There will also be a 'student to entrepreneur' structure for the design of industry oriented, interdisciplinary education schemes. And to develop new ways of collaboration between industry and research, there is envisaged the growth of an 'idea to product' system. There are opportunities to develop added value activities (KAVA) in the KICs, such as life-long learning, specialized post grad programmes, patent support, ready for market oriented technologies and services etc. There are various levels of membership within the KICs, (the core partners as named above) but Irish based partners involved at other levels include iFOSTER, UCD, DCU, SLR, the EPA, GSI, and Enterprise Ireland.

Currently EIT Raw Materials is in the process of developing its management teams, legal structures and board of directors. Once this is accomplished it is planned that, by January 2016, the strongest consortium ever created in the world in the raw materials field will be open for business. Focusing on growth and job creation by boosting start-ups, SMEs, radical innovation and education, it does appear as if there will be many interesting and productive opportunities ahead for the European raw materials sector and its prospective Irish partners. Let's see how this evolves.

For more information visit www.eit.europa.eu or follow on Twitter: @EITeu.



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Roadstone's fabric first approach for compliance with Part L

By Larry Byrne, Managing Director, Roadstone Ltd.

Following a protracted recession which has had a devastating impact on the Irish construction industry in recent years, the sector appears to be on the cusp of recovery.

At a time when construction professionals are continuing to keep a close eye on costs, regulators are focusing their attention on energy efficiency for the future. Here, Larry Byrne, Managing Director of Roadstone Ltd explains a new product innovation that he says ticks both boxes.

The Challenge

2014 saw the 4th lowest year of house completions since records began in Ireland in 1970. Since then, our population has swelled by 50% and it's no secret that current demand for housing, particularly homes suitable for families, has grown right across the country.

Innovation is critical as Ireland strives to achieve the target of 25,000 new builds per year in meeting the needs of the country's changing demographic. The focus on improving energy efficient building methods means advances are being made to reduce our reliance on fossil fuels while also reducing energy bills for end users including homeowners, businesses and industry.

As the largest manufacturer and distributor of construction products in Ireland, Roadstone is committed to product development and innovation that is aimed at exceeding national energy efficiency and performance standards. Our dedication to the delivery of a quality built environment has led us to develop the Thermal Liteblock System – a new concrete block innovation which not only enhances the Roadstone masonry product range but also provides those in the construction sector with a cost effective solution to the revised Building Regulations - in particular Part L, which relates to thermal bridging.

The Roadstone Thermal Liteblock was specially developed for use with traditional masonry after extensive research aimed at producing a cost-effective solution for architects, engineers, assigned certifiers and building contractors to comply with Part L.

Alan Lowe, Roadstone product development manager at the launch of Roadstone's new Thermal Liteblock System.

The Innovation

The Roadstone Thermal Liteblock is a robust and durable, lightweight block which can be used in conjunction with Roadstone's standard Concrete Block range, to improve thermal conductivity by an impressive 300%.

Made from a special mix which includes lightweight aggregates to achieve conductivity values of 0.33W/mK, the Thermal Liteblock is 40% lighter than a standard block - weighing just 11.5kg – and is also CE marked 2+.

Manufactured in Ireland, its key purpose is to mitigate heat loss at thermal bridges. The beauty of this innovation is that the Thermal Liteblock is required only at targeted locations in the build, which means it can be used in conjunction with standard concrete blocks to provide a cost effective solution to the construction of new buildings while also allowing greater design flexibility. We anticipate that up to

From left Tom Parlon, director-general of the Construction Industry Federation and Larry Byrne, managing director of Roadstone at the launch of Roadstone's new Thermal Liteblock System.

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Official launch event of the of Roadstone's new Thermal Liteblock System at City Hall, Dublin.

15% of the total concrete blocks required per build will be replaced by Thermal Liteblocks at strategic points.

Importantly, we have established a technical support services team, which provide a set of accredited details and fully 'y' value calculations where required by architects, engineers, assigned certifiers and building contractors. Our tests have shown that using the Thermal Liteblock System improves the Building Energy Rating (BER) – from A3 to A2 across a number of house types.

In terms of practicalities on site, the Thermal Liteblock has a distinctive heather colour to facilitate traceability and requires no special handling or treatment compared to standard concrete blocks.

Speaking at the official launch event in City Hall Dublin, guest of honour Mr. Tom Parlon, Director General of the Construction Industry Federation said, "Energy efficiency remains the best way to offset energy costs and reduce the carbon emissions of new buildings. For these reasons, improved energy efficiency standards in new residential, business and public developments are at the core of the new Building Regulations and the Government's Construction 2020 Strategy. I welcome this product innovation from Roadstone and the contribution it will make towards achieving these standards."

The Future

The Irish construction industry currently faces many challenges – the rate of project tendering is slow ; the access to credit, while improving, remains a major issue and the flow of apprentices coming through the ranks is only a trickle at present.

With the Thermal Liteblock System, Roadstone has charted a course towards improved environmental efficiency – based on investment and innovation – that will underpin our role as the backbone of sustainable construction.

We look forward with confidence to facilitating those in the industry in complying with Part L in a cost-effective way. The Thermal Liteblock is now available at all 46 Roadstone quarry locations across Ireland.

The Institute of Quarrying, Milestones in Professional Education

By Julian Smallshaw, Head of Educational Development Institute of Quarrying (UK).

The Institute of Quarrying is the global professional association, representing over 6000 members in 50 countries of the world.

IQ's primary focus is to encourage and facilitate professional development through education and training and to recognise professional competence with its suite of membership qualifications: TMIQ, MIQ and FIQ. In short, IQ is there to advance the science of mineral extraction and promote best practice for the benefit of all.

Compulsory CPD

2015 sees the marking of another major milestone for the Institute and for the quarrying industry. As an advocate and provider of Continuous Professional Development – or 'CPD' – IQ has, for a long time, followed in the footsteps of other professional bodies in setting out guidelines for the amount of time that busy professionals should spend doing CPD, in whatever for that takes (classroom training courses, on-the-job training, updating at conferences, work-shadowing etc). From the 1st January 2015, IQ went one step further: to insist upon a minimum of 35 hours of CPD from all of its members. Only a handful of (arguably the best and most forward-thinking) professional bodies has a mandatory stance towards CPD. IQ is now amongst their ranks and any qualified member who has the letters TMIQ, MIQ or FIQ after their name must now demonstrate that they have achieved that minimum of 35 hours of CPD in order to remain qualified members of the Institute.

Speaking about this new development, IQ's Chief Executive, Phil James, said, "Making CPD mandatory makes absolute sense for an Institute that has always taken a strong line in promoting and rewarding those who proactively seek to develop and update themselves. In the UK, for example, CPD is a necessary part of demonstrating competence under the Quarries Regulations, so the Institute is reinforcing its position, showing that its members are committed not only to demonstrating their competence, but in setting a higher standard for themselves than is required by the law. Signing up to standards that mean you could lose your professional status is a sign of a true professional and is exactly how other professional bodies operate."

Milestones in Education

The last twelve months has seen major growth in the number of people undertaking higher education qualifications with IQ's partner, the University of Derby. The new Foundation Degree in Mineral Extractives Technology is fully established, replacing the "old" Diploma in Quarry Technology and it is also proving popular as an international qualification with candidates joining the programme from all around the world. All course materials are fully interactive with web based content – ideal for a combination of distance learning and occasional optional tutorials. January saw the end of the first year of the brand new Honours Degree (BSc) in Minerals Management, which focuses on leadership, finance, resource management and advanced extractives technology. IQ is now able to offer a full suite of Higher Education qualifications for operational management in the extractives industry.

The Institute continues to build increasing numbers of on line CPD packages (both in the UK and worldwide) utilising its huge educational resources. A redeveloped Learning Management System

View of Baltimore Harbour (where the NSSGA AGG1 was held)

(LMS) has been launched and accessible through the IQ's new interactive website.

New Supervisors' Programme

In a year of milestones, a new qualification aimed at Quarry Supervisors is up and running. Accredited as a QCF (Qualification Credit Framework) Level 3 in Safety Health and Environmental Awareness, this is an extremely valuable and cost effective course combining on-line learning face to face sessions and encompasses quarrying operations, health and safety and leadership and communications skills.

All of the Institute's education programmes and other materials are presented within their new Skills Wheel, which sets out a 360-degree view of the skills, knowledge and attitudes needed to be a fully-rounded professional within our industry.

Growing International Reach

Building upon the global appeal of the Institute's education programmes, Julian Smallshaw (Head of Educational Development), Phil James (CEO) and Colin Jenkins (President of IQ, 2012-14) were invited along to the NSSGA Agg1 2015 Aggregates Academy & Expo, which took place in Baltimore during March. The focus was on the delivery of a selection of diverse presentations over the course of three days, to over 140 delegates. The delivery covered key topics in the industry such as attracting younger generations into the sector, enhancing a business and development of the existing workforce.

The visit underlined how the aggregates industry within the United States was facing similar challenges to those we have been working towards addressing in the UK. This is in terms of an aging workforce and requirement for educational offerings, which focus on the development of an individual's skills and knowledge.

Phil James presenting to the NSSGA Board

In a first for IQ, a pilot partnership programme is being launched in the autumn to an initial cohort of 40 or so candidates across the USA. The partnership between the Institute of Quarrying and the National Stone, Sand and Gravel Association will provide the opportunity to widen the reach of IQ's bespoke and well-developed suites of learning materials, whilst also offering international accreditation and exposure of the Institute to a wider audience.

In 2013, production of aggregates in the United States totalled more than 2 billion metric tonnes at a value of $18.6 billion with the aggregates industry alone employing around 100,000 highly skilled men and women. Every $1 million of stone, sand and gravel sales in the US is supporting more than 19 jobs. The National Stone, Sand and Gravel Association (NSSGA) are the world's largest mining association by volume and represent the producers across the USA - its member companies produce more than 90 percent of the crushed stone and 70 percent of the sand and gravel consumed annually in the United States.

Elsewhere in the world, the Institutes presence in Australia, New Zealand, Malaysia, Southern Africa and Hong Kong continues to grow, with increases in membership and the reach of their education programmes and publications.

Since its initial scoping work in the Middle East during 2014, IQ is now delivering programmes of education and training to over 100 supervisors and foremen across a number of quarrying companies and suppliers. The autumn of 2015 will see further development of its presence in the Gulf region, as the Institute launches conference and seminar activity for its members and others who are active in that part of the world.

The autumn of 2015 will also see the launch of a new series of Pocket Books, designed to be easy-to-read reference guides on a variety of geological and operational subjects.

Technical Membership

2015 also saw the first full year of IQ's new Technical Membership grade, or 'TMIQ'. The introduction of the new grade took a step towards providing greater recognition to the unsung heroes of the industry and recognising the commitment individuals have made. Technical membership is open to those providing specific technical services to the industry, including Shot-firers, Blast Designers, Laboratory Technicians, Mechanical Fitters, Electricians and Weighbridge staff in addition to many other highly skilled individuals within the sector. Providing recognition to people within their role is seen as key in pushing the professionalism of the sector forward. In turn this brings additional benefits such as attracting new generations into the industry, retaining and further developing those within it, along with ensuring it is viewed as being both highly competent and world class in its aspirations and achievements with a motivated, committed workforce.

As it approaches its 100th birthday, and as another year of milestones passes by, it is clear that the Institute of Quarrying is as active as ever in pursuing its goal of raising standards of professional practice in our industry.

Fifty Years On.
Looking Back at Tynagh

By Robin A Oram, ACSM, FIMQS, MCIM, and colleagues

On the 50th Anniversary of the opening of the Tynagh Mine, Co Galway, 22nd October 1965

On a bright morning in February 1965, off Roche's Point, the S S Maasdam had arrived from New York and was disembarking a few passengers for Cobh. We were Southampton-bound and took in our first view of Ireland as we watched the little ferryboat head off to Cork Harbour past green headlands and brightly painted houses.

Hoping that we might soon return, to share in the exciting new developments in Irish mining, we were not disappointed; and I was fortunate to to join the Northgate Exploration / Irish Base Metals team at Tynagh. Work was building up to production start up and an opening ceremony at year's end.

This reflective piece will recall some events and people in the early life of Ireland's first "new mine" in the series of 1960s - 1970s discoveries. The mine was formally opened on 22 October 1965 by An Taoiseach, Sean Lemass, TD. My notes will conclude with reminders of some later activities at Tynagh.

Discovery of the Tynagh ore body

An "old Tynagh Mine" is noted in Geological Survey of Ireland records of 1865 and remains of mining activity were reported in Lisduff, to the east of the new discovery. Stories were told of fowl deaths from grazing on freshly tilled ground, and some boulders of galena had been found during farming and road building work.

The 1961 discovery of the Tynagh ore body was the culmination of five years of fieldwork by Patrick J Hughes' company Northgate Exploration, of Toronto. It was the first significant new mineral deposit to be found in Ireland or Britain in 100 years and it would prove to be a remarkable and challenging ore body, both to mine, and to concentrate into saleable products. [1]

Fig. 1 Exploration scene, Mr Frank Regan, his turnip crop, and exploration rigs behind. (© Irish Photo Archive)

A summary of ore reserves, and a note on the eventual production out-turn is included as an End-Note to this paper.

Early work

A note by Paddy Connolly [2] recounts his experiences of early exploration drilling and subsequent activity.

"In 1956, Northgate in Toronto announced that they had found gold in Clontibret, Co Monaghan. As a Monaghan native I felt a sense of pride that the hills of Monaghan could be so valuable. Little did I know at that time that I would join Northgate in 1962, not in Monaghan, but in Co Galway.

"On a May Sunday morning Glenn Clark interviewed me for a position at the Tynagh prospect. Two weeks later I settled in as a sidekick to the three Geologists, Noel Gillatt, Brian Byrne and Glenn. At the early stages, the job was basically recording, plotting and presenting the results of assays flowing from the Drill Core that the two drill companies on site were providing. The office essentials were basic - a phone with a handle, a pen with ink and lots of drill log forms to complete.

"Later, in the production phase, card punch machines were used to input and verify data for computer calculation of the open pit blocks' mining reserves. The data were processed in the Aer Lingus Company's computing division in Dublin. Printouts were sent back to us on the train to Loughrea Station. There were no desktop computers or electronic data exchange in those days; on the contrary, Tynagh Mine was still connected to the outside world with ancient crank handle phones and the local operator!"

Paddy continues;- "The Tynagh discovery was unique in many respects. The mineralisation consisted of unconsolidated limestone and compacted mud masked by a mantle of overburden. By mid 1963, on the completion of 70,000 feet of drilling, some 8 million tons of secondary

and primary (underlying hard rock) material was identified. Metallurgical test work was started, in a newly built flotation test plant. This plant's operating experience proved that viable concentrates could be produced and showed us the way to the blending, sequencing, and timing of future open pit mining operations in the varying ore types.

"Overburden stripping was followed by the removal of under-ore-grade mineralization. This exposed the ore body proper and enabled access for more detailed infill drilling on a 25 foot grid on each 20 foot high mining bench. The first step in the open pit mining plan was the classification of sulphide and oxide ores and assessment of metal distribution and grades of lead, zinc and copper; silver was carried in the lead minerals. Infill drilling on a bench basis provided detailed tonnage and grade data to plan daily mine production. [3]

"During mining, grab sampling procedures were set up to check the ore grades from different areas on arrival at the crusher feed storage pad. The results guided the blending from ore piles and informed the mill on short-term variations to assist flotation management. On occasion we encountered high-grade direct-shipping ores (lead in cerussite, and copper in malachite and azurite). These were visually identified, then sampled and sent directly to the smelter. [4]

"By the late '60s the planning and mining operations became fairly routine. My involvement with Tynagh ceased when I was invited to join Tara at the new prospect in Navan. All told, from 1962 to 1997 I had the privilege of scheduling and planning the production of 60 million tons of ore.

"Between 1965 and 2015, I estimate that some 30,000 man-years of full-time mining employment were created in the extraction of about 100 million tonnes of ore at Tynagh and Tara; generating an income of approximately 1.5 billion euro in wages for the economies of East Galway and Navan. The contribution made by Pat Hughes, Mike McCarthy and associates in pioneering these discoveries was enormous.

"Finally, I hear that the latest update in Monaghan has valued that same gold prospect at 150 million Euro. Hopefully, it will figure in the next IMQS Review on mining in Ireland."

There were many geological and mineral oddities associated with the ore zone. Some are described by Glenn Clark. [5]

"Scientifically Tynagh was geologically interesting as the deposit is quite different from other world lead zinc deposits, in that the large upper part of it has been altered by removal of much of the original carbonates. Another point of interest was the tuff bands that were associated with the mineralization and the adjacent iron formation. The vulcanism that is associated with the tuff bands seemed to be a big surprise.

"The other scientifically important thing was an indication of the climate before the glaciations in Ireland. At the base of the glacial till and in the top of the ore we found some wood fragments. It seems that these had been protected from complete glacial removal by a ridge of a less decomposed high grade ore.

"The people in Figure 2 are Noel Gillatt, then geologist at Tynagh and on the right Dr. Mitchell from the National Museum in Dublin, watched over by a few local children.

"The Museum took some samples of the fragments and told us that the wood was a sequoia type and estimated at 1,000,000 years old. The wood itself had a lot of minerals in it." [6]

Metallurgical investigations

Richard Down [7] has sent some key detail of the complex ore treatment. "The secondary ore deposit was unusual. It was a mud rather than solid rock. It had to be proved that the mud could be processed to produce saleable concentrates. To this end, a customised processing pilot plant was built. A sand and gravel washer and crushing, grinding and flotation equipment were installed.

"The operators were local people who, at that time, had no knowledge of mining or milling and were trained for the task; most of them eventually going on to work in the mill during production. To provide expertise, some specialists were hired, notably Frank Burke from Canada, and Jim Fitzpatrick who had worked at the Avoca Mill.

"The pilot plant operated 24 hours a day, five days a week, and tested different batches of mineralized material from the deposit.

"The first challenge was the unusual physical nature of the ore. It consisted of a mixture of very fine slimy material together with some sand and gravel and the odd boulder of solid mineralized rock. It has been described as akin to ´Black Shoe Polish´. The slimes comprised almost half of the secondary deposit. When put into the washer, the lumps of mud simply became rounded into mud balls, which could not be processed further.

"The problem was resolved when we selected a Hazemag rotary impact crusher rather than a jaw crusher. When this crusher was arranged ahead of the washer and operated wet by adding copious water, the mud disintegrated into a slurry suitable for further processing.

"Separate flotation circuits were required for the slimy and the sandy fractions of the crusher plant products. From the sands, lead, and zinc concentrates could be produced, suitable for sale to the smelters. Flotation of the slimes produced only a combined lead-zinc bulk concentrate but, fortunately, this could be smelted using the Imperial Smelting Furnace, which had recently been developed for such mixed lead and zinc material.

"Initially, the pilot plant treated sulphide ore in which the lead was mostly present as galena [8] and the zinc as sphalerite. But, the surface deposit also contained some oxidized lead ore in which the lead was present as cerussite. Pilot plant work showed that this oxidised ore could also be processed, by adapting the flotation reagent dosage.

"Of environmental importance, it was shown that the process had the dual advantages of minimizing both the fresh water usage and the quantity of effluent water discharged into the environment.

"The pilot plant remained in use after 1965 to train mill staff and operators."

Fig 2. Excavating ancient mineralised wood in ore, Noel Gillatt and Dr F Mitchell. (Glenn Clark)

Company Formation, and Project Financing

In 1956 the Irish Government introduced a favourable regime for new mining projects, including a 4-year corporate income tax holiday followed by a further four years' taxation at 50% of normal rates. Various other charge-offs were available for royalties, interest and depreciation.

The parent company Northgate Exploration formed an Irish company, Irish Base Metals Ltd, to manage the mining operation and its financing.

The project was international, with financing linked to

banks and smelter contracts in Belgium, Britain, Canada, France, and Germany; machinery came from Canada, the U.S., Britain and other European countries; metallurgical testing was done in Canada, France, Sweden, and the U.S.

Debt financing of $ US 6.5 million was provided through three smelters and executed by Irish Base Metals Ltd, together with a $ US 6 million debenture loan issued by Northgate Exploration and underwritten by Canadian financiers. These debts were retired in as little as two years. Financing was completed with the issue of 4.97 million common shares in Northgate Exploration.

Project Construction

Bechtel Overseas Corporation was awarded a contract in June 1964 to build the mine's concentrator and support facilities, including the Port of Galway concentrate storage and ship loading terminal. Irish, Scottish, and English contractors were involved, together with local craftsmen of many disciplines. Electricians were in short supply, and many had to be hired from further afield.

Equipment and supplies procurement was handled by Bechtel offices in Montreal and London, and much equipment was flown in from N. America.

On the open pit site, removal of 750,000 cu yds of glacial till overburden, 70,000 cu yds of rock, and 80,000 cu yds of subgrade mineralization was required to expose the two upper mining benches of the ore body.

Two tailings pond dams totaling some 10,000 feet in length, with rock filter beds, were completed; one for sands flotation tailings, the other for slimes.

Fig 3. Opening blast fired by An Taoiseach, Sean Lemass, with Mine Superintendent David FitzGerald and Chairman Pat Hughes. (© The Irish Times)

Official opening, Friday 22nd October 1965

The event was held in a marquee near the mine garage. The Taoiseach, Sean Lemass, and Mrs Lemass, headed the guest list, which included government officials from Ireland and Canada, ministers of religion, and people from financial and mining industries associated with the project.

177 guests and press flew in from Canada, and attended a performance of Sean O´Casey's The Shadow of a Gunman at the Abbey Theatre, where they were welcomed by the Lord Mayor of Dublin. They later arrived in Loughrea by special train. Open pit and plant tours gave the guests their first views of the new Tynagh Mine installations.

There were, of course, many local dignitaries, equipment suppliers, contractors, commercial representatives, and company employees present. It was estimated that 1000 people sang the anthems, A Soldier's Song, and O Canada, before enjoying a celebratory lunch.

The Opening was marked by a massive blast in the open pit, fired by Mr Lemass from the lunch table, to loud cheers.

More cheering followed the announcement by Tynagh's PP, Father Flannery, that the Bishop of Clonfert had declared a dispensation from that Friday's abstinence, to those present.

Fig 4. Concentrator tour, An Taoiseach, Sean Lemass, Pat Hughes and General Manager Murray Pickard. (© Irish Photo Archive)

Early production, 1965 - 1967

The plant was completed in September 1965 and operations got underway with start-up and plant testing, producing 23,060 tons of concentrate from 105,684 tons of open pit secondary ore, before the end of 1965 [9] [10]. In 1966 the plant operated at 71% of capacity, treating 545,693 tons of ore for an output of 121,564 tons of concentrate. Full production was reached by 1967, with 703,511 tons treated, to produce 190,985 tons of concentrate. Several hundred tons of high-grade copper ore were also shipped, directly.

Open pit mining equipment included Ruston Bucyrus 54-RB face shovels, Aveling Barford 15-ton rear dump trucks, an IR drifter drill mounted on crawler tracks, a D-8 bulldozer, and a grader. Structurally, the open pit, being in competent limestones and sandstones, was fairly straightforward to design and maintain.

Fig 5. Site general view, Mr Eamonn O'Reilly's farm in foreground. (Northgate 1972 Annual Report)

Later production - Noteworthy events

Open pit production

This continued until 1973/74, with increasing amounts of primary ore arising, in boulders and in-situ rock. There was greater pressure on the Hazemag rotary breaker, which maintained a good performance, but the need to complete the open pit / underground mine primary ore handling system was obvious. Underground mine development was accessed by a decline tunnel driven between 1968 and 1971 [11]. An ore pass was bored to connect the open pit with the new underground crushing and hoisting system.

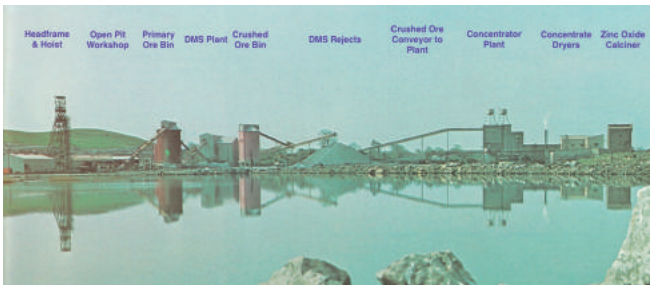

Fig 6. - Plant panorama, 1974, (Northgate 1974 Annual Report)

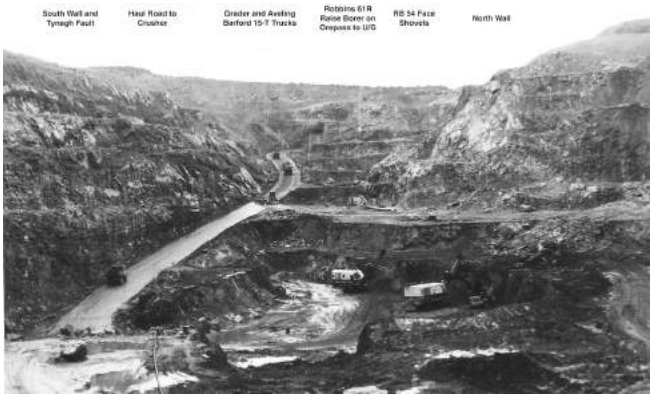

Fig 7. Tynagh open pit looking west (Robin Oram)

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Transition to underground production, and end-of-mine life

The open pit secondary ore was largely depleted by 1971; production continued in open pit primary ore, but increased from the underground mine.

Fig 8. David FitzGerald in Tynagh with Jean FitzGerald, Peggy Conachy, and children. (Kathy FitzGerald)

By 1973 80% of the ore hoisted came from underground stopes. Open stoping with delayed backfill was used in the massive Zone 1 ore body, with room and pillar mining in the thinner, eastern, Zone 2 ore; both zones using trackless equipment. The ore was reduced in a jaw crusher on the 4500 level and conveyed to a shaft loading pocket for the 750 foot hoist up to surface.

The last underground ore was raised in July 1980. A 120,000 ton silver ore stockpile treatment project then ran until 1981, when Tynagh Mine's production run came to an end.

Zinc oxide ore treatment

According to Richard Down; "Among the suite of minerals in the Tynagh surface deposit was a substantial amount of oxidized zinc material, containing 20 % to 25 % zinc; being mainly smithsonite (zinc carbonate), with some sphalerite (zinc sulphide). Processing was deferred, pending improvements in techniques and process economics.

"Smithsonite's zinc content is lower than sphalerite's, and it has poor flotation qualities. The concentrates produced were of too low a grade for direct sale, but, fortunately, Tynagh's metallurgists confirmed that they could be upgraded by calcination to remove the carbon dioxide content. A multiple hearth furnace was installed for this purpose, and the resulting calcine (zinc oxide, ZnO) was acceptable to zinc smelters. Production started in 1971."

Primary ore, beneficiation

Test work showed that primary ore could be upgraded by removing low-grade rock, using a dense media separation process (DMS).

A surface secondary crushing and DMS plant was assembled, with two Nordberg gyratory crushers (-1 inch) feeding a Wemco dense media separator; the rejected waste rock being used for underground mine fill, and the "sink" material being sent to the concentrator. From data in an annual report [12] it may be estimated that the plant rejected about 26 % of the total feed tonnage, as waste. In the process, there were small losses of the contained metals; 2 % of the lead, 4 % of the zinc, 1 % of the copper, and 2 % of the silver content were discarded in the rejects.

Raise and shaft boring

At the time, raiseboring, as distinct from the traditional, and sometimes hazardous drill-and-blast procedure, was a new concept, and gaining ground in world mining. The Tynagh Mine was the first operation in Europe to acquire a raise-borer, a Robbins 61-R machine, (#1146), to bore access and ventilation raises, the open pit to underground ore pass, and, notably, the 7 ft diameter production shaft. [13, 14]

Barytes recovery

Milchem Inc treated the sands tailings pond content to recover barite for use in North Sea drilling operations; a plant was erected at Barnacullia on the north side of the pond containment area. Production amounted to some 400,000 tons over several years. The Milchem plant location is now the site of the Milchem Equestrian Centre.

Tynagh Mine and the community

David FitzGerald [15] provided a brief outline of his many interests and duties concerning local matters.

"Having been involved with Tynagh Mine from the outset and up to the end of production and the site's decommissioning, I witnessed the economic and social impact the mine had on what was predominantly an agriculturally based community. Many locals were able to subsidise their farming incomes by taking on mine work, and they had good mechanical aptitudes. We engaged with the community to ensure the mine operation was recognized for its positive benefits.

"Although running the mine was the priority, I had other important roles; one I particularly enjoyed was that of being Santa to the local children in Tynagh!

"I was also involved in the mine site's rehabilitation, leveling the mine dumps, and replanting them with specialist grasses. For this, we had the services of Dr Mike Johnson of Liverpool University and Pat Timson from Sligo, acting as consultants on best practice.

Fig 9. Tynagh Energy Ltd power station, old tailings pond and open pit mine. (RTE's Documentary on One Website Picture 00025b9e-488)

We purified the tailings ponds and placed a raft on them with feed for ducks, encouraging wildlife back into the area.

"It is good to note the site now houses a major gas-fired electricity generating plant."

Tynagh Energy Ltd, power station

Tynagh Energy acquired a large part of the Tynagh Mine site in 2003 and built a 400-megawatt combined cycle gas turbine plant, which was commissioned in 2006. Natural gas feed is supplied from the Bord Gais Eireann network. Tynagh Energy is a joint venture between some General Electric companies, and Gama Power Systems.

Sperrin Galvanisers

A part of the old concentrator site is occupied by Sperrin Galvanisers (Irl), specialists in hot-dip galvanizing and painting systems.

The future; Tynagh Mines II ?

In September 2014 Timothy Daffern, CEO of Tynagh Iron Mines Ltd, (since renamed Viridian Metals Ireland Ltd) gave a talk to the Irish Association for Economic Geology (IAEG) entitled "Tynagh Iron Mines – Developing a Premium Flux Pellet Producer for the European Steel Market." The quotation below is from the Abstract. [16]

"Tynagh Iron Mines is developing the mineral property that surrounds the historic Tynagh base metal mine. The development work is aimed at justifying the economic viability of re-opening the mine, using the previous underground mine infrastructure to access the Base metal and Haematite mineralisation that lies adjacent to, below and to the north of the previous base metal mining activity."

Acknowledgements

Thanks are extended to my colleagues of the time, Glenn Clark, Paddy Connolly, Richard Down, and David FitzGerald, for their valuable remarks, which also prompted further research.

I am also grateful, for all their

support over the years, to my wife Diana, and my family. They put up with much disruption as we moved around, but they say they enjoyed it!

Information was gleaned from newspaper archives, and from numerous other sources, in personal papers and on the internet. Photographs from The Irish Times and Irish Photo Archive are copyright, and licensed for use in this article only. Due credit has been made in the photo captions.

Author

Robin Oram worked with Sherritt-Gordon Mines Ltd in Canada from 1960 to 1965, then at the Tynagh Mine from 1965 to 1973. He moved to Tara Mines Ltd, Navan, where he became Chief Mine Engineer. In 1986 he joined Rio Tinto, at Somincor's new Neves-Corvo copper mine in Portugal. He became an independent consultant in 1994 and worked in Africa, Asia and the Americas. He now lives in Santa Bárbara de Nexe, near Faro, Portugal.
E - robin.oram@gmail.com

End Note - Summary of ore reserves, production out-turn

Ore reserves [17]

[17] **Secondary deposit,**
Sulphide ore 2,800,000 ST, grading 8.66% Pb, 7.36% Zn, 0.23% Cu, 2.93 oz/ton Ag
Oxide ore 1,200,000 ST, grading 9.92% Pb, 4.66% Zn, 1.32% Cu, 3.69 oz/ton Ag
Primary deposit
Sulphide ore 3,760,000 ST, grading 4.76% Pb, 4.27% Zn, 0.60% Cu, 2.04 oz/ton Ag
Total 7,760,000 ST @ 6.97 % Pb, 5.45 % Zn, 0.58 % Cu, 2.62 0z/ton Ag

Production out-turn

Between 1965 and 1981, 9,092,300 ST [18] of ore were processed, from both open-pit and underground mines. Concentrates were produced containing 481,723 tons of lead, 281,232 tons of zinc, 19,958 tons of copper, and 16 million ounces of silver. [19]

1 *"The Northgate base-metal deposit at Tynagh, Co. Galway, Ireland". D R Derry, G R Clark, and N Gillatt. Economic Geology, Vol 60, 1965*
2 *Paddy Connolly was Geological Assistant and then Grade Control Officer at Tynagh. Later, he moved to Tara Mines Ltd at Navan, where he became Production Control Engineer*
3 *"Grade Control at Tynagh mine, Ireland, using data processing techniques", D H B FitzGerald and R A J T Oram, Paper 31, Ninth Commonwealth Mining and Metallurgical Congress, 1969*
4 *Author's note:- In 1967 we shipped out 1000 tons of high-grade azurite and malachite copper ore, in bulk. The load was wet from recent rain and started to shift after leaving Galway Harbour. The ship returned to port, to unload the ore and have it bagged, for safety. 18 months later, it was shipped out again. Meanwhile, the price of copper had increased by 52%, so the bagging had more than paid for itself!*
5 *Glenn R Clark was Chief Geologist at Tynagh during exploration and in the early years of production.*
6 *Author:- I have a piece of this wood, and it is possible to make a saw cut in it, after one million years.*
7 *Richard F. Down was Mill Superintendent at Tynagh, and responsible for mill design and planning as well as for the early years of mill production.*
8 *The flotation process fascinated our young family members when they saw it on a Family Open Day. They still recall the "thick frothing galena, with grey metallic rainbow bubbles, not like anything they'd seen before".*
9 *The first shipment from Galway was of 4000 tons of lead concentrate on the MV Gonzenheim, to Germany, in mid-January 1966. This coincided with the birth of our first daughter, but we resisted many well-meaning suggestions to name her Gonzenheima!*
10 *Silver bullion arising from smelting of this first concentrate was returned to Dublin. It was used by sculptor Edward Delaney, (1930-2009), to craft the IMQS Gavel and Stand which was presented to David FitzGerald, President of the Society, by Pat J Hughes, Chairman of the Board of Irish Base Metals Ltd, on January 13th 1968. The bullion was also used to produce 500 Tynagh 1961-1980 Commemorative Medallions. They were struck by Jack Segal, former Master of the Company of Goldsmiths, Dublin.*
11 *"Driving the Exploration Decline at Tynagh Mine", Robin Oram, IMQS Annual Review, 2003*
12 *Northgate Exploration, Annual report, 1974 p 13*
13 *This was the first known use of a raise borer to excavate a mine hoisting shaft. The novel system was proposed by Tynagh's consulting mining engineer, Herbert H Cox. Notwithstanding some gloomy predictions to the contrary, it functioned well for the life of the mine. A "First" for Irish mining!*
14 *"Raise boring practice and the boring and equipping of an ore-hoisting shaft at the Tynagh Mine, Ireland", Oram and Bedford, Trans IMM, Vol 82 1973*
15 *David FitzGerald joined Tynagh in 1962 as a Mining Engineer and later became Mine Superintendent and then General Manager. After overseeing the mine's lengthy closure and rehabilitation work, he turned to consulting work in 1997.*
16 *Courtesy of Timothy Daffern, and the IAEG; www.iaeg.org*
17 *Official Opening, Handbook 1965*
18 *ST Short Dry Tons of 2000 lb, throughout this article.*
19 *Acknowledgement:- These and some other statistics are taken from "Review of the Tynagh Mine Operation", by Gerry Allison, in "Tynagh - The Mining Era", Tynagh and District Development Association. 1995*

Enhancing skills to increase efficiency in an older deepening mine

By Lucy Welsby, Marketing and Communications Manager, Atlas Copco UK, and Mike Lowther, Manager of Mining, Boliden Tara Mines Limited.

Boliden's Tara Mine in Navan has been in production for nearly 40 years and has many of the classic challenges of an older deepening mine.

The Management Team at Tara knew the mine had to work smarter and continually improve in order to address these challenges. In autumn 2013 a re-structuring of the mine's organisation commenced, working together with the main unions. The focus was to reduce headcount and to move to a 'one mine concept', away from three areas within the mine each having their own self-contained mining teams. This change was seen as essential in order to maximise the efficiency and flexibility of the workforce.

Mike Lowther, Manager of Mining appreciates that: "The deeper we go into the mine the tougher the logistics get. We can't do anything about exchange rates, metal prices or the ore body grades but we do have the ability to control the efficiencies of our mining and our costs. Mineralisation is only ore if you can mine it profitably – to turn it into ore the mine has to be economically viable".

The re-organisation was the largest in the mine's history and was implemented in September 2014, resulting in a stream-lined management structure and workforce.

Mike Lowther

Left to right: Patrick Finnegan, Mike Hall, Seán Gilmore, Malachy Kelly

Mine management, for a number of years, had stressed the importance of enhancing skills and they worked closely with the main mining unions to achieve this. An important part of increasing the pool of skilled operators and maintenance staff was the Atlas Copco Drill Rig Simulator Training Programme. The first programme at Tara was in the summer of 2013, and a follow up programme took place in the spring of 2015.

The Importance of Cross-Skilling

The Company's goal to decrease operating costs included cross-skilling personnel via product training to operate machine groups with a similar functionality, i.e. Drill Rigs and Bolters. To achieve these goals in all areas of the mine the main unions worked closely with mine management.

A Strong Project Team

Seán Gilmore (Training Co-ordinator) took on the instrumental role of Simulator Training Planner making sure that once the decision was made to order and deliver the Simulator in 2015, all the preparation and planning was in place. With 4 weeks preparation from go-ahead to organise the training, it proved an intensive planning process for Seán who worked alongside Atlas Copco's Service Manager in Ireland, Damien Healy, to ensure all the trainees were registered with the Simulator training software and system. Email training accounts had to be set up, upgrading of the surface training area and most importantly the training schedule had to be co-ordinated with the mine's shift pattern. The training schedule was adjusted around the trainees' holiday dates and shift rotas to achieve the target of 24 craftsmen and 24 mine drill rig operators to be trained and cross-

skilled. The total number of personnel who have benefitted from Simulator Training is 56 in 2015, an increase from 32 in 2013.

When the training schedule was in place, Mike Hall was appointed NPIC (Nominated Person in Control) for the 2015 simulator project. Mike was seconded from his normal role at Tara as Shift Boss to this position. His role as NPIC was to ensure risk assessments were completed for the preparation and installation on site of the Simulator, communication of the schedule to each trainee and liaising with the Atlas Copco Trainer to ensure teething problems were ironed out and the training plan implemented.

Simulator training

The training included both computer based introductory training and operator training on the Simulator, depending on the skill level of the trainee in the new organisation. Trainees with broad experience of the Drill Rig machine group used the opportunity to fine tune their skills, while operators in the early stages of cross-skill gained an understanding of the functioning of the Rigs on the computer programs.

The computer based training covers five modules each with 10 categories:

1. Underground Drilling
2. Rock Mechanics
3. In the Hole Drilling
4. Rock Drilling Tools
5. Maintenance and Over-hauling

A pass rate of 80% is required at each stage to progress through the training levels.

The trainees spent 3-4 hours on the computer which covers topics such as voids, cracks and varying rock hardness, as well as training on stamp load tests and common problems related to rock mechanics, rotation feed and impact, including how the gauges are affected by the changing rock mechanics and in turn stresses to the equipment. Feedback from some trainees included comments such as: "Seeing the basics of rock drill tools along with why and when the different drills are used was interesting and relevant".

For the Operators and Craftsmen the computer training is followed by hands-on training on the Simulator, which is built from the engineering plans of the real machines. With all the original components and controls in the cab, the Simulator offers a functional replica of the Boltec, Simba and Boomer machines with scenarios with increasing complexity from safety and start-up procedures, up to advanced performance. At each stage instructions on how to operate and carry out all actions is conveyed to the trainee. "When the trainee passes their training the printed report is added to their training records as part of the internal licensing process in place at Tara", states Mike Hall.

The efficiency savings for the mine from the training are highlighted by Seán Gilmore and Mike Hall's belief that: "If an operator not familiar with mining equipment were to spend 2 days on the Simulator training programme, this time spent is the equivalent of 3-4 weeks buddy training underground on a real machine".

Whilst Tara is not able change the fact that it is an aging and deepening mine, its determination to change the way it works through both re-structuring and the choice of innovative training methods, has led to clear efficiency gains. Mike Lowther concludes that the re-organisation process is proof that: "The more efficiently and cost effectively you can do things the more marginal mineralisation can be mined, thereby adding to the potential to extend the Life of Mine. Training is an important part of our focus on decreasing operating costs and Atlas Copco's Simulator Training Programme continues to form part of Tara's plans for the future".

Seán Gilmore and Damien Healy

Simulator cab

IRISH MINING AND QUARRYING SOCIETY
ANNUAL DINNER DANCE 2014

The always enjoyable annual black-tie dinner took place in Dublin city centre on Saturday, the 29th of November 2014, at the Ballsbridge Hotel.

The IMQS Dinner Dance event is unparalleled, with no close comparison to it within this sector and offers a unique opportunity for members of the extractive industries and those associated with it, to assemble, socialise, network, make new contacts, circulate and reacquaint with old friends in an amicable and congenial environment.

Music was supplied by the popular Conor McKeon band, "The Legends of Swing". Their lively and entertaining performance had the dance floor hopping!

The event was addressed by Mr. Joe McHugh T.D., Minister of State at the Department of Communications, Energy and Natural Resources and the IMQS President, Ms. Siobhán Tinnelly. There was also a special presentation from Boliden Tara Mines to mark the retirement of Mr. John Grennan.

This year's IMQS Annual Dinner Dance takes place on Saturday 28th November 2015 in the Ballsbridge Hotel, Dublin. All the major mining and quarrying companies and a significant number of service providers and suppliers support the IMQS Dinner Dance, which is why this event is an excellent opportunity to network, renew old contacts and create new ones. We also cater for individuals or small groups who wish to attend.

We look forward to seeing you there on the night.

More details on www.imqs.ie


L-R: Paddy McConnell, Mary McConnell, Sandra Gregory, Ian Gregory, Guian Barnett, Stephen Barnett, Caroline White, Pat White, Caroline Finnegan and Eugene Finnegan


L-R: David Johnson, Olive Magee, James Doody, Anna Doody, Connell McDevitt, Marie McDevitt, Gerard McCaffrey and Sheila McCaffrey


L-R: Pat Tinnelly, Frances Tinnelly, IMQS President Siobhan Tinnelly, Sean Finlay, Damien Grehan


L-R: Gearoid Lohan, Grainne Lohan, Jerome Lambe, Ken Fitzpatrick, Brid Fitzpatrick, Emma Jane Lambe, Emmet Lynch, Renatia Butkute, Mary Behan and Larry Behan


L-R: Dave Edwards & Mrs Edwards, Irish Gypsum, Andrew & Bernie Scott, Atlas Copco, Andrew & Grace Acques Atlas Copco and Don & Maura Litster, Atlas Copco


L-R: Greg Megarrell, Ruth Megarrell, John Francis, Sinead Francis, John Currie, Julie Currie, Shirley Cornet, Chris Stevenson, Deirdre Egan, Dave Egan, Karen Spillane and Declan Spillane


L-R: Sean Finlay, Heather Sanderson, Frances Tinnelly, Siobhan Tinnelly, Hilary Finlay, Les Sanderson and Pat Tinnelly

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Concrete Rheology Characterization: An Easy Way

by BASF (and as presented by BASF at the XVII ERMCO Congress in Istanbul in June 2015)

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(2) BASF Tuerk Kimya Sanayi ve Ticaret Ltd. Sti., DEV.LB.EBA - EBGZ, - Gebze - Kocaeli, Turkey

Abstract

Fresh rheoplastic concrete usually is characterized on the job site with standardised methods such as Slump, Slump Flow or VEBE Test. The obtained values are used to describe both the initial fluidity of the concrete and the workability retention, but these methods are not able to characterize the rheological properties of concrete which may have an important impact on its production.

The rheology improvement of rheoplastic concrete thanks to more advanced superplasticizers allows the solution of difficult situations where the higher concrete stickiness impedes easy placing and affects the quality of the surface.

From the mixing time to the surface finishing, through the pumping and placing, the concrete rheology plays a key role on the construction life, but its quantification in each steps is not an easy task.

In this paper, the rheology of concretes cast with different superplasticizers is quantified by new test methods able to simulate and differentiate the placing step: the laboratory trials validate the test methods and the best performing admixtures.

Keywords

concrete, superplasticizer, rheology, placing, surface, test method

Introduction

Concrete technology has already achieved almost the limit in terms of "traditional" performances: it is possible to produce members with extreme mechanical and flexural properties, to pour concrete that retains workability for hours under the most severe conditions and to assure very high performances in terms of durability and aesthetics.

But pushing concrete towards such extreme implies working with a material that increasingly becomes difficult to handle, to move, to pump, to pour and to finish.

New performances, other than water reduction and workability retention, are required today to meet the customer requests and to enter a new part of the market (labor) where the contribution of superplasticizer is not fully exploited.

Rheology is, by definition, the study of the flow of matter, primarily in the liquid state, but also as "soft solids" or solids under conditions in which they respond with plastic flow rather than deforming elastically in response to an applied force. As a colloidal system, rheology of concrete can be expressed by the Bingham model. A Bingham fluid is a viscoplastic material that behaves as a rigid body at low stresses but flows as a viscous fluid at high stress. The yield stress ($\tau 0$) determines the value when concrete begins to flow under its own mass. The plastic viscosity (μ) determines the flow time or speed of concrete during pouring or pumping. This value indicates how easily the concrete can be placed or filled into forms.

The traditional methods of measuring slump or slump flow are not capable of characterizing the fundamental rheological properties of concrete during the processes of mixing, transporting, and placement.

Rheometers for concrete are designed to characterize the static yield stress, the dynamic yield stress and plastic viscosity of the concrete. A high static yield stress is desirable because it reduces formwork pressure and increases the resistance to segregation. But for ease of pumping, placement, and self consolidation, a low dynamic yield stress is necessary. The dynamic viscosity provides cohesiveness and contributes to reducing segregation when concrete is flowing.

Till now, the tests performed in lab and job site were focused on evaluating the workability of fresh cementitious materials by measuring a change in slump or slump flow. These industrial tests are, in most circumstances, directly correlated to yield stress. Although cementitious materials are not only yield stress fluids, this pragmatic approach was justified by the fact that yield stress is often the most relevant parameter to describe the ability of a material to fill, under its own weight, a formwork or more generally a mold.

Recent trends in modifying mix design (reducing W/C ratio, adding harsh aggregates, etc.) have shown, however, dramatic consequences on the workability of the material and workers at the building site often complain about these "sticky" concretes that they are unable to vibrate and surface finish. This "stickiness" and, more specifically, the additional stress needed to place the material, is not only related to yield stress but also to plastic viscosity.

Therefore, a reduction of both yield stress ($\tau 0$) and plastic viscosity (μ) contributes to improving rheology of concrete.

The practical evaluation of stickiness and rheology, in general, is a tough task, being rather difficult to attribute a single number to the "perceived feeling" of rheology that customers have.

Usually, rheometer is used to measure yield stress and plastic viscosity values but both these numbers are not so directly and easily correlated to concrete properties measured on the job site and not all job sites are typically equipped with this instrument. Some test methods at laboratory scale have been developed [1] [2], but new tools have to be developed with the aim to simulate some aspects of the work at the job site, like placing, vibration and finishing. Moreover, they have been thought to be portable.

"Placeability" is used herein as a measure of the ease of moving concrete after pouring. In this paper a new method for characterizing placeability is reported: a special formwork which is equipped with a probe was developed, where probe shape, size, depth in concrete and displacement rate can be modified in order to achieve the best simulation of the placing in the real formwork. The use of different admixture could strongly impact the behavior of the concrete in this respect [3].

2. Test Methods

2.1 Rheometer

Generally the rheological characterization of concrete is carried out with rheometers. Different examples are available in the market: the instrument used for this study is the RHM-3000 ICAR Rheometer (Germann Instruments) (see figure n.1).

Figure n°1 – RHM 3000 ICAR Rheometer

The yield stress and the plastic viscosity are measured by a vane able to rotate in a specific and proper designed container:

- The first parameter is proportional to the maximum

torque detected when the vane constantly rotates at 0.025 rev/s

- The second parameter derives from the slope determination (according to specific calculations) of the interpolation line of six torques measured at six decreasing rotational speeds from 0.6 to 0.1 rev/s.

2.2 Portable Placing simulator

The aim of this device is to assign a number to the feeling of the skilled operator who can detect differences between concrete mixture by moving them with a trowel but is nor able to quantify them.

The developed portable tool quantifies the torque needed to move an embedded paddle in the concrete through a pulley system (the figure n°2 explains the entire equipment).

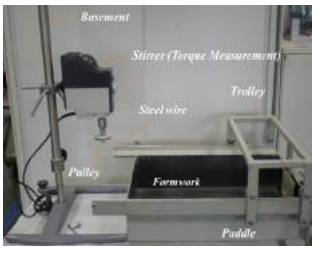
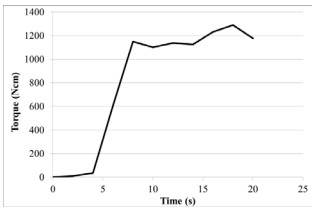


Figure n°2 – Placing Simulation Tool

The formwork is filled with 30 liters of concrete: the embedded paddle connected to a wheel trolley moves via a steel wire while the pulley constantly rotates through the rheometer (RZR 2102-Control by Heidolph). The torque evolution is recorded by a laptop connection and relative acquisition software: figure n°3 shows an example



Figuren°3 – Example of torque evolution recorded

The reproducibility of the test method has been fully assessed: after approximately hundred different concrete repetitions the standard deviation among the tests is 8%.

The limit of the test method can be identified in the minimum consistency class necessary in order to have reliable measurement: below 10-12cm slump the measured torque exceeds the maximum value of the rheometer.

3. Materials and Mix Design

The tests have been performed comparing two superplasticizers having different chemistry:

- Polycarboxilate ether (PCE); 30% solid content solution; density 1.040gr/cm3
- Polyaryl ether (PAE); 30% solid content solution; density 1.080gr/cm3

PAE chemistry is a technology for which BASF filed patent applications [4] which proved to be very effective in improving rheology of concrete.

Limestone Filler, dolomite crushed Sand 0/4, Coarse Aggregates 8/12 and 12/19 have been used in this investigation.

The experiments have been carried out with 3 different Italian cements:

- CEM II/A-LL 42.5 R Monselice
- CEM II/A-LL 42.5 R Colacem Gubbio
- CEM IV/A-P 42.5 R Colacem Gubbio

All cements reflect the limits according the EN 197-1: the average 28dd compressive strength is between 42.5 and 52.5 MPa.

The higher concrete stickiness is generally observed when higher fines (cements, binders, sands) and low water/cement ratio compose the cementitious matrix, so the materials have been combined, where 400kg/m3 of cement and 50kg/m3 of limestone filler have been blended in w/c = 0.48 concrete and the admixtures have been dosed in order to achieve 220+10 mm slump.

Apparently all concretes seem similar, because the measured slump and air content do not different so much.

However the rheological evaluation shows how the different admixture chemistry has an impact on concrete stickiness and above all on the feeling of the operators.

Both the ICAR Rheometer and the Placing Simulator assessments have been carried out for each concrete: the yield stress and the plastic viscosity have been compared towards the maximum torque detected by the new equipment.

Figure n°4 show the different behavior of the torques measured in the CEM II/A-LL 42.5 R Monselice serie.

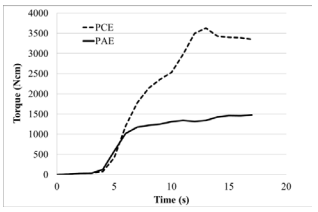


Figure n°4 – Placing Simulator (CEM II/A-LL 42.5 R Monselice)

PAE based admixture is able to reduce the max torque while the PCE reaches a torque value 3 times higher than the new molecule.

In all cases the Placing Simulator results demonstrate that PAE technology reduces the maximum torque and this trend is in line with the differences of plastic viscosity (μ). On the other hand not substantial differences can be observed from the yield stress (τ_0): the behavior can be easily explained by the fact that this parameter is more correlated to the slump, and because all concretes have similar workability, the yield stress values reflect it.

The availability of new chemistry and its capability on rheology improvement allows some considerations:

- Better Rheology approach – Concrete stickiness reduction
- Durability Improvement approach - The water content can be reduced improving both mechanical properties and durability
- Cost Optimization approach - The cement content can be reduced maintaining the same water-cement reduction and the mechanical properties by consequence

Results measured with both Rheometer and Placing Simulator confirm the possibility to optimize the cost maintaining the same properties of daily concrete: 30kg/m3 of cement can be reduced maintaining the same water-cement ratio (mechanical properties) and rheology.

4. Conclusions

New performances, other than water reduction and workability retention, are required today to meet the customer requests and to enter a new part of the market (labor) where the contribution of superplasticizer is not fully exploited and rheology improvement is one such new performance.

Its characterization can be obtained with rheometers, but in most of the cases the values (yield stress and plastic rheology) cannot be understood by all operators who work in the concrete production field.

The development of an easy, comprehensive and portable tool that can correlate the science of rheology (rheometer) with the concrete life (operators' feeling) is a must: the Placing Simulator is able to bridge these two realities.

The quantification of the stickiness reduction due to the new PAE technology can be easily measured by the Placing Simulator supported by the Rheometer avoidance.

The rheology improvement achieved by PAE polymer allows one to enhance the concrete performances in terms both of durability improvement (lower water content) and cost optimization (lower cement content).

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Siege Mines and Underground Warfare

by Tony Killian

The Miners

The siege became established as a perennial mode of human conflict ever since the first urbanised populations constructed walls to protect themselves and their property from attack.

In the annals of siege warfare few individuals commanded more fear and respect than the miner, who with his pick and shovel was a serious threat to the security of the strongest fortifications. Working in a way that was invisible and silent but no less dramatic, men who were expert in underground siege methods laboured to outwit each other in subterranean passages known as mines and countermines.

Against bastioned fortresses, the besieging miners would dig galleries about 1.25 meters high and 1 meter wide and line them with wood. Once the foundations were reached, the miners would dig a large chamber perpendicular to the previous direction of the gallery with timber props to support the earth over the chamber. These props could be collapsed by burning, causing the walls to sink and split, allowing an assault to be made on the breach by force, hopefully bringing the siege to a speedy conclusion.

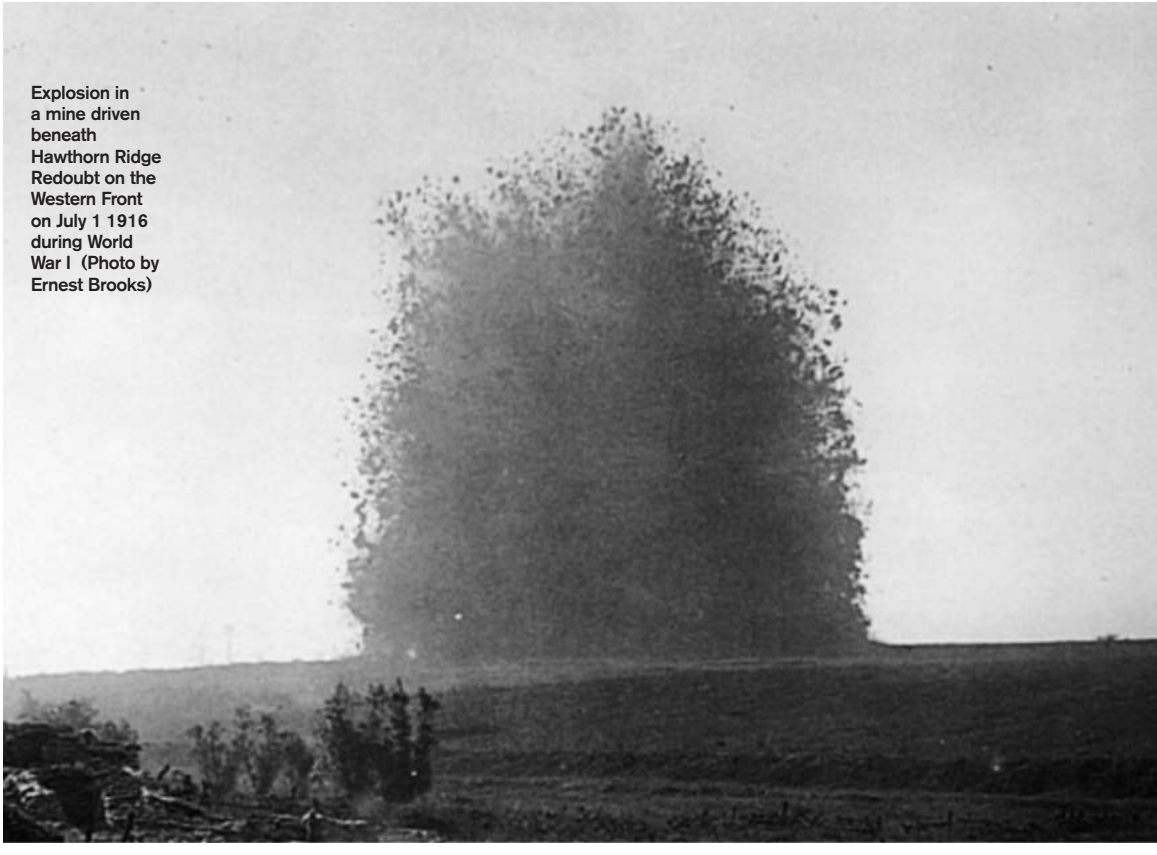
In response to this fearful threat, the defenders had no choice but to send down counterminers to detect and break into the enemy's mines, to see them off before any damage was done.

There were three ways a mine and countermine could become engaged. First, if the countermine was driven above an advancing mine, the counterminers could dig through to the mine below and pump in water to flood the enemy's work. Second, if the countermine was driven below the mine, the counterminers could "spring" the end of their gallery, thereby collapsing the mine above. And third, the two galleries could break through head to head, leaving it to hand-to-hand combat to decide the outcome.

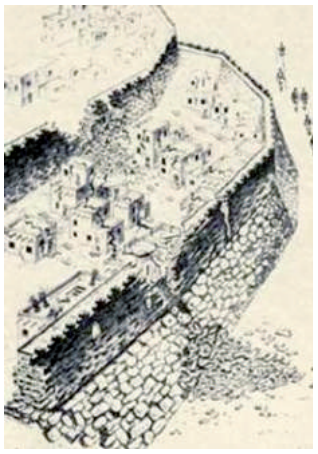
Fortified Strongholds

Early in the Bronze Age, walled cities began to appear in the Middle East to protect against raiders and other attackers. Jericho, on the west bank of the Jordan River, just north of the Dead Sea, is the oldest known walled city (dating from approximately 8000 B.C.).

The walls at Jericho were about 7 meters high and 4 meters thick. With attackers' options limited to blockading a city (starving them out), scaling the walls, breaching



Explosion in a mine driven beneath Hawthorn Ridge Redoubt on the Western Front on July 1 1916 during World War I (Photo by Ernest Brooks)



Artist's reconstruction of the north side of ancient Jericho

the walls with a battering ram, or by stratagem (such as the Trojan horse).

Early military mining techniques were developed to assist attackers, probably devised by civilian miners at their behest.

Counter Measures

Several methods resisted or countered undermining. Often the sitting of a castle could make mining difficult. The walls of a castle could be constructed either on solid rock or on sandy or water-logged land, making it difficult to dig mines. A very deep ditch or moat could be constructed in front of the walls, as was done at Pembroke Castle, or even artificial lakes, as was done at Kenilworth Castle. This made it more difficult to dig a mine, and even if a breach was made, the ditch or moat made exploiting the breach difficult.

Finally if the walls were breached, obstacles could be placed in the breach. The great concentric ringed fortresses, like Beaumaris Castle on Anglesey, were designed so that the inner walls were ready-built spaces: if an attacker succeeded in breaching the outer walls, he would enter a killing field between the lower outer walls and the higher inner walls.

Early organized military miners.

The Assyrian Army organized the first known "corps of engineers" during the time of Ashurnasirpal II. They are credited with the first known use of offensive mine warfare. This occurred about 880 B.C. when engineer soldiers drove tunnels under or through walls and fortifications to create a breach large enough for a full-scale attack. Generally during the middle Ages, coal miners were hired. Formal mining units were not formed until standing armies were raised in the 17th century. Their work demanded courage and special caution--lack of oxygen and possible flooding were hazards.

Beaumaris Castle Anglesea

Among the many successful mines throughout history are those used by Alexander the Great and his engineer Diades at the sieges of Halicarnassus (334 B.C.) and Gaza (332 B.C.) and Julius Caesar and his engineer Mamurra during the siege of Marseilles in 49 BC.

Ruins of the fornications around Halicarnassus, 4th c. BC

Use of explosives in siege mining

Although the origin of black powder is uncertain, it probably was developed by Chinese alchemists during the Tang Dynasty around 850 A.D. It however was the Mongols who successfully integrated it into an effective weapon. They carried black powder with them during their reign of conquest and introduced it to Europeans at the Battles of Liegnitz and Sajo River in April 1241. The ability to manufacture and detonate black powder occurred in Europe in the 14th century and resulted in the next major improvements in mining, both military and commercial.

The effectiveness of tunnel mines was significantly increased by exploding large charges of black powder at the end of galleries driven under fortifications. The demolition by explosives often came with a bonus that it came as a shock to defending forces, and frequently causing panic and confusion.

The first recorded use of such a mine in Europe was in 1403, during a war between Pisa and Florence, when the Florentines exploded a charge in a forgotten passage in the walls surrounding Pisa. However, for a long time black powder was a scarce and expensive commodity, so the less

Ancient Map of Pisa

spectacular method of burning out the timber supports beneath the walls continued for a long time.

High explosives

Military engineers incorporated the latest technologies from civilian mining as they became available, including more efficient explosives: nitrocellulose in 1845, dynamite in 1866, picric acid in 1871, and TNT in 1902. Other improvements included electric (galvanic) ignition (1850s) and forced-air ventilation systems. During World War I, both sides employed new mechanical tunnel-boring machines developed for commercial coal mining, as well as traditional techniques.

Tunnel mining has continued sporadically into the modern era and was used by Napoleon at Acre (1799), the Crimean War (Sevastopol), and the Russo-Japanese War (Port Arthur), most recently, the Peruvians used tunnel mines to liberate hostages held in the Japanese ambassador's residence in Lima.

Siege mining in Britain

Siege warfare involving mining was introduced to Britain following the Norman Conquest at the siege of Exeter in 1067. The same stronghold was besieged in 1136, when miners again attempted to demolish the walls. Archaeological excavations carried out in the 1930s at Bungay Castle, Suffolk, exposed a mine gallery over 7m long, dated by the excavator to the siege by Henry II in 1174. The longest siege to take place in British history,was the siege of Rochester Castle, Kent, in 1215, when miners successfully brought a tunnel below the

corner of the keep, firing the props, we are told, with the fat of 40 bacon pigs, and bringing the masonry crashing down.

Underground tactics were adopted at the siege of St Andrews Castle, Fife, in 1547. A mine dug through the solid rock below the castle was intercepted by a countermine, bringing the mining to an end. These structures were discovered intact in the 19th century, and form an essential feature of a visit to the castle.

Sieges became a staple of the Civil Wars between 1642 and 1651. The use of miners to bring about dramatic results occurred during attacks on walled towns such as Gloucester (1643) and York (1644), and also at hotly disputed castles, notably Wardour, Wiltshire (1644) and Sherbourne, Dorset (1645).

Some archaeological evidence for underground siege methods during the civil war years has come to light, such as the discovery of countermine shafts at Pontefract Castle, West Yorkshire, dating from the siege of 1645.

Siege Mining in Ireland

Mining of a primative kind was used at the first siege of Ballyallia Castle in County Clare, in 1642. However, the digging of deep galleries could be attempted if skilled workmen with civilian experience of mining were available, and these conditions prevailed in Limerick when, at the beginning of May 1642, English citizens took shelter behind the walls of the King's castle, which was immediately besieged by the Irish forces.

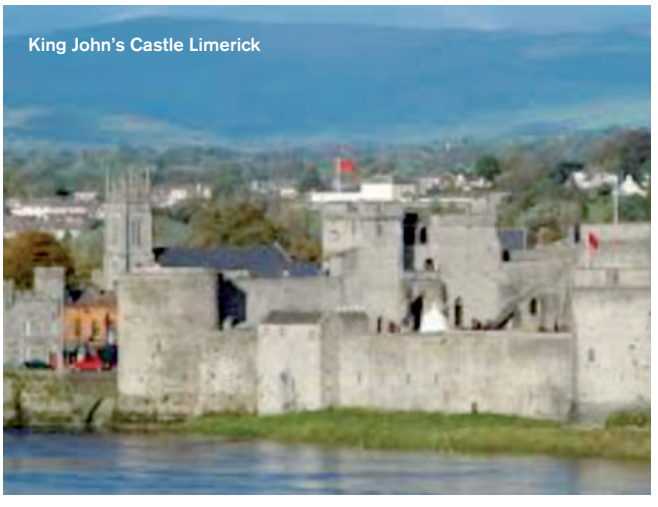
The Catholic army drawn around the castle lacked large cannons to batter the castle and breach its walls. The workers from the royal silver mines in Munster who came to Limerick for safety at the beginning of 1642 were now divided equally between the besieging Irish forces and the besieged English garrison. When mining activity commenced along the eastern side of the castle on 25th May and towards the southern side on 1st June, they was met by determined countermining on both fronts, until breaches were successfully made on the eastern side that brought about surrender of the castle on 23rd June. Altogether eleven mines were constructed by the attackers in the course of the siege, and eight countermines were instigated by the garrison.

Gallery mining employing the skills of miners from the silver mines in Munster occurred again at the sieges of Ballinakill, County Laois, and Birr Castle, County Offaly, both in 1643. These operations were also carried out with little reference to the theories of formal siege warfare that were currently practiced on the continent.

Archaeological excavations at Limerick Castle

Large-scale excavations on the eastern side of the castle in 1990-91 revealed the remains of several mining structures, and a total of more than three hundred well-preserved timbers were recovered.

The siege of Limerick Castle show that the besiegers had no time for the formal procedures of the scientific siege that were typical of large-scale operations on the Continent. Indeed, the mines themselves were of the outmoded 'burnt-prop' variety that belonged to the medieval era and made no concessions to contemporary explosive mining technology.



King John's Castle Limerick

Duncannon Fort today

Co. Wexford

In early 1645 Duncannon Fort, County Wexford, was besieged by the Irish with the assistance of a French engineer, Nicholas Lalloe, and his system of trenches and batteries was recognisably continental in its planning and execution. The Castle was surrendered before the mining was completed.

Although the fort was subsequently rebuilt, indicators visible from the air in the environs of Duncannon suggest that sub-surface evidence for the siege survives, and if archaeological excavations of the 1645 siege lines were to take place, this site could make an important contribution to the subject of siege warfare in Ireland.

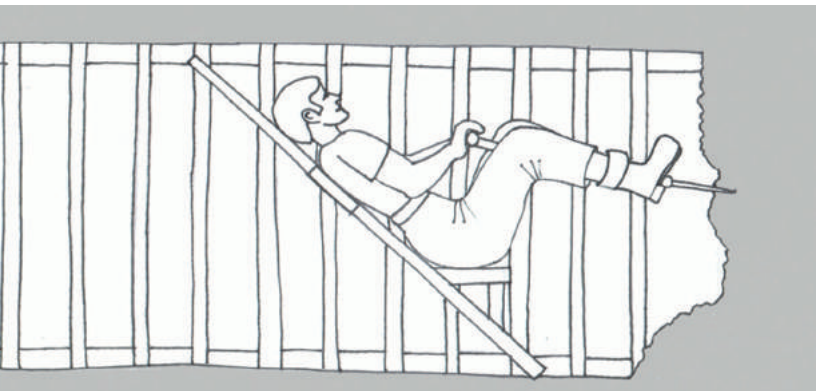
The American Civil War

During the Siege of Vicksburg, in 1863, Union troops led by General Ulysses S. Grant tunneled under the Confederate trenches and detonated a mine beneath the 3rd Louisiana Redan on June 25, 1863. The subsequent assault, led by General John A. Logan, gained a foothold in the Confederate trenches where the crater was formed, but the attackers were eventually forced to withdraw.

The most famous instance of mining in American military history occurred in the course of the siege of Petersburg, Virginia, in 1864. In considering ways of breaking the deadlock, General Ambrose Burnside conceived the idea of using coal miners from Pennsylvania to dig a tunnel, 152 meters in length, below Confederate lines. The chamber at the end of this gallery was packed with 3.6 tonnes of explosives and the charge was ignited on 30th June, creating a colossal crater. Although killing 300 Confederate soldiers, the battle, might have been decisive if not for the faulty Union tactic of storming into, rather than around, the resulting crater, allowing the defenders to shoot down onto attackers unable to climb the steep crater sides. The combat was accordingly known as the Battle of the Crater.

The First World War

The stalemate situation in the early part of the war led to the large deployment of tunnel warfare. After the first German Empire attacks on 21 December 1914, through



Sketch of a Clay Kicker (By J Fox)

shallow tunnels underneath no man's land and exploding ten mines under the Allied trenches, the British began forming suitable units. Tunnel mines were very time consuming to employ. Typically about 18 miners and 36 unskilled workmen were employed in three 8-hour shifts to construct an assault mine. Military mining during a siege could last 30 days or more, and specialists were required for the job.

In February 1915, eight Tunneling Companies were created and operational in Flanders from March 1915. By mid-1916, the British Army had around 25,000 trained tunnellers, mostly volunteers taken from coal mining communities. Almost twice that number of attached infantry worked permanently alongside the trained miners acting as beasts of burden.

An important contribution on the Allied side was made by John Norton Griffiths, an engineering contractor.

A sapper using a geophone. (Military Mining 1923)

On a drainage scheme in Manchester, he used a method for driving tunnels known as 'clay kicking' or 'working on the cross'. By this method, the digger did not use a pickaxe but sat on a narrow seat secured to a long wooden plank that was lodged at a back, giving the plank a cross-like appearance. The 'clay kicker' kept both feet on a spade, which he used to cut out the subsoil face in front of him. The spoil was gathered by his mate and passed along the gallery.

This method of mining was swift and silent, with progress in good conditions of 3.65 meters or more per day, and was ideal for use in Flanders, where the clay was deep and soft. Norton Griffiths was commissioned to enlist as many 'clay kickers' as he could find to comprise a new mining corps within the Royal Engineers, at a rate of six shillings a day. These were men with civilian mining experience in the London underground scheme and sewerage works, as well as coal and mineral miners.

The miners worked in shifts around the clock digging tunnels towards the German line. When a tunnel was completed after days or weeks of sweating labour, tons of explosive charges were stacked at the end and primed ready for firing. Careful calculations were made to ensure that the centre of the explosion would be directly under the target area.

Countermining

The detection of enemy coutermining was vital. Within the tunneling operations, side-shaft listening posts were deployed and manned by soldiers whose job entailed listening for indications that the enemy was tunneling. Initially using just manual methods, the British were eventually equipped with Geophones, which could detect noises up to 50 metres (160 ft) away. Employing two Geophones, a listener was able to ascertain the direction of hostile activity by moving the sensors until sound levels were equal in both ears. A compass bearing was then taken. When gauging distance only, both earpieces were plugged into a single sensor; this was a skill only gained by experience.

Deploying listeners in different tunnels using triangulation techniques, by the end of 1916 the scale of British tunneling warfare had expanded to such an extent that there were not enough listeners to man every post; central listening stations were devised. Working electronically like a telephone exchange, the signals from up to 36 remote sensors (Tele-geophones and Seism microphones) could be distinguished and logged by just two men.

Improved techniques

Improvements in mining continued to be made as the war progressed. Better air pumps were produced. Later still, electric lighting was rigged up for the galleries. The demands for gunpowder and guncotton were such that alternative explosives were required, and the more powerful ammonal came to be used for charging the mines. This was a blasting explosive compound of nitroglycerine, ammonium nitrate and powdered aluminum. The men worked in conditions of extreme danger and discomfort. There was constant risk of explosions by German camouflets, small charges that were designed to wreck the opposition's mines without causing any damage on the surface, which released deadly carbon monoxide gas. Many miners were poisoned by gas from underground explosions, or buried under debris.

Battle of Messines Ridge

The culmination of mining work during the war was the ambitious plan for the taking of Messines Ridge in 1917 when General Sir Herbert Plumer, gave orders for 21 mines to be placed under German lines. Over the next five months more than 8,000 metres of tunnel were dug and 600 tons of explosive were placed in position. Simultaneous explosion of 19 of the mines

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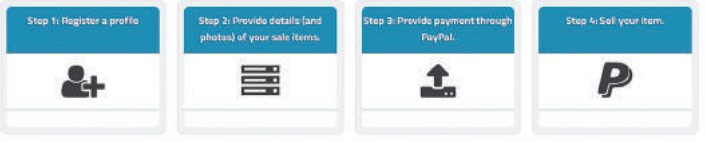

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took place at 3.10 on 7th June. The blast killed an estimated 10,000 soldiers and was so loud it was heard in London.

One of the two mines, not detonated during the war, exploded during a thunderstorm in 1955. The location of the other remains unknown to this day.

The landscape of this area in south-west Belgium remains uniquely scarred by the unparalleled magnitude of the underground operations of the craters formed by the explosions are testaments not only to the endeavors of a particular campaign but also to the long history of tunneling and mining in human conflict.

Lone tree crater 1979

The Spanbroekmolen Mine Crater, also known as Lone Tree Crater, is the site of the largest of 19 mines blown by the British Army in the early hours of the morning of 7th June 1917, resulted from the explosion of 41,275 kg of ammonal, set at the end of a gallery 521.3 metres in length: the "greatest military mine in history". The crater contains a lake that measures 131 meters across, 12.2 meters deep. The taking of Messines Ridge was a key moment in the First World War.

Fighting conditions changed thereafter, and mining was discontinued on both sides.

Conclusion

The undermining of walls by besieging armies may have been consigned into history, but something of its spirit remains embedded in our consciousness.

In the Far East, tunnels were made as hiding places by the Viet Minh in their war with the French. An extensive system was established by 1948, linking hamlets in occupied territory. This became the basis of the famous Cu Chi tunnel system, already with a total length of 200 km by the time of the arrival of the Americans in Vietnam in 1965.

The North Koreans may use tunnels in the future-- some of their tunnels have been discovered under the demilitarized zone (DMZ) and more are suspected.

Many famous war tunnels were later turned into tourist site due to their historic significance in wars.

For example, Sarajevo tunnel is now converted into a war museum, with 20 meters of the original tunnel open for tourists visit. Hebei Ran Zhuang tunnel is also a famous war tourism site in China.

Hughesovka

The Russian City founded by Welsh ironmaster John Hughes

by Tony Killian

John Hughes was born in 1815 in Merthyr Tydfil where he learnt his trade from his father, at Cyfarthfa ironworks, and as a director on the board of the Millwall Engineering and Shipbuilding Company in London, he built his reputation on a number of inventions in armour plating.

Hughes was invited to Ukraine to develop coal mining and a metallurgy industry, subsequently founding an ironworks and a railway. In 1870 he sailed to Ukraine with eight shiploads of equipment and around a hundred specialist ironworkers and miners, mostly from south Wales, to build a metallurgical plant and rail factory. He also took his wife and eight children to start a new life thousands of miles from home.

He built a metal works near the village of Alexandrovka. The state-of-the-art works had eight blast furnaces and was capable of a full production cycle, with the first pig iron cast in 1872. During the 1870s, collieries and iron ore mines were sunk, and brickworks and other facilities established to make the isolated works a self-sufficient industrial complex.

The Hughes factory gave its name to the settlement which

grew in its shadow, and the town of Hughesovka (Yuzovka) grew rapidly, to become one of the biggest industrial centres of Russian Empire.

In developments reminiscent of the south Wales valleys, a hospital, schools, bath houses and tea rooms were provided for the community, along with a fire brigade and an Anglican church dedicated to the patron saints St George and St David.

Over the next twenty years, the works prospered and expanded, first under John Hughes and then, after his death in 1889, under the management of four of his sons. Amazingly, Hughes was only semi-literate, he was unable to write and could only read capital letters.

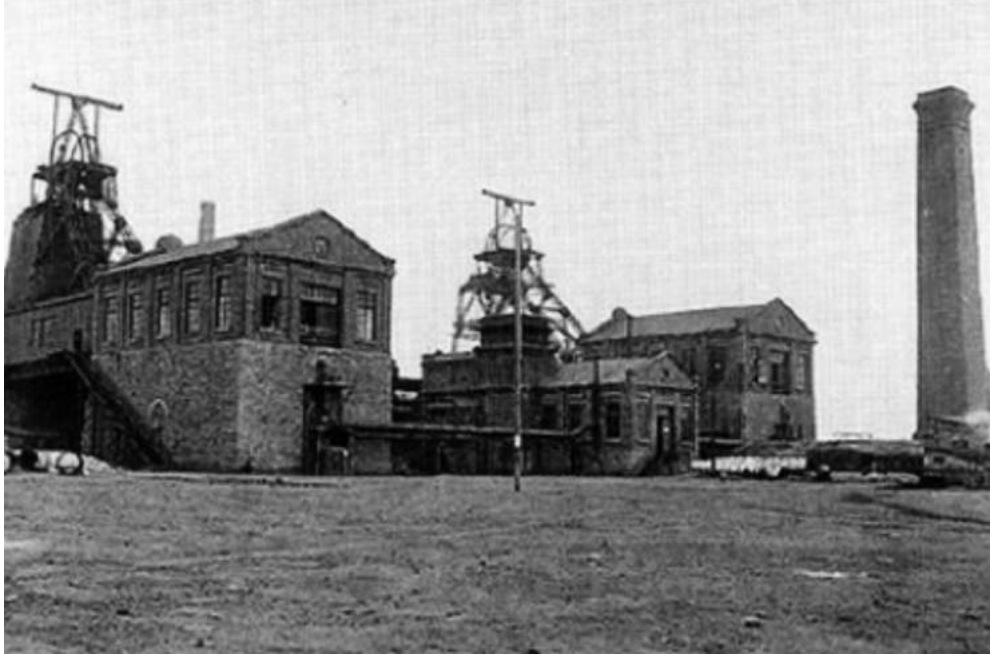
Post Hughes

By the end of the nineteenth century, the works was the largest in the Russian Empire, producing 74% of all Russian iron by 1913, but the Bolshevik revolution of 1917 brought the Hughes family connection with the works to a close. The Hughes brothers and almost all of their foreign employees left Russia, and the works were taken over by the Bolsheviks in 1919. The town of Hughesovka was renamed first to Trotsk for a few months in 1923, to Stalino, in 1924, and later to Donetsk in 1961. The works survived and prospered, and Donetsk is still a major center of metallurgical industries.

Professor Gwyn Alf Williams

In a documentary series directed by Colin Thomas for the BBC in 1991, Hughes' fellow Merthyr Boy, Historian Gwyn Williams described the satanic complications involved in the establishing and maintaining industry in this area, and his words seem remarkably prescient, given the current fighting in eastern Ukraine.

From its earliest days, there were the atmosphere, social conditions and unrest in Hughesovka common to industrial towns, like the one



The pit heads of Hughesovka were reminiscent of the south Wales valleys

Hughes had left behind in South Wales. Hughesovka of the 1890s must have been a little like the Merthyr of the 1830s, complete with 'flames, smoke, thunder, drink and disease'. As well as the 1892 Cholera Riots, there also were frequent pogroms gripping the region. A chaotic period of warfare ensued after the Russian Revolution, with fourteen million people killed, and Red armies, White armies, Ukrainian armies, German puppets and private armies all striving for power and recognition. A century on, the confusion, fragmentation and foreign interference are depressingly familiar.

Lenin and Stalin periods

For all the extreme poverty and radical politics in 1930s Wales, the suffering in Stalino was on a completely different level. Thousands died of starvation before Lenin put minors, steelworkers at the forefront of the country's reconstruction.

Then there was the shattering impact of Stalinism , when the area was overrun with idealists, careerists and half-literate peasants who enacted a communism without communists as the Soviet Union urbanised overnight. There was the 'murderous lunacy' of a period in which there were one million 'official' executions and countless more besides, with at least eighteen million passing through the gulags. In Ukraine, there was a relentless assault on national identity, intellectuals and the church, widespread starvation, and the fact that even among the privileged managerial class 'every day someone went missing'.

Donetsk Railway Station

The Second World War

Treachery and violence again ripped through the city in the wake of the hated pact between Nazi Germany and the Soviet Union. As this unlikely agreement broke down and the Germans rolled into Stalino in October 1941, the retreating Russians operated a scorched earth policy. Despite the fact that some Ukrainians welcomed the Germans as liberators from the brutality of the Stalinist regime, the Nazi cruelty was if anything worse. They threw hundreds to their deaths down mine shafts and a quarter of a million were killed in prison camps during the German two-year occupation of Stalino.

75 years after John Hughes had arrived from Merthyr Tydfil, the city he founded as Hughesovka had endured untold suffering. By the time Nikita Khrushchev came to power, preaching of the 'communism of the future', the Soviet Union had become a country of organised hypocrisy and widespread corruption.

Collapse of the Soviet Union 1991

After the collapse, Ukraine officially declared itself an independent state on August 24, 1991, when the communist Supreme Soviet (parliament) of Ukraine proclaimed that Ukraine would no longer follow the laws of USSR and only the laws of the Ukrainian SSR, de facto declaring Ukraine's independence from the Soviet Union.

Ukraine

On December 1, voters approved a referendum formalising independence from the Soviet Union. Over 90% of Ukrainian citizens voted for independence, with majorities in every region, including 56% in Crimea. The Soviet Union formally ceased to exist on December 26.

Donetsk prospered as the area started a period of transition to a market economy, in which Ukraine experienced periods of growth and recession.

In 2012, Donetsk was admitted as the best city for business in Ukraine by Forbes. Donetsk topped the rating in five indicators: human capital, the purchasing power of citizens, investment situation, economic stability, as well as infrastructure and comfort. The airline Donbassaero has its head office on the property of Donetsk International Airport.

Celebrating roots

Colin Thomas visited the city in 1991 to make a TV documentary about John Hughes, and found little to celebrate the link with the Welsh industrialist.

But Thomas noticed a change when he returned in 2008 to what was now an independent Ukraine. Since then they had put up a statue to him – there was some pride now in the origins of the place and its connection with John Hughes. His memory is a powerful presence in Donetsk, which remains the most important mining and steel producing centre in Ukraine.

In 2007 the parliament in Kiev voted to establish a museum in Hughes' honour and a commemorative stamp

Artema Street, Donetsk

is planned for the 200th anniversary of his birth in 2015.

There was a general feeling of hope, as if Hughesovka was emerging finally from the long, dark mineshaft of its history.

Donetsk in 2011

On a visit to Donetsk Professor Williams described a 'beautiful city of broad boulevards, spacious squares, 500 libraries… roses everywhere', where 'in the culture, miners are heroes'.

There were carnivals instead of marches, and a church built by Hughes was full again of young people with their children. He watched children going to school on the first day of term, thinking that from these kids may come the people who may create a decent life and a decent society in Donetsk. But his hope is tempered with a chilling undertow of caution: 'When I think of those black monsters out of Russia's dark past', says Williams, a (communist himself) 'my stomach turns over.'

He noted, that there were Ukrainian flags, but little Ukrainian nationalism – their politics was confused, with an obvious continuing hatred between the Russia-leaning east and the nationalist west. This enmity persisted since Ukraine achieved independence, with results of elections to government disputed, with accusations of vote rigging.

Ukraine and the EU

The EU is seeking an increasingly close relationship with Ukraine, going beyond co-operation, to gradual economic integration and deepening of political co-operation. In 2012, the EU created deals on free trade and political association with Ukraine, in mid-2013 when the EU-Ukraine Council agreed a EU-Ukraine Association Agenda. It was decided to postpone the signing of the agreement due to large, widespread protests in Ukraine. These led to the removal of the government by parliament and the rallying of Pro-Russian militants in eastern Ukraine.

Crimea

In March 2014, the Crimean crisis resulted in Crimea being annexed by Russia. The referendum, which was organized under Russian military occupation, was denounced by the European Union and the United States as illegal.

The Crimean crisis was followed by intensified fighting in east Ukraine with the completely destruction of Donetsk Airport and considerable civilian fatalities. Glyn Williams wonders if the school kids who were his symbols of hope in 2011, now in their twenties and thirties are now occupying public buildings and declaring a separatist state, or an allegiance to Mother Russia; some of them possibly 'protesting' for one faction or another; some of them cowering at home, fearing that their city once again finds itself on a key square of the global checkerboard.

If the current crisis in Donetsk is, at present, a far cry from such horrors, there are warnings from history in the confusion surrounding the identity of 'protestors'. Are they Russian infiltrators? Local militias? Ordinary people concerned for the future of the country?

Are all of them are pawns in a game being orchestrated from the Kremlin and the Pentagon?.

In this steel town on the steppes, founded by a Welshman, history doesn't roll on, it rolls over.

Soccer

One lasting legacy of John Hughes enterprise is that his city (albeit renamed) is hometo Shakhtar Donetsk, one of Ukraine's most successful football clubs. The team's £256m Donbass Arena, with a capacity of 50,000, which opened in August 2009 was the venue for England's Euro 2012 group matches against France on 11 June and Ukraine on 19 June.

In fact the city's role as a host city for Euro 2012 can also be credited to the legacy of John Hughes - its first football team was formed in 1911 as part of the Yuzovka steelworks' sports club.

Destruction of Donetsk Airport

Donbass Arena

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By Lima Golf to Fingal's Cave

by Tony Killian

The unique and beguiling Fingal's Cave is on the uninhabited island of Staffa, lying to the west of The Isle of Mull, and about six miles north of Iona, in the Inner Hebrides of Scotland. The 80 acre Staffa Island is a spectacular example of columnar jointing in Tertiary lava flow, similar in structure to the Giant's Causeway in Northern Ireland.

Staffa consists of three layers of rock of different types, covered with a surface of rich soil and lush grass. The lowest layer is tuff, compressed volcanic ash and dust, the middle layer is composed of the basaltic columns, and the uppermost is made up of jumbled and fractured columns and volcanic debris.

The island has five caves, the most famous of which, Fingal's Cave, is seventy-two feet tall, two-hundred-seventy feet deep. This is perhaps the best known of all caves, with a large arched entrance that is filled by the sea. With its size and naturally arched roof, the eerie sounds produced by the echoes of waves, give it the atmosphere of a natural gothic church. The cave's Gaelic name, An Uaimh Bhinn, means "the melodious cave." The basalt columns and 60m long chasm which forms the cave is a stunning piece of nature and regularly features

on "Wonders of the World".

Staffa Island is owned by the National Trust for Scotland and was declared a National Nature Reserve in September 2001 by Scottish Natural Heritage.

Early legend

The cave was a well-known wonder of the ancient Irish and Scottish Celtic people and was an important site in Irish legends, one legend holding that Staffa and the Giant's Causeway were the end pieces of a bridge built by the Irish giant Fionn Mac Cumhaill to Scotland where he was to fight Benandonner, his gigantic Scottish rival. The Giant's Causeway and Fingal's Cave were indeed created by the same ancient lava flow, which may have, some 60 million years ago, formed a "bridge" between the two sites

The naming to the Cave

Little is known of the early history of Staffa, part of the Ulva estate of the McQuarrie clan from an early date until 1777. The cave was brought to the attention of the English-speaking world by 18th-century naturalist Sir Joseph Banks in 1772.

Staffa, Fingal's Cave

At the time of Banks discovery, "Fingal, an Ancient Epic Poem in Six Books," was a very popular poetic series supposedly translated from an ancient Gaelic epic. The work was a massive hit, and was an influence on Goethe, Napoleon, and Sir Banks, who promptly named it "Fingal's Cave."

Staffa Island from 1,500 ft. Fingal's Cave at SE corner

Distinguished visitors

Though Banks is responsible for both rediscovering and renaming the cave, it would be the lasting popularity of the romantic German composer Mendelssohn's "Hebrides Overture (Fingal's Cave)", premiered on May 14, 1832 in London, which provides a stirring reminder of the wild beauty of the cave.

In 1832 the artist J. M. W. Turner painted "Staffa, Fingal's Cave", showing the cave from the south during windy or stormy weather, with a steam boat close to the cave.

Together the musician and the artist launched the cave from a little known wonder into a must-see Romantic-Victorian tourist site. The three English poets John Keats, William Wordsworth, and Alfred Lord Tennyson each made the journey to Staffa during the nineteenth century. Although there is no record of the effect the island had on Tennyson, the other two wrote graphically about it, Wordsworth in verse and Keats in both prose and verse.

In 1847, Queen Victoria was just one of a large number of celebrities to go to Staffa, and record their impressions of it, as did consummate traveler and lover of wonders, Jules Verne, who wrote: "This vast cavern with its mysterious shadows, dark, weed-covered chambers and marvelous basaltic pillars, produced upon me a most striking impression and was the origin of my book ... 'Le Rayon Vert.'"

Novelist Sir Walter Scott described Fingal's Cave as "... one of the most extraordinary places I ever beheld. It exceeded, in my mind, every description I had heard of it ... composed entirely of basaltic pillars as high as the roof of a cathedral, and running deep into the rock, eternally swept by a deep and swelling sea, and paved, as it were, with ruddy marble, it baffles all description."

Robert Louis Stevenson landed on Staffa more than once when travelling to and from Oban, and knew the island well.

Visiting Fingal's Cave

As part of my research into Fingal's Cave for this article I would have liked to visit the cave in person, but this presented problems. Staffa is exposed to the Atlantic weather, so even in calm periods a heavy swell could make sailing to the island difficult and prevent landing. So it would be necessary to visit when conditions are right, which would take advance planning.

There are regular trips to the island by ferry from Oban to Craignure on Mull, then by tour bus to Fionnphort for a 40 minute boat trip to the cave.

Getting from Dublin to Oban would involve flights to Glasgow, Edinburgh or Inverness, then travelling on by car hire or by tour coach. In my case this would involve a minimum four day trip which would be unacceptable considering my caring duties. This coupled with the possibility of a sudden change in weather could mean that despite travelling to Oban, the trip to Fingal's Cave might have to be cancelled.

Possible alternatives

I had given up hope of ever seeing Fingal's Cave, then I thought of the 1980's and the 1990's, when as part owner

Landfall: Islay 5 miles @ 5,500 Ft.

of a light aircraft, I flew a to many places in the UK and flying to Oban would not have been a problem. When weather conditions or complex aircraft movements would test my limited flying experience, my friend Bobby Power who held a full commercial license flew with me as pilot in command. We had many pleasant flights to the UK, the Channel Islands and to France.

Bobby continues to fly commercially and also runs the very efficient Leinster Flying Club, using a two seater Robin 200 single engine aircraft from the club's private landing strip at Trevet near Ratoath. As an associate member of the club, I rang Bobby and asked him if he had ever flown to Oban. Ask a silly question? I explained where I would like to go. We met, he took all details and promised to get back to me.

A few days later he came back to with a meticulously detailed plan for a 3 day, two night trip to include a visit to Fingal's Cave. I wanted to make the trip, Bobby was willing, so it was agreed that Bobby would book all the various factors necessary in his name, with subsequent settlement later.

With a 3 day period of sailing and flying weather forecast, flights were arranged for Wednesday to Friday June 10th to 12th.

Wednesday June 10th. The Trip

The Robin HR200 cruises at 95-100 knots (109-115 mph). Full fuel gives an endurance of over 5.5 hours but it would be necessary to reduce the fuel quantity when carrying luggage and gear. By refueling at Islay, we had more than enough on board for any sightseeing around Mull, with reserves to divert to other airfields if necessary due to weather.

Accordingly, the journey was planned as four flights: Trevet to Islay airport, Islay to Glenforsa airport on Mull, returning Glenforsa to Islay and Islay to Trevet.

The flight plan was filed with Shannon Control on the Tuesday prior to the trip, and the returning flights were filed with Scottish Information. The transponder was set at 7000, where it would remain unless a different setting was requested by a flight control. Radio contact with Air Traffic Control was maintained throughout with Shannon until we passed into Scottish airspace, and with Scottish information until we approached Glenforsa.

After take-off from Trevet and a climb to 5,500 ft., the first track was to Dungannon to the west of Lough Neagh, and opposite Belfast International Airport, then direct from there to Islay Airport. The track crossed the Antrim coast just east of The Giant's Causeway towards Mull of Ora, some 30 miles away. Misty skies meant that Islay Island was not visible until we were about 10 miles away.

With a light headwind we landed on runway 31 at Islay airport for refueling

From Islay we flew over Colonsay, and over Mull just east of Fionnphort, direct to Staffa, descending to 1,500 ft., to take photographs of the Island, then tracked eastwards to Glenforsa airstrip (near Salen on Mull), where we landed on runway 26, and parked the aircraft until our return trip on Friday.

The Island of Mull

The Island of Mull has a mountainous core with various peninsulas, which are predominantly moorland, radiating from this center. Tobermory, the capital and the only burgh on Mull is located in northeastern part of the island, and ferries from this port were for many years the sole connection with mainland Scotland. This changed with the construction of port facilities at Craignure in 1964, facilitating tourism, which is now the mainstay of the island's economy.

Glenforsa Airfield first opened on 13th September 1966. Built to complement the small

The Cave itself is entered by a narrow ledge, guarded by a handrail.

cottage Hospital in Salen, its main reason was to act as Mull's only fixed-wing air ambulance evacuation facility. Since 1966, an average of one patient a month has been airlifted from the strip, mainly by Britten-Norman Two Islander aircraft, and daytime Scottish Air Ambulance helicopters. For twelve years the airfield was licensed by the Civil Aviation Authority when Loganair operated a daily summer service from Glasgow to North Connel (Oban), Coll, and Mull. The improved ferry sailings from Oban to Mull - six daily - probably contributed to the termination of the air service in 1980.

An average of five hundred light aircraft visit yearly

Island transport

The local bus transport, operated by West Coast Tours Ltd., connect Craignure with Tobermory and Fionnphort on the extreme south west point of Mull. Armed with a full schedule of this bus service, we travelled to the Craignure Inn, where we were booked in for two nights.

Thursday June 11th

We boarded the 8-30 bus to Fionnphort

The road network on Mull leaves a lot to be desired. Apart from the Tobermory-Craignure Link, the rest of the roads appear to be single track, with single vehicle length passing places, every 200 to 300 meters apart.

These are marked by black and white 2 meter posts, and the restrictions imposed on traffic, seem to be generally accepted with courtesy, with no strident blowing of horns. We noted only one motorist having to (voluntarily) reverse a short distance to a passing place.

The road from Craignure to Fionnphort is tortuous, with bridges so narrow that speeds reduced to a crawl, with two round trips per day considered a day's work for the bus driver.

Fionnphort Harbour

Taking advantage of the spell of fine weather there were a number of small craft, each carrying 20 to 30 passengers, running a shuttle-like service to Staffa.

The approach to the island is most impressive, with the boat stopping just opposite Fingal's Cave. There were cameras of all kinds aimed at the cave as the passengers jostled for a good view, everyone on board striving to get a clear shot of the famous cave.

There is no landing place at the cave, so the boat sailed on to Clamshell Cave, some 400 meters to the east, where a steel and concrete landing stage had been constructed by The National Trust for Scotland in 1991.

From there a rough trek, just above high tide level across to Fingal's Cave, which involves stepping from the top of one basalt column to the next, in places assisted by a handrail affixed to the vertical cliff face.

Having seen and photographed the island and the cave, I had decided not to go any further on account of my age, but I was persuaded, and guided by Bobby to venture the hazardous trip over to the cave.

Short final approach to Islay's runway 31.

Fingal's Cave

The cave is most impressive in its scale and atmosphere and the remarkable symmetry of the 227-foot cavern. The cave, formed by the storms and gales of aeons which shattered the columns, leaving the remaining bottoms of the columns as a naturally arched roof; between the angles of which a yellow stalagmitic matter had exuded.

The air in the cave, being stirred backwards and forwards by the action of the tides, is dry and wholesome and free of the damp vapors in most natural caves.

The peaceful sounds produced by the lapping of the water, give it the atmosphere of a natural cathedral, with the hexagonal columns of basalt looking like a huge organ. Curiously the gentle lapping of the sea into the cave on the day, was a contrast to the violent stormy thunder which must have inspired Joseph Turner's painting. However, I realised that on a stormy day as described by Turner, sailing to Staffa would be impossible and the nearest I would get to Fingal's Cave would be Fionnphort harbour.

The visit was a very satisfying experience and a wonderful climax to all our efforts.

The return to Fionnphort and the bus ride back to Craignure gave us a chance to unwind and to discuss our impressions of the visit.

Friday June 12th.

We took the 11 am bus to Glenforsa, where with all pre-flight checks on the aircraft completed, we left the airstrip on track to Morvern, climbing to 3,500 ft., to take some pictures of Glensanda Quarry, where major redevelopment had been recently made. Then we flew to Lismore lighthouse and from there, as Lima Golf was heading south, skirting the western coast of Jura towards Islay, I reflected that the visit to Fingal's Cave had been completed against all odds, and that I could sit back and take an interest in the actual flying of the aircraft.

The instrument panel showed the familiar dials, which included engine dials showing rpm, fuel level, oil pressure and oil temperature gauges, and also the flight instruments, most importantly air speed indicator, the artificial horizon, vertical speed indicator, altitude and the direction indicator, which was pointing directly towards Islay airport.

I quietly monitored these instruments until Bobby started a gradual right hand descending turn onto Islay airport, where I mimed the never-forgotten pre-landing check list:

Brakes off, undercarriage down, mixture rich, carburettor heat cold, trim set for landing, hatches and harness secure.

After refuelling we took off on the same heading, took a left hand climbing turn to 5,500 ft., on a heading direct for Dungannon . The rest of the flight was pleasantly routine, with a gradual descent to a right hand downwind heading for Trevet's runway 22.

A gradual right hand turn over the M3 and an ultra- smooth landing brought our very successful trip to a close. The total flying time was 4.8 hours

After landing I thanked Bobby sincerely for his technical expertise, his unfailing attention to detail, his enthusiasm and his help in making the trip such a valuable experience.

His reply was typical Bobby Power:
"I enjoyed every minute of it"

Editor's note: All pics except the representation of Turner's painting were taken by B. Power or by the writer

Roof of the cave.

One can go no further into the cave.

Dr. Yvonne Scannell

Environmental Law

Dr Yvonne Scannell, a long term member of the Society, has just retired from the Law School in Trinity College to (as she says wryly) "pursue other interests."

Yvonne was educated in Trinity College Dublin, Cambridge and Paris Universities and the Kings Inns. During her career in Trinity, Yvonne hugely influenced the development of Planning and Environmental Law and wrote seven books on these subjects. Her work has been cited numerous times in the High Court and Supreme Court and it was cited by the Supreme Court to declare unlawful practices by planning authorities (requiring developers to provide free rights of way through lands) illegal.

In recent years, she has branched into Regulatory law generally and is a recognised international expert on EU environmental and natural resources law for which she has won international awards. She has lectured judges all over Europe and China on EU Environmental law and was invited to do a workshop with the Supreme Court of China last year. She has consistently been rated as one of the top environmental lawyers in Ireland and she has been involved in many of the great environmental law cases in her capacity as a consultant to Arthur Cox, Solicitors where she is currently located.

Yvonne is a long time director of Boliden Tara Mines and she has great insights into the practical aspects of mining and quarrying. She has served on the boards of several public companies including CIE, Coillte, Whitegate Oil Refinery and the Irish National Petroleum Corporation. She was recently elected a judge and Vice President of the European Nuclear Energy Authority, a role which she notes jocularly indicates that the world is in safe hands.

Those who have worked with Yvonne always note that underneath her somewhat serious demeanour lies a very developed and irreverent sense of humour. She is forthright and honest in her advices. Asked what the highlights of her career were, she states the improvement in the quality and accessibility of third level education and the increasing professionalism of the Irish workforce. Her greatest disappointment is with the variable quality of public administration at national and local levels. Some public servants are excellent but many are not and industry is required to bear the burdens of an inadequately qualified and resourced public service and the most convoluted and opaque legal system in the common law world. She is astonished at the failure of industry (with the exception of the agricultural sector) to insist on better standards of regulation and service and disappointed at the failures of most Ministers and many civil servants to take a genuine interest in improving the systems they are administering. She says the most exciting part of her career has been discovering and nurturing real talent in the University and legal practice and advising and winning arguments and cases compelling public authorities to abide by the rule of law. A particular bugbear is the inefficiency and expense of the judicial system which she says is badly in need of reform. But she thinks nobody will provide resources to study the way it operates properly and to devise a less expensive and fairer one.

Asked about her future plans, Yvonne says that she is on the visiting faculty of several international Universities which she visits regularly and she plans to do more hill walking and spend more time with Arthur Cox, "the best environmental law firm in Ireland". She says she would go mad "doing nothing" but if anyone wants to do a TV series with an Irish Judge Judy, she wants to be Judge Judy!

Padraig Connaughton
Reminiscences

By Padraig Connaughton (recently retired as Chief Superintendent of Cartography, Geological Survey of Ireland)

The Geological Survey of Ireland (GSI) was founded in 1845. When I joined in 1970 it was 125 years old and 14 Hume Street had been the headquarters for the past 100 years.

During the 1800s the GSI's geologists perfected the art of detailed regional geological mapping on the 1:10,560 scale. The results were published on the 1:63,360 scale and the maps were accompanied by explanatory memoirs. Following this, the Survey entered a long period of decline and stagnation until the 1960s when Ireland was found to contain significant base metal deposits. This led to a revitalisation of the Survey under the Directorship of Dr Cyril E. Williams who was appointed in 1967.

By 1970 there were 14 geological staff in place and I joined three other staff in the drawing office. The full complement of staff included administrative, typing, telephonist and Hughie the doorman. Our office was situated in a back room on the top floor of the building.

It was a well-stocked office with adjustable drawing boards, Rotring Rapidograph drawing pens, lettering stencils, rulers, dividers, magnifiers, opaque brushes, X-Acto knives, burnishing tools, and leather-covered weights which rounded out most of the tools required for cartographic preparation.

At this stage Letraset was used for nearly all lettering. This is a dry transfer system perfected in the 60s where each letter is rubbed down and applied separately. Tracing paper was little used and in these early years the drawing medium most used was Kodatrace from Kodak. We were also using an assortment of scribing tools used to engrave or remove the yellow-coloured emulsion on mylar known as Scribecoat. Basic three-legged metal/plastic engraving tools, using different size needles as scribing points were developed into an array of specialized tools with attached magnification lenses, some had swivel points, ideal for scribing smooth, flowing lines. In 1970 the lack of photographic and reprographic facilities limited our use of some of these materials.

By late 1972 the three other drawing office staff had left and been replaced. The Survey now had a Geological Staff of 23 and a second premises was made available at 4 Kildare Street. The Cartographic unit was one of the sections to move.

In October, I was shipped off to the Geological Survey of Canada where I spent the next five months learning all I could about map production. Here I was introduced to a new world of darkrooms, developers, fixers, registration of film layers, Cromalin Colour proof system and a host of reprographic and photographic techniques.

In 1973 Amos Walsh was appointed Superintendent of the Unit. During the 70s we invested heavily in photographic/reprographic facilities. Darkrooms were constructed; a Dainippon 450-E-ST-E process camera, Cromalin Colour proof system, and a large Dyeline machine were purchased and installed. Ray Weafer and I attended a training course in Antwerp organised by Agfa Gevaert who had won the contract to supply us with photographic material. This training was for ourselves and several Agfa Gevaert Sales Reps from around the world. For our part, we explained what we were trying to achieve and produce, they then proposed options and the facilities in Antwerp taught us all how to utilise their films to the best effect. Throughout this time we continued with staff training but unfortunately, most left for private industry. John Dooley and Eddie Hand were two who stayed.

In the early 80s we had a new group of trainee Cartographers some of these are still with us, Marie Marini, Anne Scanlon, Eddie McMonagle. In 1984 The Survey which was now scattered around 4 offices, Hume Street, Kildare Street, Baggot Bridge House and Bishop Street moved to the new custom-built offices in Beggars Bush. All the equipment we had purchased was carefully dismantled, transported and reinstalled in specially designed facilities in

Beggars Bush. At this time we also installed an automatic film processor. We were now in new premises, well equipped and trained with nothing to stop us. Except? What base map to use for a national series? The 50k was deemed the best but not produced yet by OSi. The possibility of producing our own base was investigated but proved too time-consuming. In the end it was decided to use the half-inch base enlarged to 100K.

In the mid 1980s I visited the Geological Survey of Norway with John Dooley followed by a visit to the Geological Survey of Austria with Ray Weafer. Then, in the late 80s Amos Walsh retired as head of the Unit just as the first 100k map was in planning. This was a shock to the office

Dainippon Process Camera

but we continued with the preparation for the first 100k sheet. In 1989 I was promoted to Superintendent. In 1991 it was decided by departmental management to have another review of the GSI (there had been a review in the 80s) this ran for about a year. During this time the Cartography Unit was steadily working away on 7 1:100,000 scale maps, one for the Geological Survey and 6 for Chevron.

1992 was mixed for me, I was diagnosed with cancer and underwent chemotherapy for the rest of the year, but with everyone working together, we finished and published all 6 sheets for Chevron and we published sheet 6 North Mayo, the first of the national coverage at 1:100,000 scale. The review concluded and we learned that sheet 6 was the only sheet we would ever publish by conventional methods. In future map output would be digital.

For most of you today that may not seem like a big deal but at that time we, in Cartography, had one PC which had been provided to me a year or two earlier. When I got it I was told it was the fastest in the house with the largest hard disk 32MB and the most RAM 4Mb but it had that new Windows operating system, it would be ok for keeping records but we would never be producing maps on it.

The Survey now had to decide on a computer system to produce maps and after much investigation, Arc Info was selected with lots of bells and whistles to make them look like maps. In Cartography we were fortunate that Archie Donovan and Eddie McMonagle had themselves embarked on a degree course in computer science so when the manual said "hit any key" they knew where to find it! Archie, Eddie Mc, Eddie Hand and Anne Scanlon formed the backbone of the Unit's digital map production. John Dooley, Ray Weafer, Marie Marini and Gerry French (who had transferred from Osi) took care of the desktop publication needs.

The Bedrock programme continued through the 90s with the first digitally produced map, Sheet 23, published in 1994. Probably because we were so late coming to the digital arena we were, for a brief time, at the forefront of desktop mapping. In the next years we were visited by other organisations to see how we had done it.

The last sheet of the series was produced in 2003 (the final Reports came later). It took a bit more than the 7 years the Review had set, but it was a much better product. Originally the review had required a monochrome map with codes and an accompanying text which would be Xeroxed.

In 1998, I was promoted to the new post of Chief Superintendent. The late 90s saw the introduction of the Seabed Survey, during the early phase Archie Donovan, Mary Carter, Deepak Inamdar and myself visited the University of New Brunswick in Canada and Woods Hole Oceanographic Institution, Cape Cod, USA. With Bob Aldwell I also visited St John's, Newfoundland where a contract was signed with the Canadian Centre for Marine Communication (CCMC) to provide assistance. By 2003 staff losses found me with the job of liaison on building management. Many of the staff professional and technical who had worked in GSI during the Cyril Williams period (1967-87) had retired (or passed away) and by 2010 most of our management team had retired. It was at this time I inherited the job of managing the Archives.

During my time in the Geological Survey of Ireland I worked for about seven different Departments. I served with three Directors, five Assistant Directors, countless geologists, technicians, administrative and contract staff, totaling in excess of 1000 people. Although there were highs and lows, I have no major regrets for the 45 years I spent in the Survey. I always considered myself as a cog in the wheel and if I was occasionally instrumental in greasing that wheel, then job well done. Over the years I worked directly with 27 staff in Cartography but I have spent more time with the seven I leave behind than anyone else. They were great to work with and everything I achieved was with their cooperation, dedication and expertise.

Padraig Connaughton, GSI
Chief Superintendent (Retired)

Beggars Bush, Geological Survey of Ireland headquarters since 1984.

Eugene Hyland Mine Geologist

by Jim Geraghty, Chief Geologist, Boliden Tara Mines

Following a career of thirty seven years in industry, with over thirty of those as a Geologist at Tara Mines, Eugene Hyland decided to throw in the hammer and retired in mid-2014.

Eugene graduated with a BSc. Hons. from UCD in 1974. He then went on to complete a Higher Diploma in Education in 1975 and subsequently spent two years in the teaching profession.

He joined Tara Mines Ltd. in 1977, then owned by the Noranda Corporation, and stayed until 1980. During those early exciting days at Tara, Eugene was involved in the surface and underground delineation of the orebody. He left Tara in 1980 and worked for Minerex Ltd until 1985, spending the latter three years of this period working on the Navan orebody as a Project Geologist. He returned to work for Tara in 1985 until his retirement from his position as Senior Geologist in 2014, during which time he saw Tara's owners change from the Noranda Corporation to Outokumpu to Boliden, the current owners.

It was a privilege to have worked with Eugene in Tara over the years. He is a great orator and had many stories to tell of life's experiences. One could write a book on the excursions that took place to Mrs. O'Connell's in Skryne in the early days of Tara. Most of the stories are best left out of print.

He is a long standing member of the Irish Mining and Quarrying Society (IMQS) and the Irish Association for Economic Geology (IAEG) and was a regular attendee of the weekend courses. The most memorable of these was his table top performance in Bunratty Castle in 1989.

Throughout his career, Eugene

was a great communicator and had a remarkable ability to listen and explain issues in great detail. There are a lot of young (and older) Geologists out there working in industry and academia that have benefited from his professional attitude and teaching ability.

We all wish Eugene the best of luck in the next phase of his life, knowing that if we need advice or information he would only be too happy to oblige.

John Grennan Mine Safety

by Brian Crinion, Health and Safety Manager, QME, and Mike Lowther, Manager of Mining, Boliden Tara Mines

Being a member of John's Safety Team at Tara Mines was an experience and a privilege.

The photo shows John deep in Lundin's Neves Corvo Mine in Portugal, judging the Search and Rescue exercise at the inaugural European Mine Rescue Competition in May 2015.

His vast knowledge in the mining industry coupled with his leadership and steadfast commitment to the enhancement of health and safety standards in the industry will be difficult to replace.

Throughout his term as Safety Superintendent he has seen many changes, not least in the ownership of Tara Mines, from the early days of Noranda Corp. through Outokompu and current owners Boliden, but also in the advancement of mining technology, changes in safety legislation and changes to his team.

He was and still is a great communicator with an admired rare ability to try to understand and appreciate the alternative viewpoint.

During such occasions of consideration John would be observed fastidiously tugging on the right side of his hundred-year-old mustache, in a trance of deep though, before moving on to the next question, proposal or suggestion.

Perhaps his many personal and team battles on the rugby fields of Ireland and beyond, primarily with Rockwell College and for many years thereafter as Hooker for Drogheda RFC, helped to develop this young man's skills and made him, as they say "into the man he is today". To have been his Tight or Loose Head or Lock, or stand in the line-out (before lifting was permitted) must have been, for the most part, as enjoyable an experience as it was working with him, unless of course you were the opposition.

John has also given years of commitment to the development of Mine Rescue, initially at Tara Mines, and then as one of the founder members of the Irish Mine Rescue Committee in 2003. He served as Secretary for 12 years. Through this he has overseen the development of great mutual cooperation between all Irish mines, north and south, the respective regulatory authorities, and the Irish Air Corps. He has been central to the development of the All Ireland and UK Mine Rescue Competition, and even in retirement continues to give his all.

Johnnie may have hung up the boots with the studs but I have a feeling that the working boots, in a Mine Safety Coaching capacity, have much more ground to cover.

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Brendan O'Reilly Environmental Scientist

by Oliver Fitzsimons, Environmental Engineer, Boliden Tara Mines

You could say that Brendan O'Reilly was born with the industry in his blood.

His uncle, Matt Gilroy, who travelled the world in search of minerals and his fortune returned to Ireland to begin what was soon to become one of the world's largest lead and zinc mines.

In the early 1970s 'Barney' O' Reilly left his native Fermanagh in search of work at a time of political turmoil in Northern Ireland. He followed his uncle Matt to Co. Meath but didn't seek, nor receive, preferential treatment. That's not his style. He was given 'a start' with the then fledgling Tara Exploration and Development Company joining such company luminaries as Pat Hogg, Tom Donohue and Dessie O' Brien.

After a short stint in the exploration department Brendan found his roots in the environmental department's nurseries. Thousands of trees were planted then replanted as part of the extensive landscaping plan. At this stage in his life Brendan cared more about the 'craic' than in professional development. Navan, then a sleepy rural town, was awakening to the mining bonanza and money, jobs and young people flooded the town. If there was a party, and there were many, Brendan was at it. Brendan remained in the environmental department, outgrowing the nursery to become an expert in the fields of acoustics and seismology and later to lead the environmental department. He qualified with a master of science and has contributed to research and industry guidelines.

However, through it all his real passion was Gaelic football. Some would say his first love; but I know this right is reserved for his wife Rosemary and sons James and Aaron. Football and the GAA community was the fulcrum in Brendan's life. As a young man he played for Fermanagh and his beloved Teemore Shamrocks with his three brothers. His role of honour is measurable against any of the games greats. 'Barney', as he was known, graced the pitch over four decades

Picture above was taken C.1980 at the then 'state of the art' noise and vibration monitoring equipment. Ollie Fitzsimons

remarkably winning county honours in all four (Five senior county championships with Teemore, the first in 1969 and a further four with Navan O'Mahonys, the last in 1990).

Brendan has long been a member of the IMQS. He is widely known and respected in the industry. In well over 40 years of service to the industry Brendan has witnessed it all. He would often quip; "you could write a book about it". And maybe he should!

The late Tim Heeran-an appreciation

Tim, a Chartered Mechanical Engineer with a worldwide experience in the mining and quarrying field, passed away peacefully on March 18th last.

Tim was born in Leitrim one of twelve children. He married Loughrea-native Mary Devine, in 1968 and they eventually settled in Mallow. They have 3 daughters, Janet, Stephanie and Susan. He was also the indulgent grandfather of Lizzie and Tadhy.

His career included employment as an engineer in Gypsum Industries, Tynagh Mine, Gortdrum Mine, and P.D. Buckley & Sons, Mallow. He was M.D. of LMH Engineering from 1972-1993.

During his working career, as an engineering consultant and trouble shooter, he visited many different plants throughout the world with large and small conveyors and processing plants.

These included the Tar Sand Project in Alberta, the Minnesota Taconite Mines, Port Talbot Steel works, a Steel Works in Libya, a coal burning power station in China, coal mines in the UK and many quarries in France.

He was a great admirer and friend of the late John Yeoman, who invited him to lead off the design and layout of Phases 1 and 2 of the his Super Coastal Quarry in Glensanda in Scotland.

After John Yeoman's untimely death, he continued to advise Mrs. Angela Yeoman on all technical matters relating to her quarrying business.

Tim was a valued member of IMQS over the years. In May of 1995 he arranged permission for 30 members of the Society to visit Glensanda quarry. He also wrote an excellent paper entitled "Glensanda Super Quarry-From Dream to Reality" for the Extractive Review of 2012, and a further paper on Designing Chutes for the 2014 issue. I had the great pleasure of spending some time with Tim during the writing of these papers and will miss his witty conversation and I am sure we will all miss his knowledge and experience about the design and installation of quarry and mining plants.

I wish on behalf of Siobhan Tinnelly , President of the Irish Mining and Quarrying Society

and the Members of the Council to pass on our sincere condolences to Mary and the members of her extended family. (By Tony Killian.)

IRISH MINING & QUARRYING SOCIETY

Membership Application Form

University College Dublin, School of Geological Sciences, Belfield, Dublin 4
Phone - 01 716 2085 Fax - 01 283 7733
Website - www.imqs.ie E-mail - info@imqs.ie

PERSONAL Details (PLEASE USE BLOCK CAPITALS THROUGHOUT)

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EMPLOYER Details (PLEASE USE BLOCK CAPITALS THROUGHOUT)

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Address _____

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Telephone Number _____ Mobile _____
Work E-Mail Address _____

Correspondence Address (please tick both location to be sent to & by what means)
Home ❑ Work ❑ E-Mail (preferred by IMQS) ❑ Post ❑

Please state association with the Mining or Quarrying Industry: _____
Proposed by: _____ (Existing IMQS Member)

Note: Should the candidate be unable to obtain a proposer who is a member of the IMQS, the application will be assessed by the Council of the IMQS and membership is subject to the approval of the Council. Please send to address above enclosing payment of €40 (ordinary membership). (Membership fees are payable in January each year and are valid for that calendar year).

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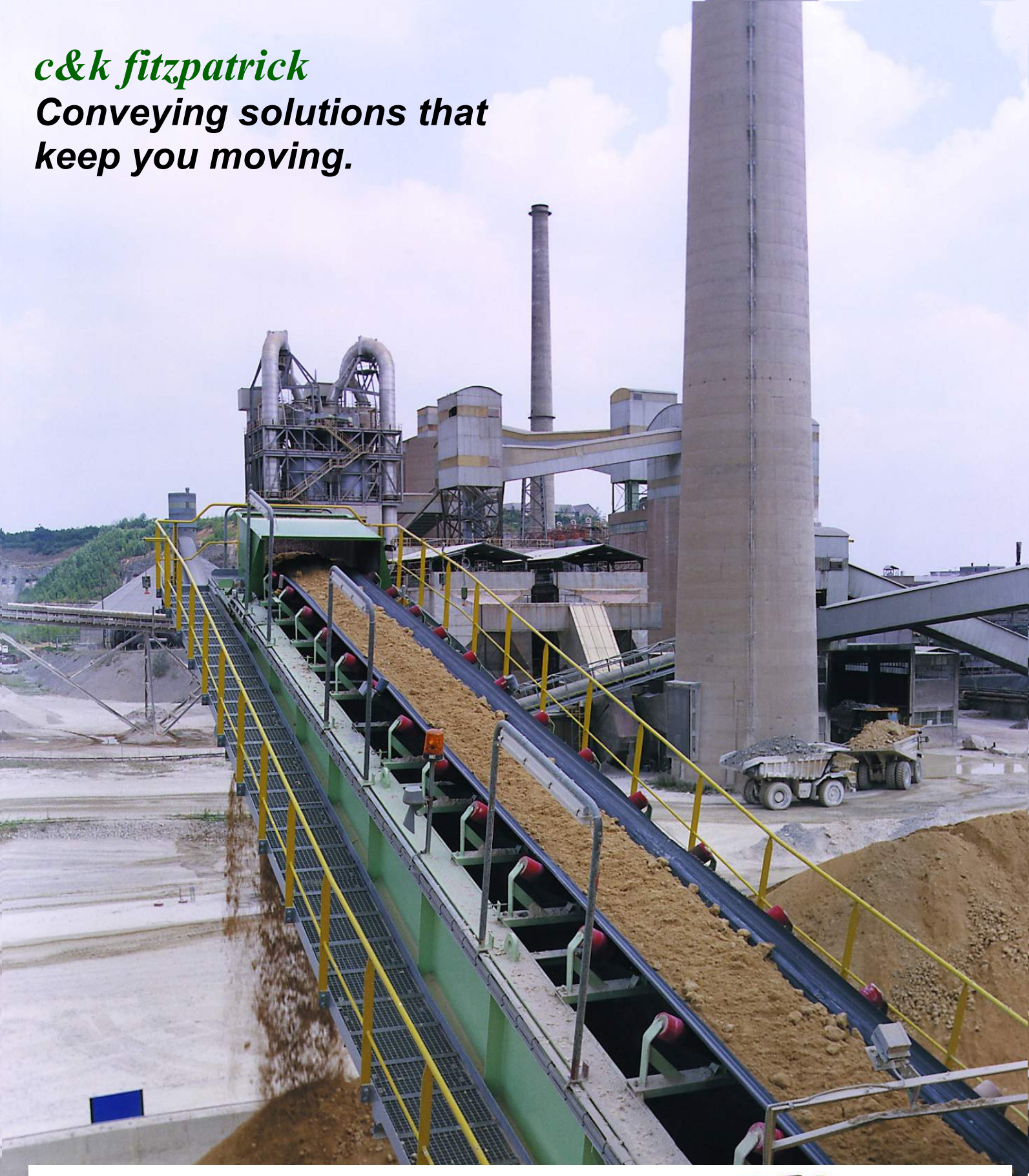

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