Irish Chemical News

The Journal of the Institute of Chemistry of Ireland

Issue No. 4, September, 2016

Feature Articles:- **"Chemistry and law - complementary sciences" Part 1 Revised**

Particle Size Analysis for Process Optimization

Eurachem Ireland Analytical Measurement Competition

ICI Schools Chemistry Newsletter Winner 2015/16

Climate Change

Irish Chemical News

The Institute of Chemistry of Ireland

PO Box 9322, Cardiff Lane, Dublin 2

www.instituteofchemistry.org

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Note: Opinions expressed in this Journal are those of the authors and not necessarily those of the Institute.

A Message from the President

Dear Fellows, Members, Graduates and Associates,

I trust you have all had a pleasant summer break. As we start a new academic year, I hope you find some interesting reading in this, the 4th issue of our Journal to appear in 2016. With this issue, our hard-working editor has reached the target he set at the beginning of the year, so warm congratulations are in order!

It seems all roads led to Cork this summer. The Irish Universities' Chemistry Research Colloquium was hosted by UCC at the end of June and was a great success. https://www.ucc.ie/en/chemistry/chemistry-colloquium-2016/

Now in its 68th year, this is the longest-running event with which The Institute of Chemistry of Ireland has been associated and we were happy to be in a position to provide sponsorship in support of it again this year. The Keynote lecture on atmospheric chemistry and climate change, entitled 'Every Breath You Take' was given by Professor John Sodeau. Since 1998, he has been based at UCC, where he set up the Centre for Research into Atmospheric Chemistry (CRAC Lab). The Professor answers some questions on Climate Change on Page 49 of this issue.

University College Cork was also the venue for a major International Symposium on Chromatography, which has just taken place. http://www.isc2016.ie/ Congratulation to Professor Jeremy Glennon of UCC and Professor Apryll Stalcup of DCU for bringing this important symposium to Ireland.

As mentioned in the Editorial, The Institute of Chemistry of Ireland is sending a delegation to Seville this month, to make a bid to host the 8th EuCheMS Congress in the Convention Centre, Dublin, in 2020. The delegation consists of Pat Hobbs, Professor Thorfinnur Gunnlaugsson of TCD and Noel Mitchell of Keynote Professional Conference Organisers. It is a brave endeavour and I wish them well.

Last year saw the inauguration of a new Industrial Award, which was won by Donal Coveney of TopChem Pharmaceuticals and sponsored by Henkel Ireland.

We are delighted that Henkel has agreed to sponsor the award again this year.

We are accepting nominations at present and the closing date is September 30th, so, if you would like to make a nomination, please note full details are on Page 5.

As happened last year, we plan to hold an awards event in November, which will include the Industrial Chemistry Award, along with one of the Eva Philbin Public Lectures. Members will be notified, by e-mail, of the date & venue as well as the names of the award winners. The details will also be posted on our website, which you are encouraged to visit regularly, in order to keep up to date with our events: www.instituteofchemistry.org

I hope to see many of you at the 2016 Institute of Chemistry Awards!

Margaret Franklin, FICI, President September 2016.

Editorial

This is the 4th Issue in 2016 which is the target I set at the beginning of the year. I will exceed this with another Issue in December.

The Institute has been invited to this year's EucheMS Congress in Seville, to present our bid to host the EuCheMS Congress 2020 in Dublin. We are bidding against five other countries, Israel, Romania, The Netherlands, Portugal & Poland. Our Local Organising Committee Chair, Professor Thorfinnur Gunnlaugsson, Trinity College along with myself will present in Seville on September 14th. Dr Noel Mitchell of Keynote PCO will support us there. This EuCheMS Chemistry Congress is growing in importance, strength and popularity and I urge chemists from Ireland to make the effort to attend. See advertisement in this Issue.

Last October I publish an article by Seán Ó Muircheartaigh titled "Chemistry and Law - complementary sciences. Part 1". In July we received a request from the California Association of Criminalists for permission to publish this article in their journal CACNews (http://www.cacnews.org). Sean agreed to publication in September but decided to rewrite the paper, extend it and include references. In the original paper Professor Duncan Thornburn Burns, whose evidence helped in the release of the Maguire seven, was rather casually described and this oversight is corrected in this new version. As a result Part 2 dealing with the chemistry and interpretation of the TLC tests is delayed but I hope to have it for Issue 5 in December.

The last Issue had a paper on crystallisation and complementing that I have a paper on particle size measurement courtesy of Mettler Toledo by a former UCD, PhD graduate.

The winning paper from the **ICI Schools Chemistry Newsletter Winner 2015/16** is published here. I hope to publish the winner's article next year and future years so this is a great opportunity for chemistry teachers to encourage students to demonstrate their chemistry writing skills.

We also carry reports on the **Eurachem Ireland Analytical Measurement Competition** with an in depth review by the judges and photos of winners and participants.

We have a copy of an interview with Professor John Sodeau, UCC, on climate change and global warming.

The closing date September 30th 2016 for nominations for our Industrial Chemist Award is approaching and please make sure to nominate a deserving chemist or team or yourself if you feel you qualify. See flyer next page.

Following the success last year of The Sustainability Summit this year's National Sustainability Summit 2016 will be held at City West hotel on October 11th and entry is free. You do need to register – see advertisement in this Issue.

Just as we go to press there is the good news that the US and China have agreed to ratify the Paris Climate Change deal. A report courtesy the Guardian is included.

You can send these to The Editor at:-

mailto:info@instituteofchemistry.org

Patrick Hobbs MSc, FICI, CChem, CSci, MRSC.

Editor ICN,

Immediate Past President.

Institiúid Ceimice na hÉireann
Institute of Chemistry of Ireland

Henkel Excellence is our Passion

The Institute of Chemistry of Ireland
Industrial Chemistry Award 2016
Sponsored by Henkel Ireland Ltd

This award has been instituted to recognise the achievement of an individual chemist, or team of chemists, for making a significant contribution to the chemical or pharmaceutical industry in Ireland

1) **Eligibility (Membership):** FICI, MICI (applicant who is not a member can apply for membership at same time, but membership process including entry fee and payment for first year must be completed by closing date for award).

2) **Eligibility (Industry Award):**

a) Employees, a group or principals of the ***chemical, pharmaceutical industry, and related sectors on the island of Ireland, involving work substantially chemical in nature (consideration will be given to self-employed and service sector entries)*** that can clearly show support of industrial chemistry functions.

b) A **Group** or **Team** may be nominated provided at least one member of which is a Member or Fellow of the Institute or whose company/employer/organisation is a member of the Institute and who has played a principal role in the team. This Chemist will be nominated by the team to accept the award on behalf of the group.

c) Current members of Council are not eligible.

d) For former Council members to be eligible, a period of 3 years must have elapsed since the end of their term on Council.

e) Employees of Henkel Ireland and its subsidiaries are not eligible (while Henkel Ireland is sponsor).

3) Application must include:

a) 2-page general CV. Candidates may self-nominate or be nominated by their company or organisation.

b) List of publications (3 most significant to be at the top *i.e.* ones the applicant considers best supports their case for award or list of up to 5 significant contributions of the applicant(s) to his/her/their industry based in Ireland accompanied by confirmatory evidence. Such evidence might

include technical documents, patents, journal articles, contribution to formulation of industrial standards etc.

c) Brief summary of research/investigational work/developmental work and its particular value (*i.e.* why applicant considers themselves worthy of award).

d) Brief summary (400 words) of article for ICN should applicant be successful (for consideration, *inter alia,* by editor of ICN).

e) Names of 2 referees prepared to support application (and their connection with/knowledge of applicant, including length of time they have known applicant), one of whom (at least) should be FICI/MICI or Fellow/Member of an EuCheMS chemical society (these referees should write a statement of support of 250-400 words to be submitted by the same deadline as applicant).

4) Confidentiality: Applicant should make clear any issues of confidentiality concerning their application, but are advised that any independent adjudicators will only be considering the material for the purpose of award adjudication, and such adjudicators will not be connected with the applicant's employer/organisation.

5) Adjudication: possible shortlisting by ICI sub-committee (depending on the number of applicants, with proviso that sub-committee members initially declare any conflict of interest with respect to applicants) … then an independent panel (2-4 persons) and should include a Council Member, an FICI with an industrial background and a senior representative of the sponsoring organisation. Each to be checked for conflict of interest with respect to group they are adjudicating on *i.e.* in respect of all applicants, or in respect of shortlist, as relevant; panel to carry out their work via correspondence, with tele- or video-conference if necessary.

6) Prize: **a) Award Certificate + b) Memorial Trophy + c) €1000**. The candidate will be required to give a Public Lecture and contribute an Article to ICN. The award will not be arranged until prospective Awardee has agreed date for the lecture and supplied the article for ICN. The Lecture would coincide with date for the formal ceremony for Award.

Awardee's organisation to get free company membership for 1 year (if not already a company member).

7) Publicity: Awardee to provide reasonable assistance to advance publicity for award ceremony, and publicity arising from it; sponsor to be consulted on format/timing and venue of Public Lecture & Award.

Closing Date for Nominations Friday 30th September 2016

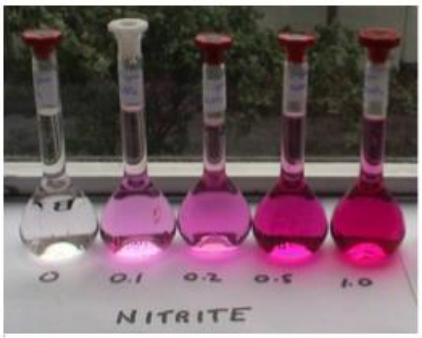
Inquiries can be E-mailed to: - info@instituteofchemistry.org

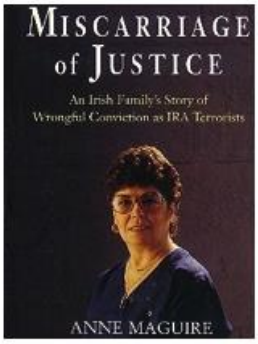
Check website: - www.chemistryireland.org

Again we thank our Sponsors:-

"Chemistry and law - complementary sciences"

Part 1





Seán Ó Muircheartaigh, B.Sc. PhD., MBA, LLB, F.I.C.I., retired lecturer RTC Galway / Galway Mayo Institute of Technology*

Introduction:

The general circumstances surrounding the Maguire case may be seen in the BBC video available on line.[1]

In the early seventies there was a series of criminal cases in Great Britain (including the Birmingham Six, the Guildford Four and Judith Ward cases, not considered in detail here) in which persons, predominantly of Irish origin, were convicted of terrorist offences. Many of these convictions were subsequently, indeed very much later, quashed and seen as miscarriages of justice. When Gerry Conlon of the Guildford Four was being questioned in 1974, he implicated his Aunt Annie Maguire saying she had taught him to make bombs in her kitchen. "*Later that day Gerard Conlon made a further statement in which he allegedly named Annie Maguire as the person who had shown him how to make bombs*" [2] This allegation triggered a police raid on the Maguire house and resulted in the arrest and trial of the seven persons subsequently tried and convicted..

This paper reviews the legal processes, reports, and use of forensic science involved. The Maguire Case continued from 1974 to 1991 in the London Courts. First the Maguires were tried before a judge and jury in the Central Criminal Court at the Old Bailey in March 1976 and were convicted and given long prison sentences. The Court of Appeal upheld most of that decision in 1977. Three law lords (senior judges) sitting in one court in the final appeal, which resulted in mounting doubt about the forensic evidence (1991) quashed their convictions, nevertheless in a manner which seems to the authors incomplete. At least seven forensic and analytical scientists, as highly qualified and experienced as any in the world, assisted the courts and subsequent inquiries in their deliberations.

Important details of the trials and inquiries.

These judicial proceedings were initiated in 1974. This was a time when a series of random bomb attacks on civilians was being carried out by the Irish Republican Army (IRA) and which killed many people. Several other similar instances of trial and imprisonment in England, following upon bombing outrages, at around that time, gave rise to some disquiet, which was publicly aired by a few prominent citizens.

The British Home Secretary then engaged the Rt. Hon. Sir John May (a retired judge from the court of Appeal) to carry out a Judicial Inquiry into "all aspects" that lay behind the conviction of the Maguire and Guildford Four cases in 1989. Three reports were produced [3]. Not only was the science that lay behind the convictions dealt with in detail, but also the mechanisms by which the case came to be initiated by the Law Officers and the Home Office were examined. This comprehensive Inquiry concluded there had been a miscarriage of justice. As part of this Inquiry, Sir John appointed a

scientific committee (the West Committee) under a very experienced scientist - Professor T S West, and representing many of the senior professionals involved in the trial (prosecution, defence, Home Office, independent experts etc.) to investigate the science. His first two reports are online and deal with the Maguire case. The Inquiry was very thorough and cost the British taxpayer £2.14 million. This published data makes *Regina v Anne Maguire and others)* [4] one of the most documented and in that regard important forensic cases known.

Background:

[May Inquiry Section 1.9 interim report] [5]

> "*I write this report against the backcloth of a continuing terrorist campaign in the United Kingdom and Europe by the provisional IRA. In 1990 the campaign has already claimed 32 lives. In 1974, when the Guildford Four and the Maguires were arrested, 45 people were killed in Great Britain alone as a result of similar terrorism."*

The following are three of a long list of atrocities which were carried out around this time and were linked (at least in the public mind) to these cases which may have motivated the authorities to be seen to be very active in pursuing the culprits:

- 5th October 1974 Bombs went off in Guildford and Woolwich killing 4 soldiers and injuring 44; (Guildford Four convicted for this attack)
- 21st November 1974: Birmingham pub bombings – 21 killed and 182 injured; (Birmingham Six accused of this and subsequently convicted)
- September 1973 / February 1974 ; Eight soldiers and 4 civilians killed in M62 coach bombing (Judith Ward convicted of this and other atrocities).

A list of terrorist attacks in the UK in 1970's and 1980's is to be found on the internet. [6]

The Facts of the Maguire Trial: [7] (from court and inquiry proceedings

> "*On 4 March 1976, in the Central Criminal Court, Anne Rita Maguire, Patrick Joseph Maguire, Patrick Joseph Conlon, William John Smyth, Vincent John Patrick Maguire, Patrick Joseph Paul Maguire and Patrick Joseph O'Neill were each convicted of a separate count charging an offence contrary to S4(1) of the Explosive Substances Act 1883. The particulars of each count alleged that on a day between 1 and 4 December 1974 the defendant knowingly had in his or her possession or under his or her control an explosive substance, namely nitroglycerine, under such circumstances as to give rise to a reasonable suspicion that he or she did not have it in his or her possession or control for a lawful object.*
>
> *The sentences were as follows: Mrs Maguire 14 years, Patrick Maguire 14 years, Conlon 12 years, Smyth 12 years, O'Neill 12 years, Vincent Maguire 5 years and Patrick Maguire junior 4 years' detention.*
>
> *All the defendants sought leave to appeal against conviction and sentence. On 30 July 1977 this court dismissed all the applications for leave to appeal against conviction. Leave to appeal against sentence was granted to O'Neill and his sentence was reduced to eight years. Otherwise the applications for leave to appeal against sentence were refused.*
>
> *On 23 January 1980 Mr. Conlon died while still serving his sentence. All the other defendants have now served their sentences.*"

The Crown's case [8]

" *The Crown sought to establish that each of the male applicants had nitroglycerine (NG) on their hands. For this purpose they relied upon the factual evidence of the TLC* [thin layer chromatography explained in Appendix 1 of this paper] *tests given* [sic] *by Mr. Elliott and the opinion of Mr. Elliott, Mr. Higgs and Dr. Hayes that these results showed that the substance was NG. ....*

... *that the results could not be confused with a non explosive substance which might mimic the results on the TLC……..*

… *" They also sought to show that NG could not have got there innocently, by innocent contamination with some object which itself was contaminated; but must have got there by kneading or handling the explosive.. For this purpose they relied on the opinion of Mr. Elliott and Mr. Higgs that the presence under the nails of traces of NG was only consistent with the latter hypothesis…." "*

…*"The case against Mrs. Maguire was based on the positive tests on the gloves, the suggestion was that she must have used the gloves to handle the NG and this is why her hands were clear*. "

Forensic Evidence in Maguire case

The examination of the hands of the accused on the evening they were arrested was carried out by swabbing their hands with cotton wool containing organic solvents into which traces of chemicals such as nitroglycerine would dissolve. The forensic science procedure involved was to analyse the contents of these swabs, and identify the chemicals, if any, recovered from the prisoners' hands. Thin Layer Chromatography (TLC) was used as the analytical tool.

TLC Results in Maguire Case: [9]

	Dry Swab		Ether Swab		Nails		Paper
	L	R	L	R	L	R	
Guiseppe Conlon	–	+	+	+	+	+	+
Shaun Smyth	+	+	+	+	+	+	+
Patrick O'Neill	–	–	–	–	+	+	+
Paddy Maguire	–	+	–	–	+	+	+
Vincent Maguire	–	–	–	–	–	+	+
Patrick Maguire	–	–	–	–	–	+	–
Annie Maguire	–	–	–	–	–	–	–
John Maguire	–	–	–	–	–	–	–

The first (dry) swab is designed to remove material from the surface of the hands. Any recent handling of explosive will be picked up on the swab unless the hand has been very thoroughly washed. The second (ether) swab is designed to draw out material which has been absorbed subcutaneously because explosives such as NG are readily absorbed under the skin.

A positive "+" sign in the above table indicates that a pink spot corresponding to a significant amount of NG was detected.

Description of positive spots: [10]

"*The evidence was to the effect that the pink spots had a similarity of colour across the plates. It was suggested that it would be remarkable if each tested area of the hands and nails produced the same quantity of NG. This matter was not explored at the trial when more accurate recollections would have been available. But as we have explained the test is not a quantitative one: similarity of colour to the standard means a quantity of approximately 200 to 1000 ng. After that the spot becomes more diffuse, and possibly will have a yellow centre. It is not possible to conclude that precisely the same quantity was found at each source. Both Mr. Higgs and Dr. Hayes, and no doubt Mr. Elliott too) were surprised at so many positives, but this is because on field tests, as opposed to experiments with HTK's (hand test kits) were rare. We do not think this point casts any doubt on the integrity of the tests.*"

A thin layer plate of nitrite (NO_2^-) standards was run to investigate this observation. TLC analysis of NG is a difficult technique to get quantitative results and is quite unsuitable as a definitive (as distinct from a screening) analytical technique. (The chemistry will be discussed in part 2.) The high volatility of NG does not help, and anyway, particularly in 1974, the preparation of the plates was not an exact science either. However, from the point of view of this paper it is adequate to do an illustrative experiment on standards of nitrite to observe the colour formation. It is accepted that NG is converted stoichiometrically (i.e. in a one to three ratio) to nitrite in the analysis.

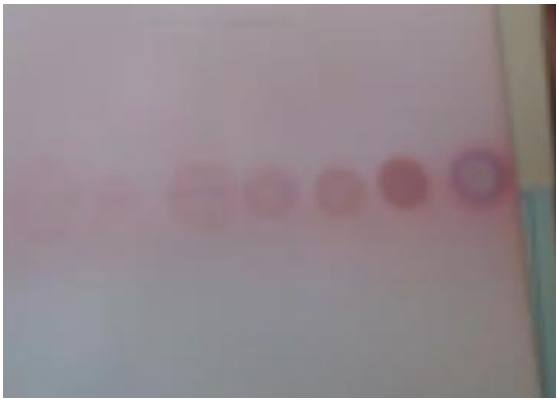


Fig 1 Note how pink colour has yellow centre at higher concentration

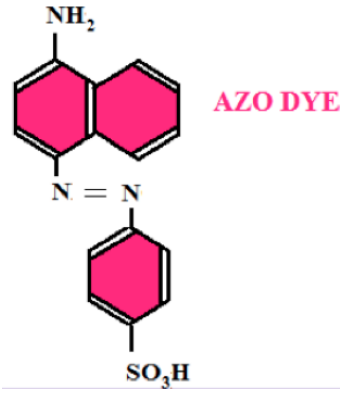


Fig 2 Azo dye formed in 1974

Various documents give detail of how a substantial colour was obtained in the thin layer plates of the Maguire Seven[10]**:**

"*7.4 It appears that positive results on this scale were something of a rarity in the laboratory. Mr. Higgs gave the Inquiry a vivid impression of the impact these results had on the* ***RARDE****[#] staff when he was asked whether he remembered viewing these particular plates:*

'Yes indeed. There was a great deal of excitement. Never before had we seen so many positives on a plate at a reasonably high level of intensity. We just did not believe it quite honestly. He [Mr. Elliott] *brought them to me, I was in my office writing at the time, so I have a distinct memory of those spots and their strength relative to the standard…My view at the time was that they contained a rather appreciable amount of nitroglycerine. The hue was similar to the standards.*"

These statements show the analysts had thereby concluded that a measureable amount of NG was detected on the accused persons.

Court of Appeal Judgement: [11]

> "*… there were two distinct factual issues at the (original) trial.* ***First*** *[sic] , was the substance on the male appellants' hands and Mrs Maguire's gloves nitroglycerine?* ***Secondly****, if so, could there be an innocent explanation for the presence of the nitroglycerine? It was implicit in the jury's verdict that they had answered both issues against the appellants*."

The Court of Appeal (COA) decided to re-examine the above two critical questions in the re-examination and would allow the defence to bring up any other issues they wanted to.

The COA therefore considered *inter alia* whether the spots found on the TLC plates were NG; whether it was possible that there was another non-explosive substance which mimicked NG; whether there was material irregularity because of non disclosure of evidence in the trial; the relevance that PETN (another explosive) was indistinguishable from NG using the TLC test and that this was known by prosecution but not disclosed to the defence at the trial; the issue of accidental contamination of the hands of the accused and whether contamination occurred before testing took place or in the laboratory during analysis. (These were the six grounds specified in Court of Appeal Judgements) [12]

Although the COA had said at the outset it was allowing the appellants to argue all new points, it overruled nearly all of them, on the basis that no new substantial evidence had been produced. Therefore the issues being raised had already been decided by a court and / or jury, and the matter was therefore "res judicata" – i.e. - the matter had been decided.

Discussion:

First: was the substance on the male appellants' hands and Mrs. Maguire's gloves NG?

The key witness regarding this question in the Court of Appeal was Professor Thorburn Burns (an expert appointed by the Court see *infra*).

> "*Finally Professor Thorburn Burns gave evidence before us. His evidence was not in dispute.. Indeed it had been suggested by both sides that we should simply read his report as containing his evidence……*"[13]
>
> "*….are we satisfied that the results showed that the substance was NG?*
>
> *Extensive experiments were done by both the RARDE (prosecution forensic scientists attached to the Department of Defence) and Mr. Yallop (expert adviser to defence counsel and retired former head of laboratory at RARDE) with a view to determining if any other substance [substance X] could be confused with NG in the TLC test. Those tests have continued after the trial. Nothing has been found. Professor Thorburn Burns said the search had been "not undiligent". He put it this way in his report* [14]
>
> *'Any compound having a false positive reaction must have the following characteristics:*
>
> - *persist on hands*
> - *be ether extractable*
> - *chromatograph with an R_f close to NG*
> - *Hydrolise to nitrite ion under the same or similar conditions than does NG*
> - *Despite extensive laboratory based laboratory searches prior to trial at RARDE and by Yallop and since, no such compound has been reported other than PETN and EGDN. I discount EGDN which appears always with NG.'*
>
> *This evidence is unchallenged*."
>
> "*Moreover, as we have said, in spite of diligent search, substance X has not been discovered. In our judgement ….. based on all the evidence in the case,* ***the substance was NG (nitroglycerine).***" [15]

The final Court of Appeal hearing decided that, based on all the evidence, nitroglycerine was found on the hands of the male members of the Maguire Seven, and on Mrs. Maguire's gloves. The ground of appeal to overturn this decision by the original trial was not accepted by the court.

Secondly, if so, could there be an innocent explanation for the presence of the NG?

The court, accepted the findings of the West [16] committee (see appendix 2) here.

"*Conclusions on accidental contamination of Maguire samples in 1974.*

… We have attempted to summarise briefly the reasons for and against thinking that contamination might have arisen from various sources. Opinion varied in the committee largely because of the absence of incontrovertible data against which to test the various hypotheses we advanced and perhaps because of the different weights given by members to what was available.

The committee counsels extreme caution over any attempt to translate this speculative review into actual probabilities of contamination thus to explain the original results. Whilst in respect of a number of possible contamination sources opinion was divided between those committee members who felt that contamination was likely or highly likely and those who felt it was neither, those that took the latter view accept the view that the possibility of contamination cannot be absolutely excluded"

" *S 3.15. I am grateful to these four scientists Drs Hiley and Marshall (RARDE) and Drs Caddy and Lloyd for arguing their respective points of view in this way. The difference between them concerns the degree of probability or improbability of contamination of samples having occurred. The committee as a whole has advised me that the possibility cannot be absolutely excluded, and at this length of time it would in any event be impossible to reach a definitive conclusion that contamination had not occurred. I accept this advice*." [17]

Confirmation that nitroglycerine could be transferred innocently from a contaminated towel to the hands of innocent users: [18]

[His Lordship …… continued:] "*In the course of the May inquiry Professor Thorburn Burns carried out a number of experiments with the assistance and co-operation of the scientific advisers of the Crown and the appellants. It is necessary to describe some of these experiments.*

The professor took a new cartridge of Gelamex which contained about 30% nitroglycerine, he unwrapped it, handled it and squeezed it in his hands and returned it to storage. He then washed his hands fairly briefly with soap and dried them on a well used but freshly laundered hand towel. After handling some mugs and glasses he rifled his hands through a box containing plastic gloves. Four subjects C, D, E and F then washed their hands and dried them on the towel. The results, shown in nanograms (ng) of nitroglycerine were as follows:

	Right Hand	*Nails*	*Left Hand*
C	*24,900*	*717*	*17,300*
D	*13,900*	*68*	*5,500*
E	*5,500*	*388*	*4,399*
F	*6,200*	*93*	*11,200*

These results came from swabs taken immediately after contamination. They do not therefore allow for the effects of delay. It is clear however that substantial quantities can be transferred to the hand of those subjects from the towel "

These quantitative results were obtained using HPLC, a modern method of analysis not available in 1974.

Evidence given in trials with regard to TLC plates:

They defence lawyers made the following points *inter alia*:

(a) There might be another non explosive chemical in ordinary everyday use [substance "X"] which might mimic the TLC test for NG in toluene.
(b) There was no certainty the substance on the TLC plates was NG in absence of confirmatory tests.
(c) There might have been some accidental contamination of the samples before they were tested. Possible contamination of samples before they reached RARDE was investigated at trial. Possible contamination in the testing laboratory could have occurred in particular by contamination of the ether used.
(d) Contamination of hands and gloves could have been by contact with object that was itself contaminated such as a towel.
(e) Contrary to evidence given at trial, NG under fingernails was not proof positive of handling or kneading explosives.

COA Conclusions:

(1) "*Moreover, as we have said, in spite of diligent search, substance X has not been discovered. In our judgement ….. based on all the evidence in the case, the substance was NG (nitroglycerin*e)."[19] [i]
(2) There was no acceptable evidence to suggest that another non explosive substance was responsible for the spots found on the TLC plates.
(3) Even though there were some technical shortcomings in the evidence, these were not deemed by the jury or courts to be significant.

The possibility that the forensic evidence was fabricated by the analytical scientists was rejected.

Further finding which may cause confusion:

The test samples from the Maguire Seven which were used in 1974 investigation to convict the Maguires had been kept stored since the trial. Re-examination in 1990 with a more sophisticated and modern technique, not available in 1974, showed the presence of NG not only in the samples that were positive in 1974, but also in those that were then negative! [20]

The Court of Appeal Final Judgement: [21]

The court rejected five of the six grounds of appeal (see judgement) bar ground 4 [22] as tendered by defence counsel:

"*Ground 4:*

The convictions of all the defendants were unsafe and unsatisfactory because fresh evidence has emerged as a result of the May Inquiry shows that (as the Crown now accepts)

(i) Incorrect evidence was given to the Trial Court on a crucial question, namely the significance of NG being found under the fingernails of male defendants; and
(ii) there is a real possibility of the hands and gloves of the defendants having become innocently contaminated with traces of NG as a result of contact with a surface, such as a towel, which of itself was contaminated with NG.

"*Professor Thorburn Burns's conclusions on this matter as expressed in his report were:* [23]

'Contamination at the levels expected to have been reported as "acceptably positive" caused by secondary transfer [of nitroglycerine] from coffee mugs, beer glasses or door handles is not very likely but is nonetheless a possibility. [Nitroglycerine] contamination at the levels expected to have been reported as "acceptably positive" from a communally used hand towel is a distinct possibility, but presupposes the presence in the house at some stage of at least one person who had significant contact with [nitroglycerine].'

What Professor Thorburn Burns meant by 'significant' can be explained as 'manipulation, not over a lengthy period of time, intimate physical contact with the material, modelling it, something like that', similar to the process by which he contaminated his own hands for the purpose of the experiment. We accept this evidence, which was not challenged. In our judgment it is possible that those whose hands were contaminated with nitroglycerine were innocently contaminated by contact with the towel. This itself must have been contaminated by one or more persons drying their hands upon it. The heavy contamination of the towel would have resulted from the type of contact described by Professor Thorburn Burns.

Similarly the gloves might have been contaminated, not by direct contact with explosive, but by contact with hands that had been in significant contact with it.

The evidence does not enable us to conclude who the person or persons were who so contaminated the towel or the gloves.

On the ground that the possibility of innocent contamination cannot be excluded and on this ground alone, we think that the convictions of all the appellants are unsafe and unsatisfactory and the appeals are allowed and the convictions quashed."

Conclusion:

This paper has attempted to set out the material facts as available to the Court of Appeal in 1991. The Court of Appeal quashed the convictions but indicated it was its view that NG had been found on the appellants' hands and gloves, which might have been contaminated, not by direct contact with explosive, but by contact with hands that had been in significant contact with a contaminated towel. However, it stated it could not say who it was contaminated the towel. Notwithstanding the acquittal, the validity of this part of the judgement does not sit well with the interpretation of the evidence by the authors, but remains to this day a slur on the integrity of the Maguire Seven.

Appendix 1: Thin layer chromatography

Appendix 2: Judges and scientists involved

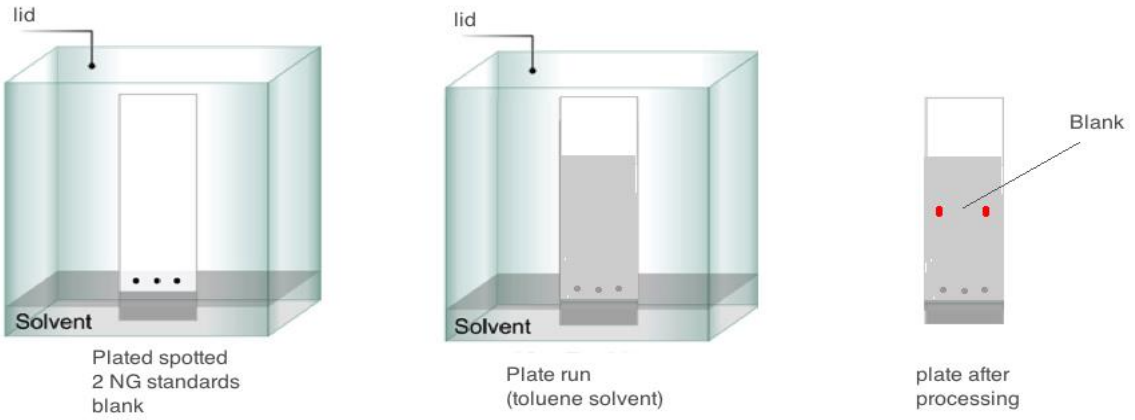
Appendix 1

Thin Layer Chromatography (Griess) for Nitroglycerine

The following is a description taken from court of appeal judgement (unrevised):[24]

> *"Since the integrity of these results and the interpretation put upon them by the experts lay at the heart of the trial and also this appeal, it is necessary to give a brief outline of TLC. The system was used both for analyzing samples from HTK's (hand test kits) and other samples. The first stage is the extraction of the suspect substance from the swab or other item to be tested. This is done by washing in ether, which is placed in a beaker and the ether allowed to evaporate. The residue is then spotted onto a glass plate treated with silica gel on which standards or controls of known explosives were also applied. Normally these explosives were NG, RDX, TNT and Nitrobenzene (NB). All the spots were placed on a line known as the origin. The plate was then placed in a tank containing a quantity of liquid known as an eluent, usually toluene, in order to draw the known standard and the suspect substance up the plate by capillary action. The eluent front can be seen to rise on the plate. When it reaches a point 10 cm above the origin the plate is removed from the tank. Different substances rise up the plate at different rates, which can be measured after being made visible. This rate of rise is not expressed as an absolute measurement, but as a proportion of the total distance travelled by the eluent. The ration is called the R_f value. When the plate is removed from the eluent tank both the standard spots and the suspect spot will have risen up the plate, but will not be visible at this stage either in ordinary or ultraviolet light, and the plate has to be subjected to two further chemical processes before they become so. NG is an organo nitro compound of the nitrate ester grouping, and the plate must first be sprayed with sodium hydroxide (caustic soda) to liberate the nitrite ion from the nitrate compound; at this stage the plate will appear white from the spray. The plate is then heated in an oven to 110 degrees C and is then sprayed with what is known as Griess reagent which reacts with the nitrite present to form a pink spot. It is at this stage known as visualisation, that the distance travelled up the plate by the standard and suspect spots can be seen. If the suspect reached the same level as the standard a positive was recorded. If the two did not exactly coincide, a positive would still be recorded provided the difference was small, not more than 3 mm either side of the standard; this was known as the parameter. Professor Thorburn Burns was of the opinion that 0.03 was an acceptable parameter for recording a positive.*
>
> *The test is a qualitative and not a quantitative one. That is to say it can give a positive for the substance but cannot give the amount. However, the practice at RARDE was to put a standard of 200ng (a nanogram is a millionth of a gram) on a TLC plate. If the pink colour spot of the suspect sample was equal to or exceeded the intensity of that standard, a positive was recorded; this would mean a minimum of 200 ng was detected. Otherwise the test was negative, although sometimes, usually in trials or experiments rather than in field tests, it might be recorded that there was a faint positive.*
>
> *The test is a highly discriminating one: the substance must rise the same level as the standard; it must be soluble in ether; it must not show up on exposure to ultraviolet light, or after heating or spraying with sodium hydroxide; and it must produce a pink spot when sprayed with the Griess reagent…..*
>
> *…..The mechanical part of the Griess testing – that it up to the final stage when the Griess reagent is applied and the plate is visualised, was often done at RARDE by relatively junior employees, in particular at the material time by Mr Wyndham, Mrs Brooker, and Mrs Cashen; but the visualisation was done, except sometimes in the case of Mrs Brooker who was the most senior and experienced of the three, by more senior officers namely Mr. Elliott, Dr. Hayes, Mr. Berryman and occasionally Mr. Higgs. But in fact the test on the appellants HTK's (hand test kits) were done by Mr. Elliott, who was the most experienced person at RARDE in the practice of TLC and they may also have been visualised by Dr. Hayes."*

(Excellent description of TLC on Wikipedia):



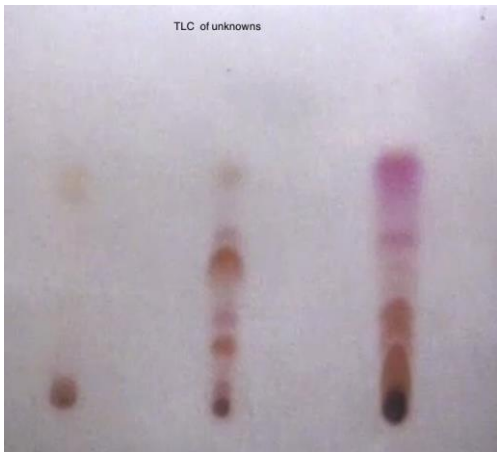
The observation of the substantial pink coloured spots on the TLC plates in Maguire case indicated a considerable amount of nitroglycerine was present.

The TLC (Thin Layer Chromatography) Griess test:

[It is accepted that there is a one to three relationship between NG and nitrite released during the TLC Griess process.]

A thin layer plate showing pink spots of standards of nitrite is shown above adjacent to azo dye diagram.

Below is a thin layer plate of a very impure sample with multiple spots, some possibly NG: this shows that TLC is not a very selective or precise analytical technique.



Appendix 2

The Judges involved in original case:

Donaldson, J subsequently was promoted to Lord of the Rolls, the second highest ranking British judge. He was the also the presiding judge in the Guildford Four trial.

Court of Appeal Judges:

Lord Justice Roskill (Court of Appeal 1977)

Lord Justice Stuart Mills (Court of Appeal 1991).

Lord Justice Mann (Court of Appeal 1991).

Lord Justice Mc Gowan (Court of Appeal 1991).

[May Inquiry (1989 – 1994) into Guildford and Woolwich Bombings]

Rt Hon Sir John May (May Inquiry) Court of Appeal Judge

Scientific Personnel:

Independent Experts:

1. **Professor Thorburn Burns** Professor Duncan Thorburn Burns, Ph.D., D.Sc., F.I.C.I., C.Chem., F.R.S.C., F.R.S.Edin., M.R.I.A., was appointed as an independent expert analytical chemist to the Guildford and Woolwich Inquiry. He appeared as an "expert witness" in the Court of Appeal. Among his numerous medals and awards is the first Boyle-Higgins Gold Medal of the Institute of Chemistry of Ireland in 1990. He has published over 450 scientific papers and 9 books, including 100 papers since formal retirement in 1999.

   He is currently an Honorary Research Professor of Analytical Chemistry and resident in The Institute for Global Food Security, The Queen's University of Belfast.

   [Professor Burns' status in the Guildford and Woolwich Inquiry are made quite clear in the Interim Report on the Maguire Case (para 1.6)

   ".....Accordingly thought it right to have appointed to advise the Inquiry an independent expert analytical chemist. The Inquiry was fortunate to obtain the services of Professor Duncan Thorburn Burns, Ph.D., D.Sc., F.I.C.I. C. Chem, F.R.S.C., F.R.S Edin., M/R.I.A. of Queen's University of Belfast....." "He went on to say what I did, and commented very favourably about my approach and evidence. I did appear at the Court of Appeal as an "expert witness" with the duties and responsibilities that entailed to the Court."…… personal communication to author [SOM] correcting previous reference to Professor Burns in Irish Chemical News Issue 2 October 2015, .

2. **Professor T.S. West CBE, FRS:** Professor of Analytical Chemistry in the Imperial College in London. He set up a world famous research team that pioneered atomic absorption and atomic fluorescence spectrophotometry. He chaired the scientific committee that examined the science of this case for the May commission. Regarded as one of the great British scientists of the 20th century, by (cite reference). Decorated (CBE) for his contribution to Science.

Experts for Prosecution:

Dr Marshall Head of Forensic Explosives Laboratory at RARDE

Mr. Elliott: (trial only: died some years before Appeal) Senior Scientific Officer. "His honesty was never questioned at the trial, his opinions were."[1] He is described by those who knew and worked with him as meticulous and a fast experienced worker who took great care in the work.

Dr. Hayes was a careful and impressive witness He joined the forensic laboratory at RARDE in July 1974. He held the degrees of B.Sc. in chemistry, Master of Science, and Ph.D. in forensic science. He was also a chartered chemist and a member of the Royal Society of Chemistry.

Mr. Wyndham Apparently, he joined the forensic laboratory of that establishment in 1974 a few months before the tests were carried out in connection with this case. He was 17 years of age at the time. (He carried out the analysis on Mrs. Maguire's gloves). It is no slur on his abilities to point out that in most analytical practice it would be quite remarkable for such a junior to be held responsible for conduct of such a vital test on a matter of such importance.

Mrs Brooker (Kemp): "Mrs. Kemp was a scientific officer. She joined the forensic laboratory in 1973 and left in 1977. She had an 'A' level, (the most senior examination for secondary or high school students) in chemistry. She judged the results herself.

Mr. Higgs was a Fellow of the Royal Society of Chemistry and a chartered chemist. He began work with RARDE at the age of 16 working on explosives at Fort Halstead. He went to Woolwich in 1973 and took over from Mr. Yallop as head of the forensic laboratory there. … He was a very knowledgeable about explosives, particularly those used by terrorists**. He himself had not done TLC tests, but was well aware of the theory and practice of them.**

Forensic Experts for the Defence:

Dr / Professor Brian Caddy Lecturer and subsequently professor of forensic science in Strathclyde University, the UK's top academic institution of forensic science.

Dr J B F Lloyd Ph.D DSc. OBE – decorated (OBE) for his contribution to forensic science; retired from the Home Office Forensic Science Service and was private consultant to appellants.

Mr Yallop retired head of RARDE

Mr. Clancy retired head of RARDE

 # [RARDE (The Royal Armament Research and Development Establishment) is part of the Ministry of Defence. Then at Woolwich in South East London, the laboratory carried out forensic work for the Metropolitan Police on suspected explosives. Its Head was Mr. Douglas Higgs, Principal Scientific Officer. He had taken over the post from Mr. John Yallop, who was to be the principal witness for the defence. The original analysis of the Maguire samples were carried out by RARDE personnel)]

* Dr Sean O'Muircheartaigh BSc (Hugh Ryan gold medallist 1965) and PhD (1970- Organic Chemistry - synthetic organic chemistry natural product chemistry) - both UCD. MBA (1980) and LLB (1987) UCG. Worked in Unilever, Vlaardingen 1966 (GC/MS), Pfizer UK and Ringaskiddy, Ireland as R&D chemist for startup of Ringaskiddy plant (setting up of In-Process and R&D laboratories, analytical test method development for national and international). Hydrocurve (USEPA audits 1982 - 4). Round robin EPA. Supervised 100+ science and 50+ law projects - to Level 9 - on a range of scientific, business and legal issues. Chemistry (37 years) and Law lecturer (TFT 10 years) at Regional Technical College, Galway / GMIT. First chairman Galway Science and Technology Festival. Taught general, organic, physical, environmental, industrial, forensic, textile, inorganic, chemistry laboratory computation, industrial accreditation and validation of test procedures up to Level 8. Laboratory administrator for CAFDIS, an EU funded drugs in sport programme. Wrote paper with Prof. E O'Neill which contributed in the withdrawal of the forensic evidence in the Birmingham Six Case.

* Professor Eoin O'Neill, BSc, Ph.D. (N.U. I.), M.I.C.I. Professor O'Neill has a PhD in physical chemistry from UCD, and a Post Doc from Leeds University. Following post-doctoral work in Chemistry in the UK, He was involved for seven years in Environmental Protection work for a large corporation in the United States, and then worked as the Chief Technical Advisor to the Irish Department of Energy, on many large infrastructural projects and reviews, he subsequently worked as Director of Innovation Services in Trinity College Dublin and Director of Entrepreneurship there, where he still contributes to five post-graduate programmes in the Innovation Academy and the School of Business, as Adjunct Professor. He has been discussing the relevant forensic cases with Dr. O'Muircheartaigh for over twenty years. He was similarly involved in the previous paper on the Birmingham Six which contributed to the withdrawal of the forensic evidence and subsequent collapse of this case.

References

1. **http://www.bbc.co.uk/programmes/p00hrdfw**

2. May interim report S 3.16

3. Interim Report May Inquiry London HMSO, 12 July 1990, HC 556
   Second Report May Inquiry, London HMSO, 3 December 1992 HC 296
   Final Report May Inquiry, London HMSO, 30th June 1994, HC449

4. R v Maguire and others 1992 2 All England Reports, 433;
   (http://netk.net.au/UK/MaguireFull.asp)

   (R v Maguire and others 1992 Court of Appeal, draft judgement ("This is an unrevised judgement. It is available on the clear understanding that it be treated as such": this fact is acknowledged here)

5. May interim report, S 1.9;
   https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228724/0556.pdf

6. https://en.wikipedia.org/wiki/List_of_terrorist_incidents_in_Great_Britain#1970s

7. http://netk.net.au/UK/MaguireFull.asp

COA unrevised judgement R v Maguire and others Part 1; page 1. It is acknowledged that this is an unrevised judgement, and not approved by the judges.

8 COA unrevised, Part 1 P 22

9 COA unrevised judgement, Part 2; P3

10 Maguire interim report, S 7.4;
COA unrevised Part 2,P3

11 Court of Appeal,unrevised, Part 1; P 23
12 Court of Appeal, unrevised, Part 1; P36-41
13 Court of Appeal, unrevised, Part 1; P30
14 Court of Appeal, unrvised, Part 2; P4
15 Court of Appeal, unrevised,Part 2; P 32.

16 **West Committee:**

[Sir John appointed a subcommittee to thrash out the science of the case under Professor T S West. The deliberations of this Inquiry were referred to in the Judgement of the Court of Appeal in 1991.

" *I therefore decided to set up a Scientific Committee to advise me further on the disputed issues. I was very fortunate that Professor T S West, now retired but formerly of Birmingham and Aberdeen Universities, and of Imperial College agreed to be chairman. The other members were Professor Duncan Thorburn Burns; Dr. Lloyd, acting for the Conlon family; Dr. Caddy for the surviving members of the Maguire Seven; Dr. Marshall for RARDE; Dr. Scaplehorn for the Home Office; and Mr. Higgs..*"]

17 May Inquiry second report, S 3.15.
18 Court of Appeal, unrevised judgement, Part 3; P6.
19 Court of Appeal, unrevised, Part 2; P 32.
20 May Inquiry second report S3.8;
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228811/0296.pdf
21 R v Maguire and others [1992] 2 All ER 433 (also:http://netk.net.au/UK/MaguireFull.asp
22 Court of Appeal, unrevised, Part 1; P39.unrevised,
23 COA judgment unrevised, part 3, P9
http://www.chemguide.co.uk/analysis/chromatography/thinlayer.html

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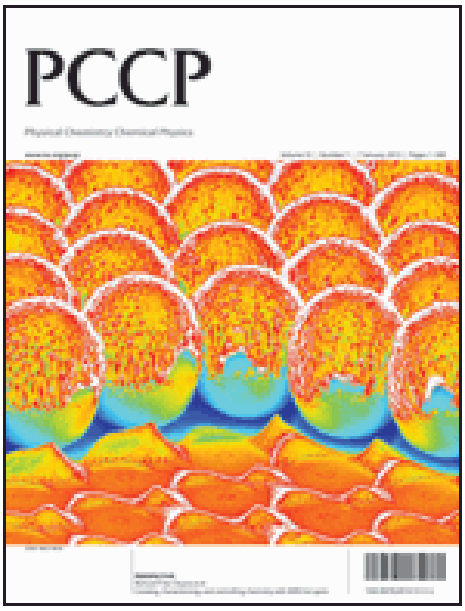

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METTLER TOLEDO

Particle Size Analysis for Process Optimization

By Dr. Des O'Grady, METTLER TOLEDO

Particles, crystals, and droplets occur in many chemical processes, across a range of industries, and often pose challenges for scientists and engineers who are tasked with optimizing product quality and process efficiency. Characterizing particle properties effectively, in particular particle size and count, allows processing problems to be solved and product quality to be improved. Historically, scientists have relied on off-line particle size analyzers, such as laser diffraction or sieving to perform this type of characterization. But in recent years, newer technologies have emerged, which describe particle size and count in real time, as particles naturally exist in process. In process measurement of particles can reduce the error associated with offline sampling, and can provide continuous information about how particles behave under changing process conditions, allowing scientists to understand and optimize difficult processes using evidence-based methods. This article will introduce some of the most common in process particle measurement approaches and how they can be deployed for the effective delivery of high quality particle products.

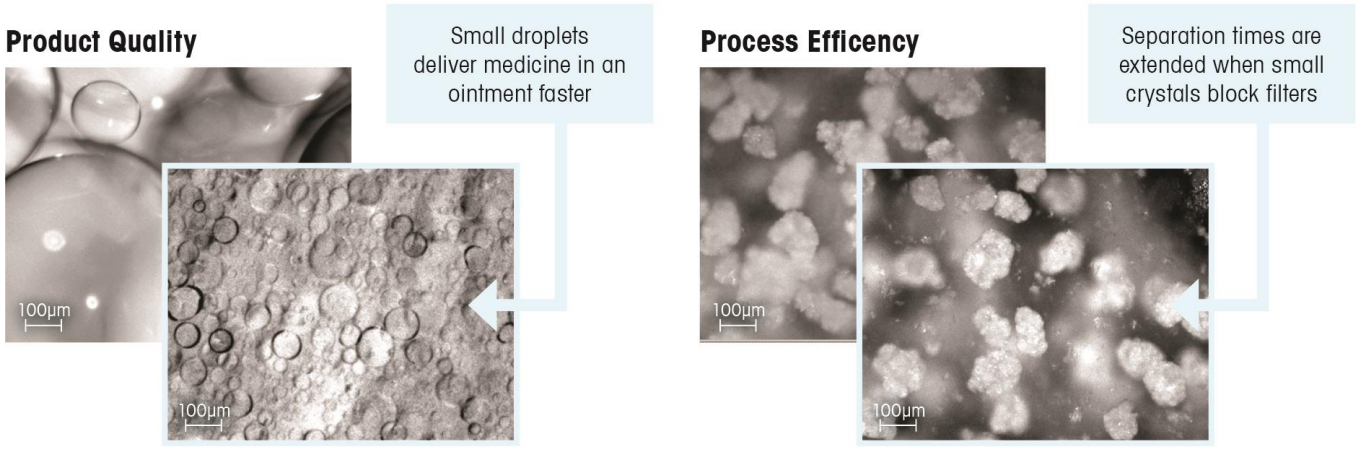

Figure 1. *Particle size and count can influence both product quality as well as process efficiency.*

Introduction

Particles and droplets are present in the vast majority of manufacturing processes and their final products. The proper control of particle size, shape and count is often a critical factor in final product quality and can greatly influence process efficiency (Figure 1).

For example, the effectiveness of medicines used to treat lung diseases has been shown to depend heavily on particle size, with large particles exhibiting poorer penetration into airways[1]. It has also been reported that particulate process plants take longer to start up, and are less likely to achieve desired production rates, versus those processing liquids or gases[2]. Multiphase systems involving combinations of particles, droplets, and bubbles result in additional complexity and magnify the challenge of understanding, optimizing, and controlling the processes used to produce, modify, or separate them.

The determination of optimized process parameters is critical to ensure the correct particle size and count can be obtained consistently. In a process such as crystallization, the cooling rate chosen will directly influence final crystal size, with faster cooling rates typically delivering smaller sizes[3]. In emulsification processes, it has been shown that mixing intensity must be controlled in order to

Common Applications:

Crystallization
Emulsification
Suspensions
Flocculation
Dispersion
Homogenization
Wet-milling
Polymerization
Microencapsulation
Oil-water separation
Disintegration
Dissolution

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obtain the desired droplet size distribution[4]. In the flocculation of fiber cement particles, high molecular weight polymer flocculants have been shown to increase aggregation resulting in larger and stronger flocs[5].

To successfully deliver particulate products to the market, scientists must develop a comprehensive understanding of how process parameters affect particle size and count. They must choose operating conditions that will deliver particles with the required attributes consistently and cost effectively. In order to do so, reliable particle characterization methods are needed, and the results obtained from these methods must be easily related to the process parameters that govern the outcome of the process.

Traditional Particle Size Analysis

Traditional Particle Size Analysis (PSA) using an offline analyzer is a powerful and widely used technique for the measurement of particle size in quality control (QC) labs. Examples of traditional particle size analysis techniques include sieving, laser diffraction, dynamic light scattering, and electrozone sensing. This approach allows QC laboratories to check the specification of particles at the end of a process against a set specification and identify deviations from the required particle properties. In order to obtain useful results from traditional particle size analyzers, it may be useful to consider the following points:

Sampling and Sample Preparation

A successful laboratory analysis of particle and droplet systems requires the removal of a representative sample from the process, and the preparation of this sample for analysis. Most PSA techniques have strict constraints on the range of concentration, size, and shape of particles that can be measured accurately. This sample preparation procedure often involves multiple steps necessary to meet these measurement constraints and can employ methods such as filtration, rinsing, drying, subsampling, resuspension, surfactant addition, dilution, and sonication. However, it is quite possible that these steps may significantly alter the particles or droplets of interest. Even with the utmost care and precision in the sampling and sample preparation methods, the actual particles that are analyzed may be significantly different from the particles that were initially present in the process vessel (Figure 2). For this reason, particles must be sampled in such a way as to minimize the possibility that change might occur during the removal, preparation, or measurement phases of the procedure.[6]

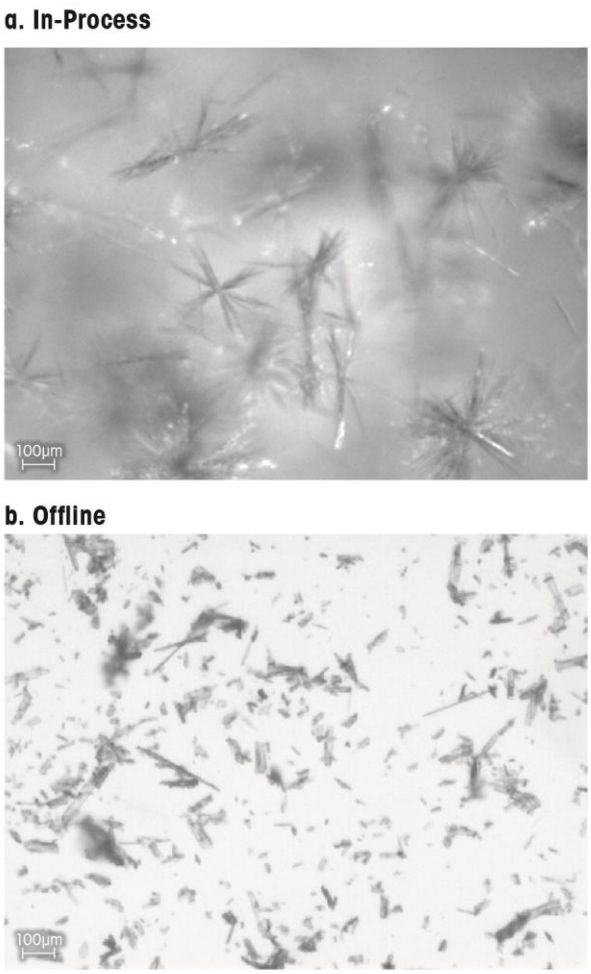


Figure 2. *Mannitol crystals compared in* ***a.*** *process using real time microscopy and* ***b.*** *offline using a standard light microscope. Sampling and preparation for microscope analysis have resulted in significant breakage and delicate dendritic structures observes in process go undetected*[10]

Consideration of Particle Shape

Many particle size analyzers assume particles are spherical to allow simplified models to be applied in order to report consistent results.[7] A sphere is the simplest particle shape in the sense that one number, the diameter, describes the particle completely. Often however, particles are non-spherical (Figure 3), and changing particle shape can be even more important than size in determining bulk solids properties, such as flowability[8], and filterability[9]. Scientists must take care to understand how particle shape influences a

traditional particle size analyzer, and in cases where particles are known to be non-spherical, it is important to take this into account when analyzing results.

The particle size of non-spherical particles is often reported using an equivalent diameter; which is the diameter of a spherical particle which will give identical geometric, optical, electrical or aerodynamic behavior to that of the particle (non-spherical) being examined. In Figure 4, particles with different shapes but equivalent volume are depicted. If particle size is reported for each of these particles based on volume, then the same particle size will be reported in each case. If particle size is reported based on sieve diameter (during sieving, a particle hits the sieve mesh until it passes with its smallest projection screen through an aperture) then different particle sizes are reported. Since changes in particle shape can influence process and product quality, care should be taken to determine how shape influences particle size analysis results, and if possible to determine particle shape using a technique such as imaging.

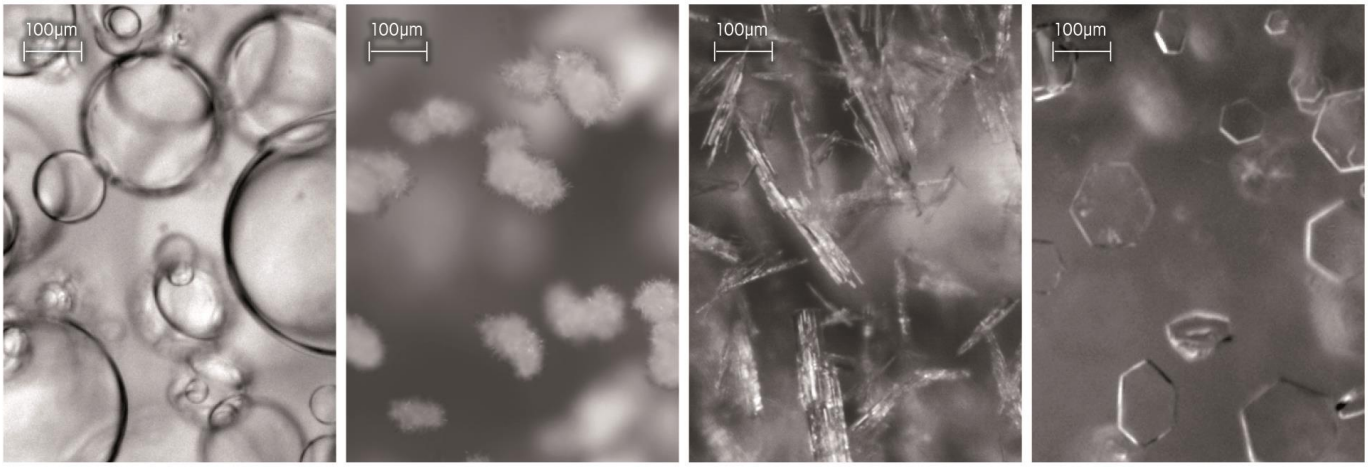
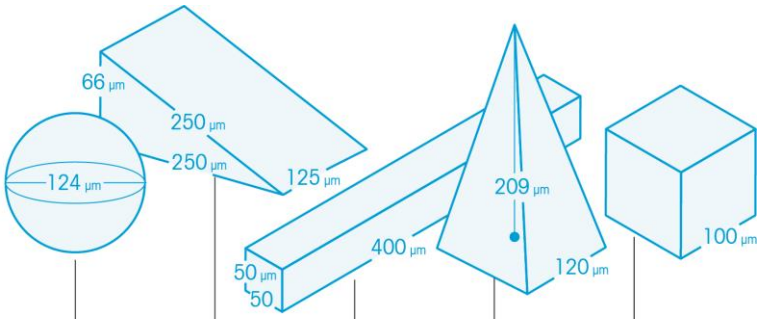


Figure 3. *Real-time microscopy examples of particles with different shapes (a) spherical droplets (b) agglomerated crystals (c) elongated rod-like particles (d) hexagonal platelet crystals*



Shape	Sphere	Prism	Needle	Pyramid	Cube
Volume (µm³)	10^6	10^6	10^6	10^6	10^6
Volume Diameter	124	124	124	124	124
Sieve Diameter	124	125	50	120	100

Figure 4. *(right) Spherical equivalent diameters (volume, sieve) reported for five particles of different shape*

Another important consideration is that particle systems are composed of a population of particles with different sizes and shapes. Many traditional particle size analyzers report a particle size distribution, from which an average (typically, a mean or median) is calculated and reported. Care must be taken to consider how particle count at the fine and coarse tails of such a distribution influence the reported particle size.

Time Delay

Since most particle process streams operate at a solids loading much higher that anything traditional particle size analyzers can handle, careful sample preparation is needed for effective measurement. It is virtually impossible to apply PSA measurements directly in a process. This means that traditional offline particle size

analyzers are not easily implemented to obtain real-time information, as process parameters are varying. In order to do so, slip streams with automated dilution and preparation systems would be required. However, even with a successful setup, the reliability of such measurements would be questionable given the likelihood of particles changing dramatically during diversion, preparation and analysis.

In order to obtain continuous information about how particle size relates to process parameters, samples would have to manually extracted and analyzed on the fly. This approach is challenging from a cost perspective and may expose those taking the samples regularly to an unacceptable level of risk – especially for processes at elevated temperatures and pressures with toxic or explosive slurries and solvents. The inevitable time delay between sampling and the receipt of results for traditional PSA makes them extremely difficult to implement for any kind of real time measurement, and makes them unsuitable for monitoring process continuously as they change over time.

Summarizing Traditional Particle Size Analysis

Offline particle size analysis is a powerful and widely used technique for the measurement of particle size, and for comparison with a set specification in QC. With care, traditional particle size analysis can be used to identify variations in product quality, and can be used to ensure that products meet the specifications required by producers, their customers, and regulators who oversee the quality of products reaching the public.

However traditional particle size analysis does not lend itself well to characterizing particles continuously as process parameters change and for this reason they are not especially suited to the task of process optimization. It is extremely difficult to rely on a single offline sample, no matter how reliable the data obtained, in order to completely understand particle behavior from the beginning until the end of a process. In order to develop truly effective process understanding and to translate this into meaningful improvements for the process, continuous measurements are needed that characterize particles in real time as they naturally exist in the process. With this information particle mechanisms such as growth, breakage and agglomeration can be directly observed, the influence of process parameters on the system can be determined and an optimized route to the desired particles properties can be identified and implemented quickly.

In-Process Particle Measurement

In-process particle measurement typically relies on inserting a probe-based instrument into a process stream for direct measurement of particles as they naturally exist in the process (Figure 6). This type of measurement occurs at full process concentrations and does not require sampling. Typically, probes can be applied across a range of scales and installation environments, ranging from small scale laboratory reactors to full scale production pipelines.

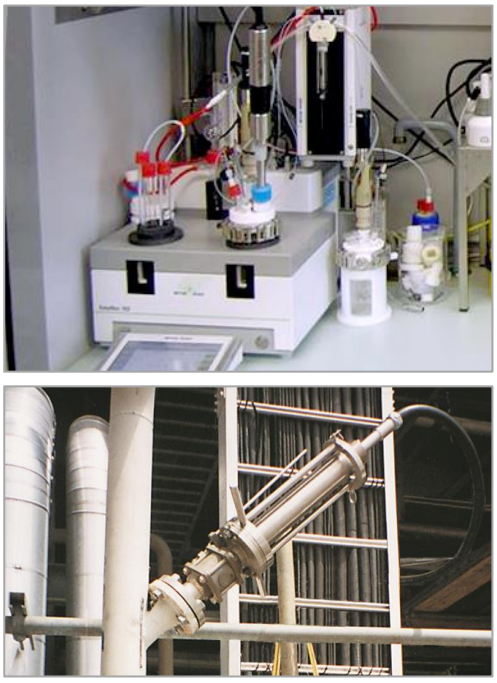


Figure 6. *In process particle measurement instruments using focused beam reflectance measurement technology (see Appendix) implemented in lab and production settings*

Study Particle Size and Count Over Time

Typically an in-process particle measurement is taken every few seconds, allowing discrete distributions to be recorded at user defined intervals. Statistics from each distribution can then be trended over time allowing scientists to monitor process trajectory in real time (Figure 7). By monitoring particles in process and in real time it is straightforward to determine (1)

when particle size and count starts changing; (2) when particle size and count stops changing; (3) the rate at which particles change; (4) the degree to which particles change. With this information scientists can develop a much deeper understanding of their processes compared to the case where they must rely on a single particle size analysis result from a single point in space and time.

a.

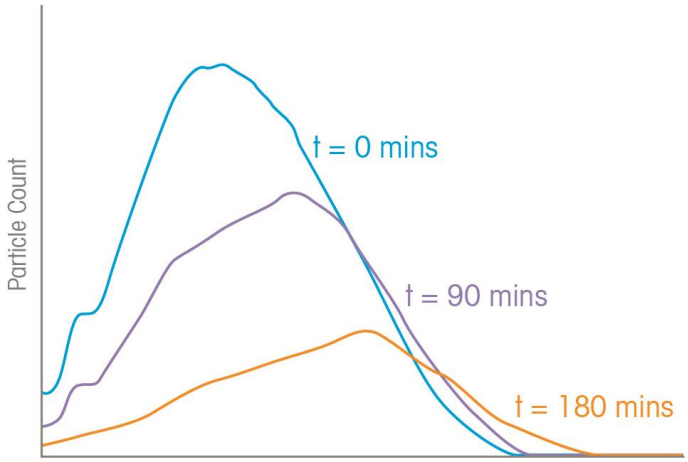


Figure 7a. *Discrete distributions can be recorded in real time at user defined intervals*

b.

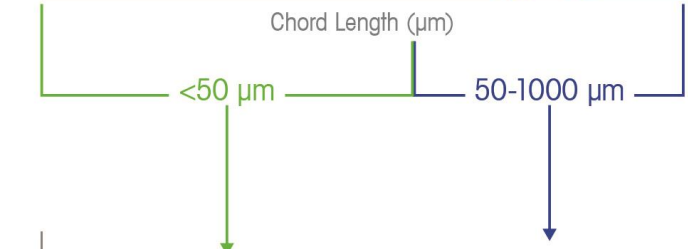


Figure 7b. *Statistics such as particle count in individual sizes classes can be trended continuously in real time*

c.

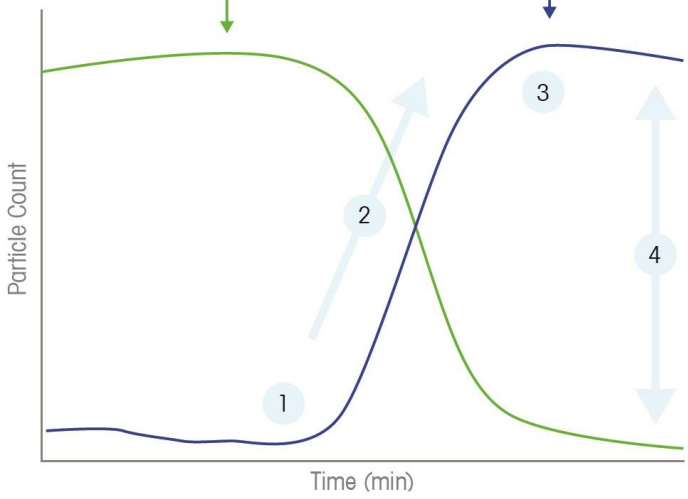


Figure 7c. *Trended statistics provide key information regarding changes to particle size and count including: 1. When does the process start?; 2. What is the rate of change?; 3. When does the process end?; 4. What is the degree of change?*

Understand the Impact of Process Parameters on Particles

An in-process approach to particle measurement differs significantly from the role traditional particle size analysis play in the characterization of particles. In process measurement takes place directly in the vessel or pipeline, while the particles are changing, rather than in the quality control lab and results are immediately related to dynamic process conditions, rather than to a pre-determined particle size specification. By combining relevant process parameter information with in process particle measurements it is possible to quickly obtain evidence that can be used to optimize processes with scientific rigor (Figure 8).

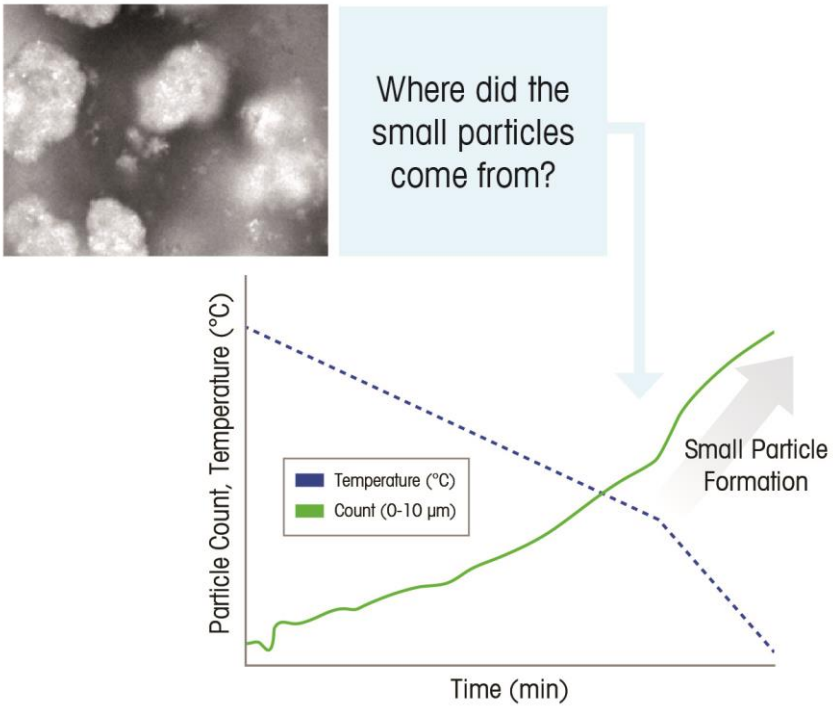


Figure 8. *In process particle measurement identifies the formation of small particles at the same time the rate of cooling increases*

Choose Parameters to Deliver the Correct Particles

By directly monitoring the impact of process parameters on particle size and count it is possible to reliably determine the process parameters needed to target a specific set of particle attributes. In Figure 9 the impact of agitation rate on droplet size is clearly shown allowing scientists to readily choose a set of operating conditions that will deliver the desired droplet size.

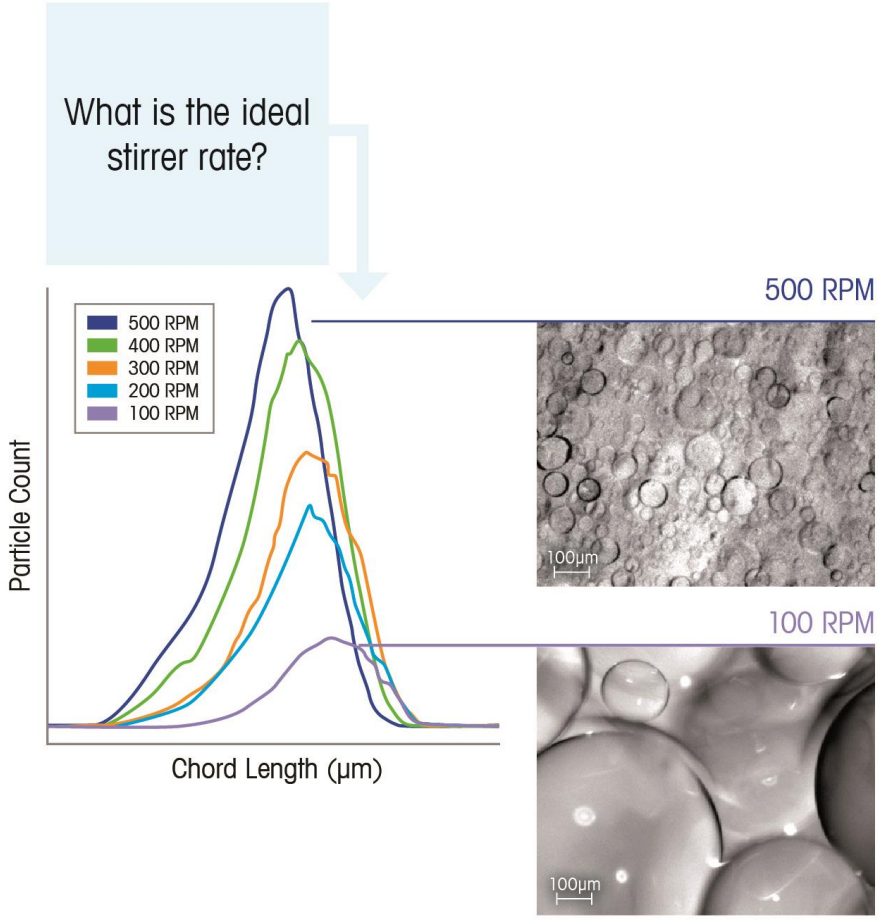


Figure 9. *Figure 8. In-process particle measurement shows influence of agitation intensity on droplet size*

Monitor and Correct Process Deviations

By monitoring particle size in real time directly in the process it is possible to identify process deviations and take corrective action to minimize the impact of the upset. In figure 10 a continuous process is being monitored where particle size must be kept within tight specifications. Here it should be noted the specification that is set using the in-process instrument is not necessarily the same as the specification set using the traditional particle size analyzer in the QC lab. Here the in process particle measurement instrument is simply identifying a dramatic process upset and can support troubleshooting the problem before implementing a corrective action that will bring the process back into specification.

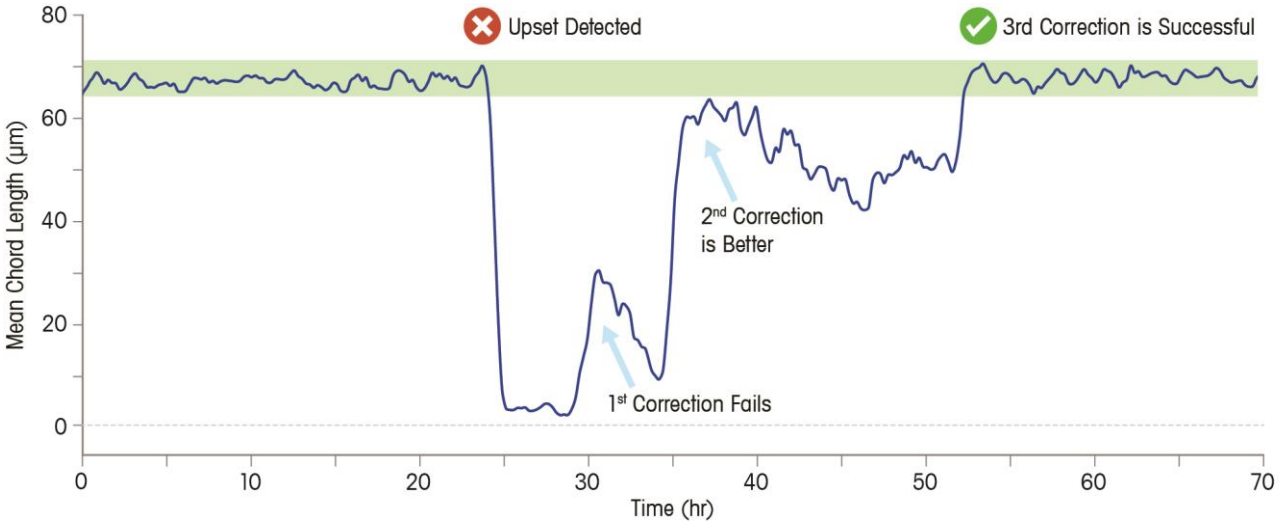


Figure 10. *Using in process measurement to identify a process upset during a continuously operating process and take corrective action*

For batch processes in process particle measurement can support the reduction of batch time by identifying when a process reaches steady state. In Figure 11 most of the process changes occur during the first two hours of the process – however in process particle measurement indicates that particles do not change for the remaining 10 hours of the batch. This is a good indicator that batch time could be reduced – and that a sample for offline quality control should be taken soon after the initial 2 hour period, where most change occurs.

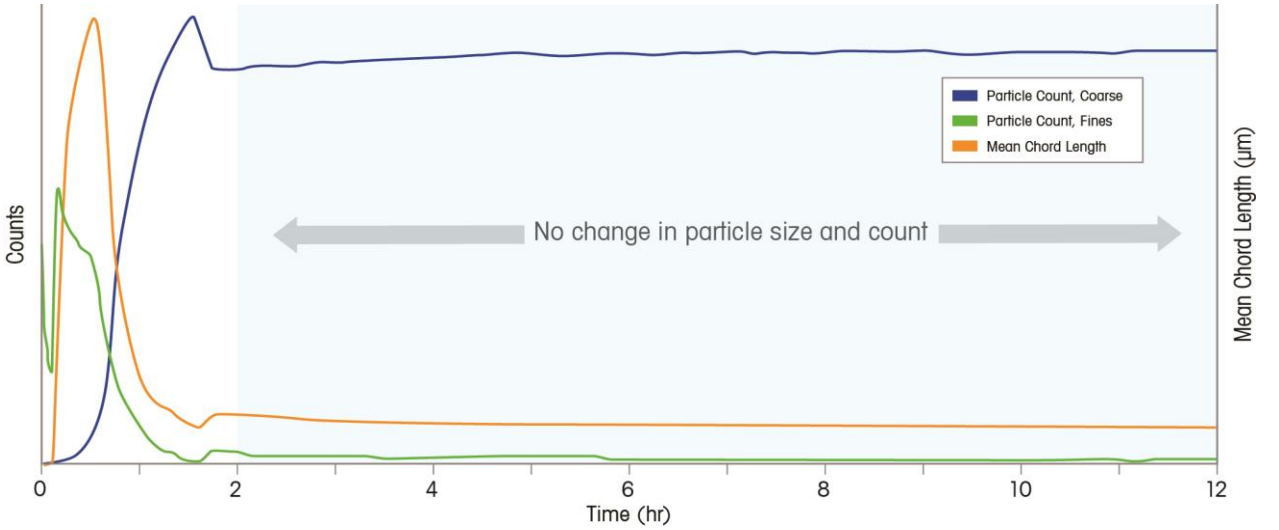


Figure 11: *A batch process where the final 10 hours of the process does not exhibit any change in particle size or count*

Summarizing In Process Particle Measurement

In-process measurement of particles is suited particularly well to developing process understanding for complex particle systems and for determining the appropriate parameters needed to deliver particles with the correct properties. In process particle measurement also complements traditional particle size analysis by supporting quality control efforts through the identification and rectification or process upsets during production.

- Avoid errors associated with non-representative sampling
- Avoid physical changes to the particle resulting from sampling, transport, storage, sample preparation, and flow through the off-line measurement instrument
- Obtain continuous and real-time information about the particle system as process parameters are changing
- Characterize particles where sampling is challenging due to temperature, pressure, or toxicity
- Directly observe the impact of disturbances and intentional process upsets

Conclusions

Particle size and count are important to characterize effectively for the successful development, transfer, and operation of processes in numerous industries. Traditional particle size analyzers are used in the quality control laboratory to measure particle properties with accuracy, however care must be taken to prepare the sample to allow for a consistent measurement. The time delay and potential for particle changes between sampling and analysis make the traditional particle size analysis approach challenging for process optimization and improvement.

In process measurement instruments offer an opportunity to track how particle size and count change directly in the process in real time. By understanding how particles behave from the beginning until the end of a process, and by comparing particle changes to process parameters, scientists can develop a deep understanding of particle systems. This allows processes to be optimized using evidence based methods and for troubleshooting to be executed during production.

In process particle measurement complements traditional particle size analysis by providing extra information about how particles actually behave naturally in process. If a quality control lab reports a deviation from specification in process particle measurement can be used to perform root cause analysis. Likewise, in process particle measurement can predict when a process will move out of specification and can help identify when a sample should be taken from a process for offline analysis and quality verification.

By combining in process particle measurement for understanding, optimizing and troubleshooting processes with traditional particle size analysis for quality control scientists can develop particle processes with higher quality, in less time at a lower total cost.

About the Author

This article written by **Dr. Des O'Grady,** who is METTLER TOLEDO's Global Technology and Applications Manager for In-process Particle Characterization. He has been with METTLER TOLEDO for 10 years and has extensive experience working with scientists and engineers in a range of industries on their particle characterization projects. Based in Columbia MD, Des supports the pharmaceutical, chemical and petrochemical industries in Europe, America and Latin America.

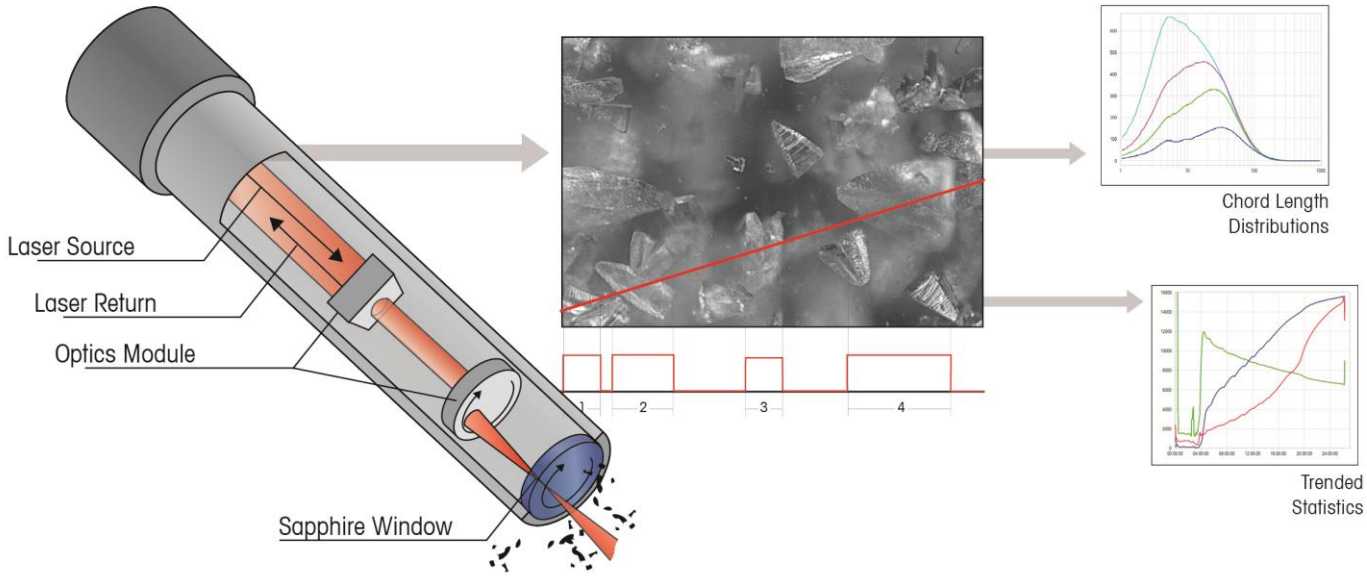
Des graduated from the School of Chemical and Biochemical Engineering at University College Dublin, Ireland with a B.E. in Chemical Engineering in 2002. He completed his PhD at the same school in 2006. His PhD thesis, entitled "*Multi-Scale Characterization of Anti-solvent Crystallization"*, focused on the use of *in situ* particle characterization technologies and novel modeling approaches to design, characterize and scale-up anti-solvent crystallization.

Des is a recognized expert in the world-wide crystallization and particle science communities. He is a regular contributor at international conferences and is a regularly published author on these and other topics.

Appendix A: ParticleTrack with FBRM (Focused Beam Reflectance Measurement)

ParticleTrack™ with Focused Beam Reflectance Measurement® (FBRM) technology is a probe-based instrument that is inserted directly into processes to track changing particle size and count in real time at full process concentrations. Particles, particle structures, and droplets are monitored continuously, as experimental conditions vary, providing scientists with the evidence required to deliver consistent particles with the required attributes.

To view the method of measurement video visit: **www.mt.com/FBRM-mom**



How Does ParticleTrack Work?

The probe is inserted directly into process streams, at an angle, to ensure particles can flow easily across the probe window where the measurement takes place. A laser beam is launched down the probe tube through a set of optics and focused to a tight beam spot at the sapphire window. The optics rotate at a fixed speed (typically 2m/s) resulting in the beam spot rapidly scanning across particles as they flow past the window.

As the focused beam scans across the particle system, individual particles or particle structures will backscatter the laser light to the detector. These distinct pulses of backscattered light are detected, counted, and the duration of each pulse is multiplied by the scan speed to calculate the distance across each particle.

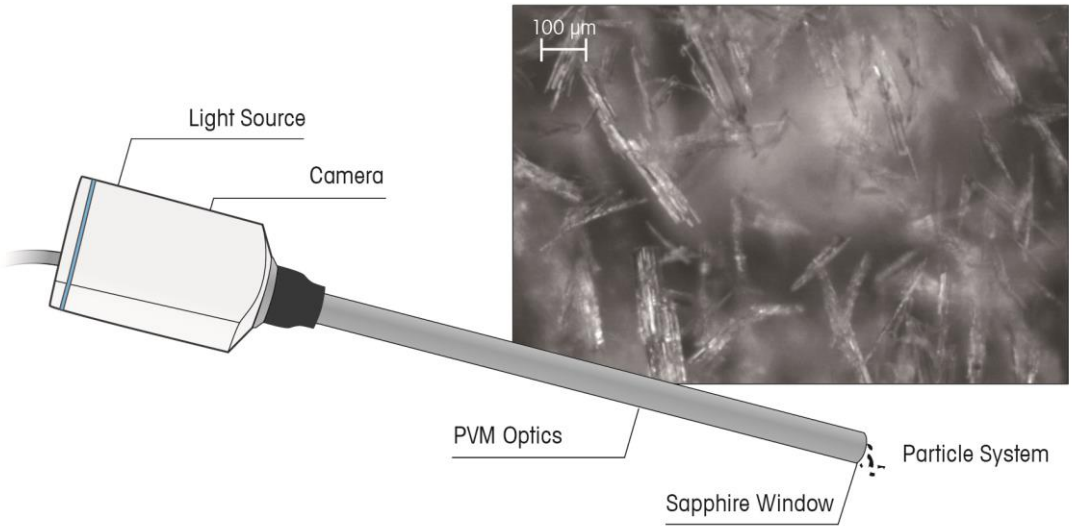
This distance is defined as the chord length, a fundamental measurement of the particle related to the particle size. Typically thousands of particles are counted and measured per second, allowing a precise and highly sensitive chord length distribution to be reported in real time.

The chord length distribution tracks how particle size and count change from the beginning, until the end of a process. Statistics from each chord length distribution, such as counts in fine and coarse size classes, can be trended over time.

Appendix B: ParticleView with PVM Technology

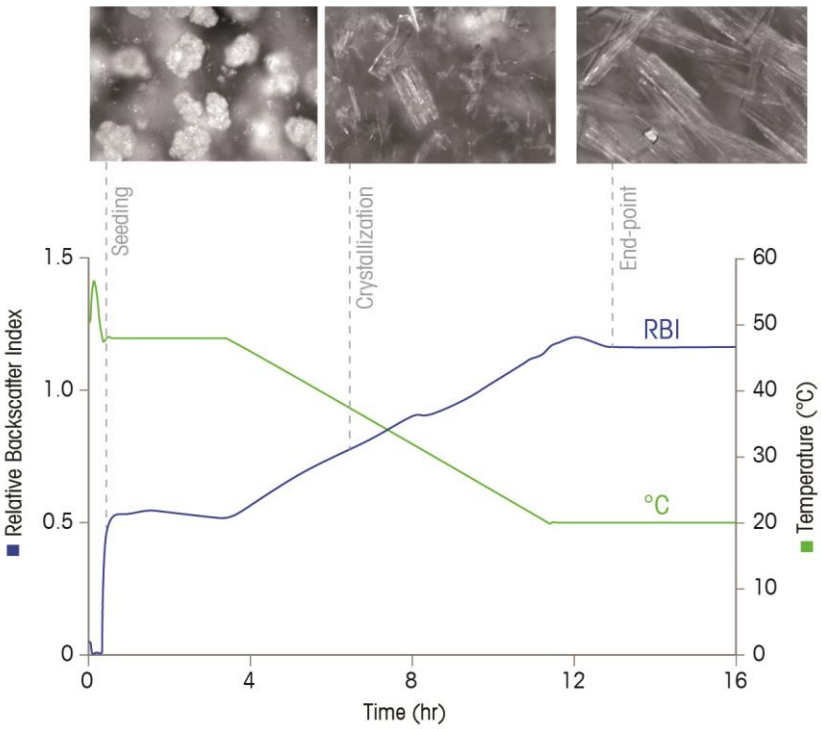
ParticleView V19 with PVM® technology is a probe-based instrument that visualizes particles and particle mechanisms in real time. High resolution images are continuously captured without the need for sampling or manual offline analysis. A process trend, sensitive to changes in particle size and concentration, is automatically combined with the most relevant images providing scientists with comprehensive process understanding.

To learn more visit **www.mt.com/ParticleView**



How Does ParticleView Work?
ParticleView uses a high resolution camera and internal illumination source to obtain images even in dark and concentrated suspensions or emulsions. With no calibration needed and easy data interpretation, ParticleView quickly provides critical knowledge of crystal, particle, and droplet behavior.

What is RBI?
ParticleView V19 with iC PVM uses information from every image that is collected to calculate an innovative process analytical trend called "Relative Backscatter Index (RBI). RBI is a measure of the overall reflectivity of a particle system and indicates how particle size, shape, and concentration is changing over time.



RBI is used to understand how changing process parameters affect process performance and combined with high resolution images provides comprehensive process understanding.

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The 2016 National Sustainability Summit will be held on the 11th October in the Citywest Hotel, Dublin.

Firstly, thanks to everyone that made last year's event such a success. Over 1000 delegate gathered to hear from 80 speakers and network with over 50 exhibitors offering cutting edge technology and services. This year we plan to expand the scope over the event with over 120 speakers. The speaker line up is drawn from senior management from the largest and most influential Irish and international companies who have delivered quantifiable eco results. Speakers come from areas such as pharmaceutical, food, aviation, retail, hospitality, food, construction, manufacturing, IT, logistics and supply chain and energy sectors will deliver compelling case studies that will help you create a sustainable business of your own or adapt your current business model.

Get ahead of your peers, and participate in the National Sustainability Summit for a engaging and thought-provoking event, which will stimulate debate and help you to make the correct decisions to improve sustainability and profitability.

Key topics will include:

Water Management, Energy Efficiency, Sustainable Energy, Recycling, Waste Reduction, Sustainable Construction & Buildings, Sustainable Food, Sustainable Manufacturing, Sustainable IT, Sustainable Technology, Consumer Engagement, Sustainable Packaging, Sustainable Logistics and Supply chain, Regulations and Policy, Sustainable Investment, Tax and Legal issues, Sustainable Transport, And Much More …

Register Now

To book your FREE place at the event

The 2016 EURACHEM Analytical Measurement Competition

This year's Eurachem Analytical Measurement Competition was hosted by AIT on April 15th. We are delighted that the competition has returned after a lapse of one year. Teams from Universities and Institutes of Technology all over the country travelled to Athlone to participate in this laboratory-based practical exercise in analytical chemistry.

This annual competition was inaugurated in 1999 under the auspices of the Association of Heads of Science at the Institutes of Technology. The aim of the competition is to make students aware, at an early stage in their training, of the importance of reliability in laboratory measurements. Participants, who work in teams of two, are given a sample which they must analyse by two different methods, according to the standard operating procedures provided. Alternatively, they may be presented with two entirely different samples for quantitative analysis. The methods involved usually involve a volumetric analysis by titration and a spectrophotometric measurement.

The competition is open to full-time science students attending any third level institution anywhere on the island of Ireland, who have not yet entered the third year of their course. The winners are those who achieve results closest to the reference value for both of the analytical measurements. Candidates are also expected to identify sources of uncertainty and as far as possible, to quantify the uncertainty in their measurements. In the event of a tie, the judges take into account the answers to a questionnaire which tests the students' understanding of the principles involved in the analytical method employed. The judges are experienced analytical chemists, based in industry or the Public Service (e.g. Forensic Laboratory, State Laboratory or the EPA.)

The Institute of Chemistry of Ireland awards prizes each year to the First Place winners and also presents a plaque to the winning College.

This year's overall winner was a team of students from Limerick Institute of Technology (LIT), Marcin Raszka and Jamie McNamara.

Runners up were Amy O'Donoghue & Nathan Feely of UCD and Sean O'Halloran & Ferial Smew from DCU.

Congratulations to all of the winners and indeed to all of the participants. Congratulations also to the organisers at AIT, who put in a great deal of preparation for a successful event and ensured that the day went smoothly.

We wish to express our thanks to Alexion Pharmaceuticals, Inc. Athlone, who also sponsored some of the prizes this year.

The judges' report is published next page.

Report compiled by Margaret Franklin, President of the Institute of Chemistry of Ireland.

Judges Report on the Eurachem Ireland Analytical Measurement Competition – Athlone Institute of Technology, April 15th, 2016

Judges: Dr Ray Leonard, Dr. Thomas Hannigan, Dr. Darragh Cunningham

The competition required students to determine the concentration of iron (II) in an unknown solution by a colorimetric method with 1,10-phenanthroline and in a second experiment to determine via titration the concentration of Iron (II) using standardised potassium permanganate.

Twenty three teams from Irish higher level institutions were evaluated based on experimental data and associated data handling, bench practice, knowledge of background theory and adherence to health and safety guidelines. The purpose of this report is to summarise the overall results and document various observations noted in the course of the day.

Overall team performance was evaluated based on the closeness of the reported result for each experiment to that of the "reference" result as measured by means of a "Z" score. A tolerance interval of [-1,1] was used to screen results – corresponding to approximately a 10% allowable error. Figure 1 summarises the overall individual performance of the teams, Z scores outside [-2,2] were set to either -2 or 2, such scores were invariably a result of calculation rather than experimental errors. The reference result was selected as 0.0198M for titration and 0.0083M for the colorimetric experiment to facilitate analysis of the overall scores.

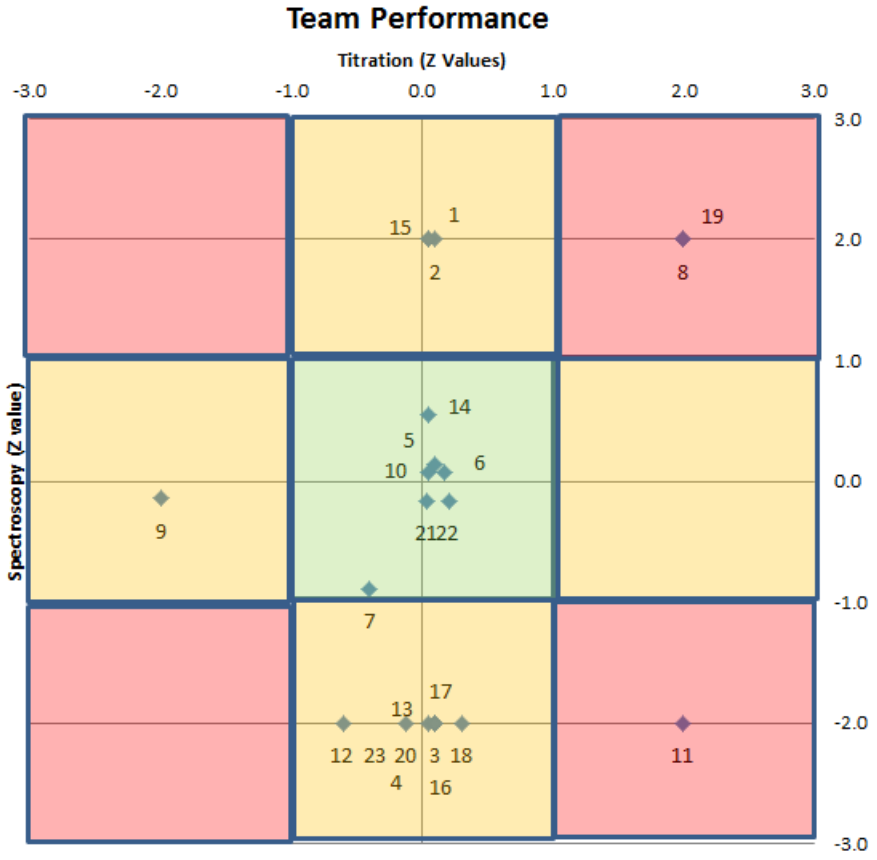


Figure 1: Overall Team Performance

Based on this criteria, seven teams reported satisfactory results for the Iron (II) concentration in both experiments. Team 10 were judged to be the overall winners based on having come closest to the expected answers in both experiments and the standard of their answers to the questionnaire. Teams 21 and 22 were judged to be the runners up.

Experimental

Each team was initially assessed on how close a team got to the reference value. A more detailed review was subsequently performed looking at each stage of the experiments and how each team performed within a stage

The spectrophotometric experiment consisted of three distinct stages namely:

A. Preparation of the Calibration Curve
B. Reading Unknown
C. Determination of Fe II

Twenty-two of the teams could have generated curves with a correlation coefficient ≥ 0.995 based on standard preparations and absorbance's obtained. Five teams determined the actual concentrations of the standards incorrectly. Two teams had one standard incorrectly plotted based on their data. Two teams had an incorrect x-axis selected (one using the volume of std added and the other plotting absorbance on the x axis).

Five teams reported either no result or an incorrect concentration of the unknown based on the calibration curve provided. In the majority of these cases, this was because the unknown as originally prepared is over range and no dilution was performed. A feature of this year was that a number of teams did not read their unknown from the calibration curve but determined it from the slope of the calibration curve based on two points.

The known concentration of FeII in the unknown was actually 0.02M – in its original form this solution gives an absorbance outside the calibration range. The original sample required a further dilution to bring the absorbance into range. This diluted sample, should have been brought through the whole procedure again (addition of phenanthroline, buffer solution and hydroxylamine hydrochloride solution). No team performed the dilution in this manner with most diluting the originally prepared unknown leading to some of the FeII being converted to FeIII, resulting in a decrease of the FeII concentration. The absorbances for the unknown sample in cases where it was diluted were consistent and based on the average absorbance, a 'reference' value of 8.3×10^{-3} mol dm^{-3} was used for evaluating performance. Eight teams (35%) obtained a valid result within 10% of the 'reference' value. Of the 15 teams failing to obtain a satisfactory answer, the underlying reasons were evenly split between:

a) obtaining an incorrect 'diluted' concentration largely because of an incorrectly constructed calibration or not performing a dilution and

b) Incorrectly calculating the FeII concentration in the original sample.

Teams were also asked to comment on whether the graph obeys the Beer-Lambert law which most answered correctly regarding the linear nature of the curve going through the origin.

The titration experiment consisted of the following stages:

A. Standardisation of Potassium Permanganate
B. Determination of [FeII] solution with Potassium Permanganate

Nearly 90% of teams correctly standardised the $KMnO_4$ reagent. The three teams which failed to do so either used the incorrect stoichiometry or in one case, a correction was applied for the addition of the H_2SO_4. Only 1 team, failed to get an acceptable answer, having correctly standardised the permanganate solution (a blunder, 8.1 ml converted to 0.081 l).

Overall sixteen teams (~ 80%) successfully reported the correct FeII concentration in the unknown 2.0 x 10^{-3} mol dm^{-3}. In general, the results were slightly biased high, which is an artefact of the reporting of the final result where users were asked to report to two significant figures in the majority of cases this was understood by the students to be to two decimal places and in many cases, students did not write down the original result before rounding for reporting purposes. To highlight this effect, the original (unrounded) experimental result of 1.98 x 10^{-3} mol dm^{-3} was used as a reference value.

Questionnaire

The questionnaire was important in deciding overall positions this year given the number of teams which had satisfactory results in both experiments and answers to the questionnaire largely determined the final positions. Each question was marked out of 5 and the average results are displayed below. One team (5) failed to submit an answer sheet.

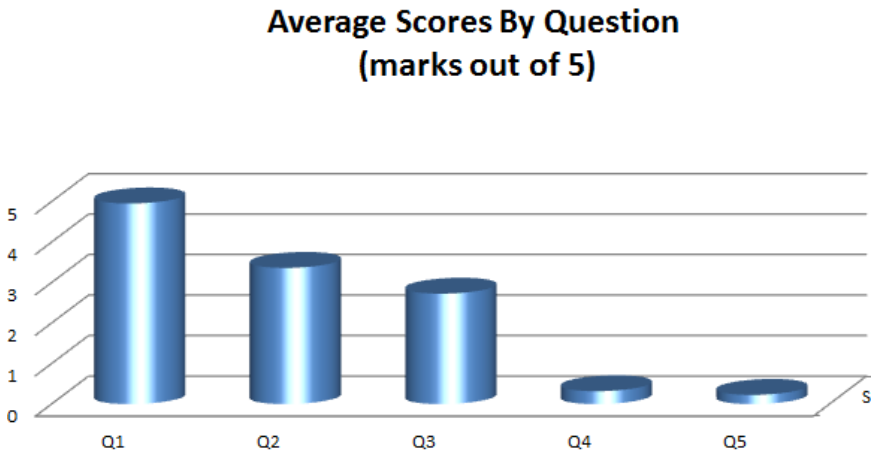


Figure 2: Questionnaire Results

From this analysis question 1, regarding definition of precision and accuracy was answered correctly by nearly all teams. Most teams were also able to provide at least one advantage of either technique, although teams were asked to provide an advantage for **each** method. Question 3 regarding the students opinion as to which technique gave the more accurate result saw a lot of confusion regarding the difference between sensitivity and accuracy, with many teams selecting the colorimetric method. Question 4, asked users to comment in the why a buffer was used with two teams correctly identifying the impact of low pH in the colorimetric method. Only one team correctly identified the role of hydroxylamine in the colorimetric method.

Health and Safety

All teams showed good awareness of Health and Safety issues with regards to keeping the work area clean and the wearing of white coats, glasses and gloves. Bench practice was good and the majority of teams showed both good teamwork and organisation and were able to successfully complete the experimental work within the time allotted. General bench tidiness was of a high standard.

Summary

There was a very high success rate in the Titrimetric experiment with most students correctly performing the experiments and calculating the correct result, this was a much higher success rate than in previous years. The success rate in the colorimetric experiment was lower but consistent with previous years, once the failure to repeat the whole procedure for the diluted sample was accounted for.

There was little difference in the success rates depending on the order in which teams performed the experiments. Questionnaire scores were nearly identical between the two groups which suggests the fact that there were two question regarding the colorimetric method did not favour those teams who had just completed that method.

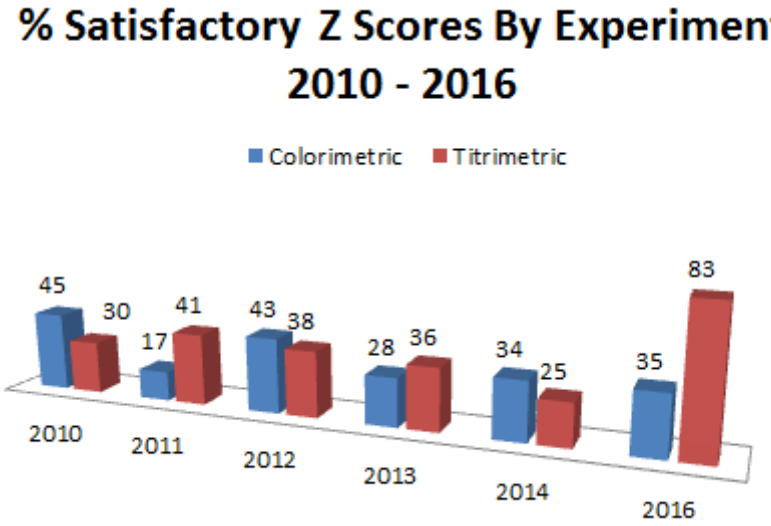


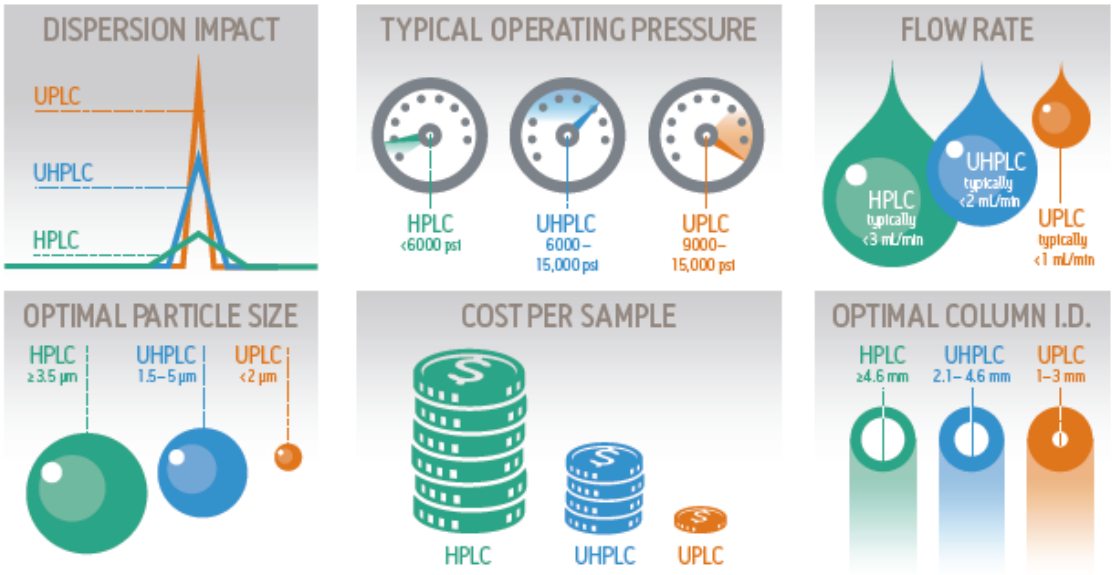
Figure 3: Comparison with previous years

Finally the judges wish to congratulate Brian Murphy, Cynthia Coyne and the staff at AIT for a very well organised and run competition.

Compiled by: D.Cunningham, T.Hannigan & R. Leonard

DISPERSION MATTERS: RETHINKING LC SEPARATION CATEGORIES

For the best system performance, pair the right system dispersion and characteristics with the right column.



Eurachem Analytical Measuring Competition April 15th 2016 held in AIT

2016 EURACHEM ANALYTICAL MEASUREMENT COMPETITION WINNERS

LIMERICK INSTITUTE OF TECHNOLOGY

Competition winners Marcin Raszka and Jamie McNamara being presented with their trophies by Professor Ciaran O'Cathain, President of AIT and by Susan Neenan, Senior Director QA Site Operations at Alexion Pharmaceuicals Inc. Also in the picture are the accompanying lecturers from LIT, Dr. Josephine Treacy and Dr. Elaine Raggett.

Judges: Dr. Tom Hannigan, State ForensicsLaboratory;

Dr. Ray Leonard , ex Directorate Analytical Services, Loctite Ireland;

Dr. Darragh Cunningham,EPA; judged the competition this year.

Above is a picture of the two accompanying lecturers from LIT, Dr. Elaine Raggett and Dr. Josephine Treacy, being presented with their plaque by Institute President, Margaret Franklin.

The two Runner-Up Teams from UCD and DCU

Picture of the Eurachem runner up team from UCD being presented with their prize plaques. Congratulations!

L to R: Dr. Don Faller, Head of Science, AIT, Professor Ciaran O' Cathain, President, AIT, Amy O'Donoghue and Nathan Feely, winners of Runner-up prize, Susan Neenan, Alexicon Pharmaceuticals, and Dr. Eoghan McGarrigle, UCD.

L to R : Professor Ciaran O'Cathain (President, AIT), Ferial Smew (Runner-up, DCU) Sean O'Halloran (Runner-up, DCU), Susan Neenan (Alexion Pharmaceuticals), Dr. Pat O'Malley (Lecturer, DCU), Dr. Don Faller, (Head of Science Faculty, AIT).

A group photograph of the two participating teams form LIT below.

EAMC 2016 Participating teams from LIT: Jamie McNamara, Marcin Raszka, Ahmed Hassen and Blanca Arino, with their accompanying lecturers, Dr. Josephone Treacy and Dr. Elaine Raggett.

Athlone Institute of Technology

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

5 Questions on Climate Change

Professor John Sodeau, UCC: There are now measurements from NASA that show the 10 warmest years in the 134-year record that is available (since 1884) have all occurred since 2000, with the exception of 1998. Photo: Emmet Curtin.

Professor John Sodeau discusses climate change and what Ireland can do to play its part in the fight against the phenomenon termed global warming.

97% of climate scientists believe that we humans have a direct influence on our climate and are responsible for the phenomenon termed global warming. After many years of dithering, politicians have recognised that something needs to be done, and done quickly, to avoid globally catastrophic events such as drought, extreme weather events, desertification, food shortages and mass-scale emigrations from the most likely affected countries such as Bangladesh. But the general public still are skeptical, in part due to some politicians who hold strident opinions not based on scientific facts.

Fortunately, a fight-back by people who are knowledgeable has begun to happen. For example, a striking temperature spiral graphic was shown at the recent opening ceremony of the Rio Olympic Games to show how close we are to now breaching the 1.5 ^{o}C barrier beyond which our planet might not be able to environmentally recover. And so here is my own small contribution to the debate.

Q. *Is a greenhouse a good way of explaining to the public why climate change is happening?*

A. It is good for explaining the **natural** (or baseline) Greenhouse Effect that allows planet Earth to be habitable. As we all know seedlings, flowers and vegetables thrive in the glass structures often found in our gardens. And we thrive in a world that has an atmosphere like ours. Ultraviolet and visible light from the Sun gets through to the surface turning into heat, which then tries to escape the planet. But much of it is effectively trapped by an atmosphere that contains water vapour, carbon dioxide and ozone.

However, there is a better analogy for the **enhanced** Greenhouse Effect that we have experienced since the Industrial Revolution began in about 1830. That is to think of our atmosphere as a woolen shawl with holes in it. Then, if we increase the thickness of the wool (the carbon dioxide content) or fill in the holes (with other “Greenhouse” materials like methane or nitrous oxide or soot-like particles), we get hotter. And that is the global warming experience we read about most days of the week now, although that is just one of the changes in our climate system that we are currently experiencing.

Q. *Who is to blame for global warming?*

A. We all are because we all want three cars, four TVs and five laptops/i-Pads/mobile phones in every household (go on count them!) Using all that energy in a fossil fuel based economy leads to carbon dioxide production. But if we want to identify some particular whipping boys besides prevaricating politicians and decision makers around the world then one of them would be me for keeping quiet for too long about the dangers we face from climate change. The reason I have held back, but it's not a good enough defence really, is that scientists tend to use safe, precise, remote vocabulary that has any emotional resonance stripped away. And so we often lose the ability to communicate effectively with the general public. That has meant demagogues and village idiots have been allowed to occupy (until recently) an empty playing field in order to seize the climate change agenda for their own purposes.

Q. *What current scientific data is available about climate change that worries you the most?*

A. There are three, likely connected, sets of measurements that have worried me from observations made over the last couple of years. The first is from an Observatory sited in a remote location in Hawaii called Mauna Loa. Measurements of carbon dioxide levels in the atmosphere have been taken there since 1958. Between 1960 and the mid-seventies the increase was about a 1 ppmv (parts per million by volume) increase on average per year. This value increased to an average of about 1.5 ppmv between 1975 and 1995 and again increased after that, by about 2015, to a level of 2 ppmv. But between 2015 and 2016 the figure doubled to 4 ppmv. That worries me.

Also there are now measurements from NASA that show the 10 warmest years in the 134-year record that is available (since 1884) have all occurred since 2000, with the exception of 1998. And the year 2015 ranks as the warmest on record!

And then there are the record lows in Arctic sea-ice that have been observed this past year.

Q. *Is it too late for us to prevent the environmental problems (such as extreme weather events, drought, food insecurity and mass migrations) predicted to accompany climate change over the next 30 years?*

A. It might be.

Q. *What can Ireland do to play its part in the fight against global warming?*

A. Individuals can always do more by reducing their carbon footprint in a fossil fuel-based economy. But every country can always do more by continually assessing their policies about agriculture, transportation and generation of energy that underpin their respective economies. However, we should be wary of making political deals that put the strength of the national economy first and foremost. No matter what the calculations about “Greenhouse” gas reductions are and the relative fairness to national economies, we should all aim to reduce our footprints to zero. Otherwise triumphant politicians may simply win Pyrrhic victories because the various national economies will not be there if we are under water or live in a desert or on an island that has no fields or wildlife or agriculture. Just trees.

John Sodeau is an atmospheric scientist who has who has performed research in the area since the late 1970s. When he worked in the University of California at Irvine, UCI, he had coffee most mornings with Sherry Rowland and Mario Molina who were soon to win a Noble Prize in Chemistry for making the connection between chlorofluorocarbons (CFCs) and stratospheric ozone depletion. He came to UCC in 1998 where he set up the Centre for Research into Atmospheric Chemistry, CRACLab, which is part of the Chemistry Department and the ERI, alongside John Wenger. He had an epiphany about two years ago when he realised how little scientific knowledge breakfast-time radio presenters possessed and decided to become much more active in communicating with the public about the problems and challenges we face with air pollution and global warming. Check out the crac.ucc.ie website for much more information on air pollution and climate change.

Breakthrough as US and China agree to ratify Paris Climate Deal

Extracted from Guardian newspaper on line report 5/8/2016

https://www.theguardian.com/environment/2016/sep/03/breakthrough-us-china-agree-ratify-paris-climate-change-deal

Campaigners hail key moment in battle against global warming as presidents Obama and Xi announce deal on eve of G20 summit in Hangzhou

The United States and China, the world's biggest emitters of greenhouse gases, have announced they will formally ratify the Paris climate change agreement in a move campaigners immediately hailed as a significant advance in the battle against global warming.

Speaking on Saturday, on the eve of the G20 summit in Hangzhou, US president, Barack Obama, confirmed the long-awaited move, the result of weeks of intense negotiations by Chinese and American officials.

"Just as I believe the Paris agreement will ultimately prove to be a turning point for our planet, I believe that history will judge today's efforts as pivotal," said Obama, who was speaking in the presence of the Chinese president, Xi Jinping, and United Nations secretary general, Ban Ki-moon.

G20 summit: US and China ratify Paris climate change agreement - as it happened

"Where there is a will and there is a vision and where countries like China and the United States are prepared to show leadership and to lead by example, it is possible for us to create a world that is more secure, more prosperous and more free than the one that was left for us," added Obama, for whom the commitment is part of a final push to secure a green legacy for his presidency.

Earlier China had announced it would formally ratify the Paris accord with President Xi vowing to "unwaveringly pursue sustainable development".

"Our response to climate change bears on the future of our people and the well-being of mankind," Xi said, according to the Associated Press.

Obama said the joint announcement showed how the world's two largest economies were capable of coming together to fight climate change.

"Despite our differences on other issues we hope that our willingness to work together on this issue will inspire greater ambition and greater action around the world," he said.

"We have a saying in America that you need to put your money where your mouth is," Obama told an audience at Hangzhou's West Lake state guesthouse. "And when it comes to combating climate change that is what we are doing … we are leading by example."

If the Paris agreement comes into force this year as hoped, it means the nearly 200 governments party to it will become obliged to meet emissions-cutting pledges made before the deal last December. For example, the EU has a "national determined contribution" of cutting emissions by 40% by 2030 on 1990 levels, and the US by up to 28% by 2025 compared with 2005.

The deal coming into force would also commit the countries to aspire to keep temperatures below 1.5C above pre-industrial levels – a tall ask and one that will require those country pledges to be ramped up – and for rich countries to continue giving climate aid to poorer countries beyond 2020.

Analysis Paris climate deal: key points at a glance

The goal of 1.5C is a big leap below the 2C agreed six years ago in Copenhagen. Here's what the agreement means for global emissions and the future of the planet

David Waskow, the international climate director of the World Resources Institute, a Washington-based thinktank, described the US-China announcement as a sign the world's two largest economies had moved from "making commitments to delivering action".

"When the two largest emitters lock arms to solve climate change, that is when you know we are on the right track," Waskow said. "Never before have these two countries worked so closely together to address a global challenge. There's no question that this historic partnership on climate change will be one of the defining legacies of Obama's presidency."

Ranping Song, the group's China expert, called the announcement "a tremendous milestone" in the fight against climate change. "[This is] the two big countries coming together to acknowledge the challenges and then working together to tackle them," Song said. "It's good news."

"The world finally has a global climate agreement with both the US and China as formal parties," said Jennifer Morgan, the executive director of Greenpeace International. "This signals a new era in global efforts to address climate change."

In Washington, the Republican-controlled Congress has questioned Obama's legal right to ratify the accord by decree, noting that the constitution grants the Senate a role of "advice and consent" in making treaties.

But the chamber does not ratify treaties, and the US also has increasingly relied on "executive agreements" since the second world war. Those agreements are not submitted to the Senate but are also considered binding in international law.

The Paris agreement, sealed last December after two weeks of frantic negotiations, must be ratified by 55 countries, representing 55% of global emissions, in order to come into force.

The news that the world's top two emitters – who are together responsible for about 38% of emissions – would formally ratify the deal is therefore a major step towards achieving that.

Before Saturday, only 24 countries – responsible for about 1% of global emissions – had ratified the agreement, while 180 had signed it.

Shortly before Obama landed in Hangzhou, China became the 25th country to ratify the agreement. It said the move would "safeguard environmental security" and was "conducive to China's development interests".

Song said the move increased the likelihood that the Paris deal would be implemented by the end of this year, possibly even before November's UN climate summit in Marrakesh. "This would not be happening without the US and China ratifying the agreement," he said.

Climate campaigners now expected a ratification "surge" in September, with other major emitters such as Brazil, the world's seventh largest emitter, following suit, Song added.

Li Shuo, Greenpeace's China climate policy adviser, said that if the international community did succeed in bringing the Paris deal into effect by the end of 2016 it would have been achieved "at lightening speed" compared with most international treaties.

ICI Schools Chemistry Newsletter Winner 2015/16

Tim Hannon, St. Flannan's College, Ennis, Co. Clare winner of this year's School's Newsletter Competition

Introduction

From the beginning of time, we have used the Sun's rays to warm ourselves during the day and the glow of a weary flame to accompany our nights. Now man has mastered the inter-conversion of energy in order to produce light from electricity, heat and chemical reactions.

Every day in our modern world, we use chemistry and light in communication, electronics, medicine and entertainment. It is the ambition of science, to devise ever more effective ways of converting sunlight into energy and ultimately create a safe, clean, and sustainable means of fulfilling the worlds ever growing energy needs.

Without experiment I am nothing." - Michael Faraday

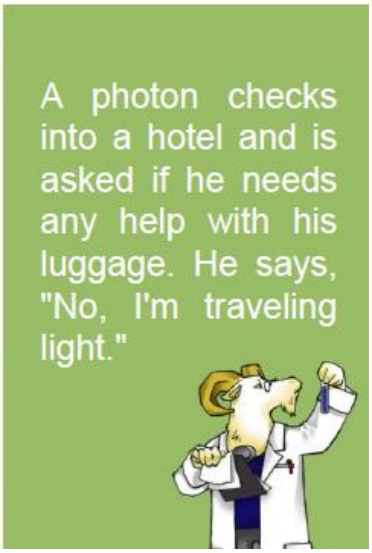
What Is Light?

Light is part of the electromagnetic spectrum, which ranges from radio waves to gamma rays. Electromagnetic radiation waves, as their names suggest are fluctuations of electric and magnetic fields, which can transport energy from one location to another. Visible light is not inherently different from the other parts of the electromagnetic spectrum with the exception that the human eye can detect visible waves.

Electromagnetic radiation can also be described in terms of a stream of photons which are massless particles each travelling with wavelike properties at the speed of light, I shall give a more comprehensive insight into the role of photons as the newsletter progresses.

How Does Light Travel?

Light travels in the form of waves. These are transverse waves, much like the ripples in a tank of water. The direction of vibration in the waves is approximately 90 degrees to the direction that the light travels. One property which light waves possess which sound waves do not, is that light waves can travel through a vacuum. Light waves can travel through transparent and translucent substances also.



The speed of light VS the speed of Sound

So which is faster, the speed of light or the speed of sound?

Light is by far the fastest, in fact it is the fastest thing in the universe which we are "currently aware of". Hence the term "Light speed", often employed by science fiction writers. Light travels at a maximum speed of (300,000,000 m/s), when it travels through a vacuum, where as sound travels at a speed of (343m/s) in air.

To put this stark contrast into perspective, consider this. Light travels so fast that if you had the ability to travel at the speed of light, you could theoretically circumnavigate the Earth in less than the time it takes to snap your finger.

It is this enormous difference in speed which has given rise to phenomena such as the delay between lightning and thunder. This delay is due to the fact that light from a lightning bolt reaches us many orders of magnitude faster than the compression wave which it creates. It is also why you see a firework explode before you hear it.

Spectroscopy

Spectroscopy is the study of the interaction of electromagnetic radiation in all its forms with matter. When a beam of white light strikes a triangular prism it is separated into its various components (ROYGBIV). This is known as a spectrum. The range of visible wavelengths is 400 to 700 nanometers. The optical system which allows production and viewing of the spectrum is called a spectroscope. There are many other forms of light which are not visible to the human eye and spectroscopy is extended to cover all these. Such as Ultraviolet light and Infrared radiation.

Ultraviolet Light

Ultraviolet light is a type of electromagnetic radiation, as are radio waves, infrared radiation, X-rays and gamma-rays. UV light, which comes from the sun, is invisible to the human eye. It makes black-light posters glow, and is responsible for summer tans — and sunburns. However, too much exposure to UV radiation is damaging to living tissue. Getting painful sunburn, just once every 2 years, can triple your risk of melanoma skin cancer.

Infrared radiation (IR)

Infrared radiation is a type of electromagnetic radiation, Infrared (IR) light is the part of the EM spectrum that people encounter most in everyday life, although much of it goes unnoticed. It is invisible to human eyes, but people can feel it as a result of the heat it generates.

IR radiation is one of the three ways heat is transferred from one place to another, the other two being convection and conduction. Everything with a temperature above about 5 degrees Kelvin (minus 450 degrees Fahrenheit or minus 268 degrees Celsius) emits IR radiation. The sun gives off half of its total energy as IR, and much of its visible light is absorbed and re-emitted in the form of Infrared radiation.

The Light of the Sun

The Sun is constantly releasing energy, which we see in the form of light and feel in the form of heat. The Sun generates this energy in a process known as Thermonuclear fusion, this happens at the core of the Star. The energy of fusion is released in the form of a photon, which is an energy-carrying particle that moves at the speed of light.

A photon released by one atom collides with another atom, energizing it and causing it to release another photon, which collides with yet another atom, and so on. Through this chain of events, energy radiates out from the core of the Sun, which is the only part that is hot enough to sustain fusion reactions. The sun emits many different forms of electromagnetic radiation, 99% of its rays are in the form of visible light, ultraviolet rays, and infrared rays. The Solar energy emitted by the Sun, warms the Earth and allows for photosynthesis to take place. Without the existence of our Sun, life on Earth would be virtually impossible.

Photosynthesis

Photosynthesis is the process used by plants, algae and certain bacteria to harness energy from sunlight. It converts the Sun’s solar energy into chemical energy. There are two types of photosynthetic processes: oxygenic photosynthesis and anoxygenic photosynthesis. Oxygenic photosynthesis is the most common and is seen in plants, algae and cyanobacteria.

During oxygenic photosynthesis, light energy transfers electrons from water (H_2O) to carbon dioxide (CO_2), which produces carbohydrates. In this transfer, the CO_2 is "reduced," or receives electrons, and the water becomes "oxidized," or loses electrons. Ultimately, oxygen is produced along with carbohydrates. The Equation below outlines effectively what is taking place during photosynthesis.

Solar Energy

It is estimated that solar energy will account for between (8-15%) of global electricity by the year 2050,depending upon energy policy, manufacturing costs and technological advances. In 1905, Albert Einstein described the nature of light and the photoelectric effect, for which he later won a Nobel Prize in physics. All modern Photovoltaic technology is based upon Einstein's ground breaking discoveries and work.

Photovoltaic literally means "light" and "electric."

Electricity can be produced directly from photovoltaic technology, PV, cells. When sunshine hits the PV cell, the photons of light excite the electrons in the cell and cause them to flow, thus generating electricity. Scientists across the globe are currently researching the possibilities of using sunlight in order to produce molecules such as hydrogen, carbon monoxide and methanol and carbon dioxide (Artifical Photosynthesis).

Fire and Faraday's Candle

Before electric light was commonplace, all artificial light was produced by means of chemistry. Light is often the result of combustion or heating, or both. A simple fire produces light because the sticks or coals get sufficiently hot to glow red – "red hot".

Gas was widely used for streetlights and in the home, but a gas flame itself does not produce much illumination. It was found, however, that heating a substance such as (Calcium hydroxide, Ca(OH)2) lime (hence the term 'in the limelight') or a mantle impregnated with thorium produced a brilliant white light. This principle is still used in mobile lighting and gas lamps used for camping, although thorium has generally been replaced by other elements such as yttrium (yttrium oxide, Y2O3), zirconium, (Zirconium dioxide ,ZrO2) and cerium (Cerium (IV) oxide, CeO20).
The candle was the centrepiece of one of the most famous series of popular science lectures. The six Christmas lectures delivered by Michael Faraday at the Royal Institution in December 1860 and January 1861 were on The Chemical History of a Candle.

Over the course of the lectures Faraday demonstrated to his audiences of around 700 many aspects of the chemistry relating to candles. Starting with how candles can be produced, he ranged far and wide and covered, using deceptively simple experiments, chemical themes including the composition of the gases produced on burning and the structure of the flame itself.

Bioluminescence

Bioluminescence is light produced by a chemical reaction within a living organism. Bioluminescence is a type of chemiluminescence, which is simply the term for a chemical reaction where light is produced. Bioluminescence is a "cold light." Cold light means less than 20% of the light generates thermal radiation, or heat.

Most bioluminescent organisms are found in the ocean. These bioluminescent marine species include fish, bacteria, and jellies. Some bioluminescent organisms, including fireflies and fungi, which are found on land. There are almost no bioluminescent organisms native to fresh water habitats.

The chemical reaction that results in bioluminescence requires two unique chemicals: luciferin and either luciferase or photoprotein. Luciferin is the compound that actually produces light. In a chemical reaction, luciferin is called the substrate. The bioluminescent colour (yellow in fireflies, greenish in lanternfish) is a result of the arrangement of luciferin molecules.

Some bioluminescent organisms produce (synthesize) luciferin on their own. Dinoflagellates, for instance, bioluminesce in a bluish-green color. Bioluminescent dinoflagellates are a type of plankton—tiny marine organisms that can sometimes cause the surface of the ocean to sparkle at night.

Chemiluminescence (The Luminol Effect)

Chemiluminescence is the production of light from a chemical reaction. Two chemicals react to form an excited (high-energy) intermediate, which breaks down releasing some of its energy as photons of light.

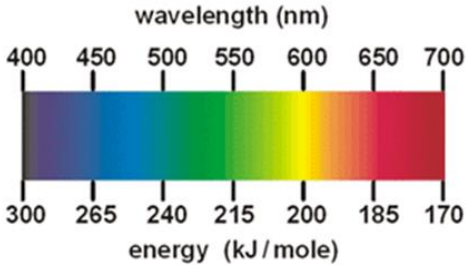
One good example of chemiluminescence practical applications, is the use of Luminol ($C_8H_7N_3O_2$) in forensic science. Forensic investigators use luminol to detect trace amounts of blood at crime scenes, as it reacts with the iron in hemoglobin. Biologists use it in cellular assays to detect copper, iron, and cyanides, as well as specific proteins by western blot (a core technique in cell and molecular biology).

When luminol is sprayed evenly across an area, trace amounts of an activating oxidant make the luminol emit a blue glow that can be seen in a darkened room. The glow only lasts about 30 seconds, but investigators can document the effect with a long-exposure photograph. Crime scene investigators must apply it evenly to avoid misleading results, as blood traces appear more concentrated in areas that receive more spray. The intensity of the glow does not indicate the amount of blood or other activator present, but only shows the distribution of trace amounts of in the area.

Luciferase is an enzyme.
An enzyme is a chemical (called a catalyst) that interacts with a substrate to alter the rate of a chemical reaction without being used up in the process. The interaction of the luciferase with oxidized (oxygen-added) luciferin creates a byproduct, called oxyluciferin. More importantly, the chemical reaction creates light.

Fireworks and Light

The multitude of colours we see in fireworks are produced by the use of different metallic salts. When ions of the metallic elements in each salt are heated their electrons become excited. Excited electrons drop back down to lower energy levels and release light of very specific colors in the process. This makes for a beautiful demonstration and colourful fireworks. It also allows one to determine with great ease which metallic salts were used in the production of the fireworks.



The atoms of each element absorb energy and release it as light of specific colors. The energy absorbed by an atom rearranges its electrons from their lowest-energy state, called the ground state, up to a higher-energy state, called an excited state. The excess energy of the excited state is emitted as light, as the electrons descend to lower-energy states, and ultimately, the ground state. The amount of energy emitted is characteristic of the element, and the amount of energy determines the color of the light emitted. For example, when sodium nitrate is heated, the electrons of the sodium atoms absorb heat energy and become excited. This high-energy excited state does not last for long, and the excited electrons of the sodium atom quickly release their energy, about 200 kJ/mol, which is the energy of yellow light.

The amount of energy released, which varies from element to element, is characterized by a particular wavelength of light. Higher energies correspond to shorter wavelength light, whose characteristic colors are located in the violet/blue region of the visible spectrum. Lower energies correspond to longer wavelength light, at the orange/red end of the spectrum.

Light and Circadian clocks

Embedded within our genes, and almost all life on Earth, are the instructions for a biological clock that marks the passage of approximately 24 hours. Biological clocks, or "circadian clocks" (circa "about", diem "a day"), help time our sleep patterns, alertness, mood, physical strength, blood pressure and much more.

About 1% of the cells that form the optic nerve are directly sensitive to light. These photosensitive retinal ganglion cells (PRGCs) detect the dawn/dusk cycle and send projections to the SCN (The suprachiasmatic

nucleus) and force the molecular clock to be exactly 24-hours long. Under normal conditions, we experience a 24-hour pattern of light and dark, and our circadian clock uses this signal to align biological time to the day and night. The clock is then used to anticipate the differing demands of the 24-hour day and fine-tune physiology and behaviour in advance of the changing conditions. Body temperature drops, blood pressure decreases, cognitive performance drops and tiredness increases in anticipation of going to bed. Before dawn, metabolism is geared up in anticipation of increased activity when we wake.

Sleep and Circadian Rhythm Disruption (SCRD) occurs when our natural circadian rhythms are pushed out of sync. Small changes in brain function can have a big impact on sleep, and disrupted sleep leads to health problems ranging across increased stress hormones, heart disease, weight abnormalities, reduced immunity, increased risk of cancer, and emotional and cognitive problems.

Severe SCRD is a feature shared by some of the most challenging diseases of our time – from schizophrenia and bipolar disorder to Alzheimer's and stroke, as well as in serious disorders of the eye. SCRD is also widespread in the ageing population, those who work shifts and everyone affected by the demands of today's 24/7 society. Despite the prevalence of SCRD, its origins remain a mystery, its detection is frequently overlooked, and it is rarely treated.

The Effects of Artificial Light

Artificial light is composed of visible light as well as some ultraviolet (UV) and infrared (IR) radiations, and there is a concern that the emission levels of some lamps could be harmful for the skin and the eyes. Both natural and artificial light can also disrupt the human body clock and the hormonal system (as I have previously said), and this can cause health problems. The ultraviolet and the blue components of light have the greatest potential to cause harm.

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Industry and Business
Promoting Manufacturing Excellence

Posted on 04 August 2016

€40 million funding granted to 24 research projects

Minister for Jobs, Enterprise and Innovation, Mary Mitchell-O'Connor TD today announced nearly €40 million in research funding for 24 major research projects. The funding is distributed via Science Foundation Ireland's Investigators Programme through a funding stream provided by the Department of Jobs, Enterprise & Innovation. With awards ranging from €500,000 to €2.7 million over four to five year periods, projects funded by the Investigators Programme will support over 200 researchers.

Minister for Jobs, Enterprise and Innovation, Mary Mitchell O'Connor TD said, "*This funding provides an important platform for researchers to advance their investigations and further enhance Ireland's reputation for excellence in sectors such as health, agriculture, marine, energy and technology. Engaging with 39 companies, the programme offers researchers the opportunity to develop their careers, as well as providing industry collaborators with access to the wealth of outstanding expertise and infrastructure found throughout the island. The alignment of the Investigators Programme with Horizon 2020, the European Union's research funding programme, will lead to further successes in leveraging EU resources and increasing international collaboration. The projects within this programme clearly demonstrate excellent and impactful research which is a key goal of the Government's science and innovation strategy – Innovation 2020.*"

To drive national success in Horizon 2020, the SFI Investigator Programme involved the collaborative participation of a number of Government Departments and funding agencies. Co-funding for seven of the projects is being provided by the Department for the Economy, Northern Ireland (DfE), the Geological Survey of Ireland (GSI), the Marine Institute (MI), and the Environmental Protection Agency (EPA).

Professor Mark Ferguson, Director General of Science Foundation Ireland and Chief Scientific Adviser to the Government of Ireland added, "*The Science Foundation Ireland Investigators Programme supports the highest standard of impactful research, as clearly demonstrated by the outcomes of previous awards. I have high expectations for these projects; all have undergone rigorous peer review by international experts and we have funded only those projects deemed to be at the pinnacle of scientific excellence. As well as providing an important platform for engagement in Horizon 2020, the programme also creates training and employment opportunities, promotes industrial collaboration and drives advances in energy, agriculture, science, technology and health which will benefit Ireland's economy and society.*"

The 24 research projects funded are in a range of strategically important sectors. A further ten projects were also deemed scientifically excellent and impactful by the International Review Panel and are on a reserve list to be funded, if budgets permit later in the year.

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Jazz Pharmaceuticals™
Innovation that performs

Posted on04 August 2016.

Drug manufacturer Jazz opens €50m facility

Posted on 04 August 2016.

Jazz Pharmaceuticals today announced that the Minister for Jobs, Enterprise and Innovation, Ms. Mary Mitchell O'Connor and the Global Head of Life Sciences of IDA Ireland, Mr. Barry Heavey joined the Chairman and Chief Executive of Jazz, Bruce Cozadd, at a ceremony today to mark the official opening of a new Jazz manufacturing and development facility on a 17 acre site in Monksland in Co. Roscommon, near Athlone, Ireland. The opening was also attended by local Independent TD and Minister for Communications, Climate Change and Environment, Mr. Denis Naughton TD.

This is the first directly owned, managed and operated manufacturing facility built by Jazz and the company has invested approximately €50 million in its development, which commenced in February 2014 and was supported by IDA Ireland. The facility has recently secured full regulatory approval from the United States (U.S.) Food and Drugs Administration (FDA) and the Health Products Regulatory Authority in Ireland. The company expects to employ up to 50 people within three years. Jazz is a global pharmaceutical company with its headquarters in Dublin, Ireland where it employees approximately 100 people, and with operations in multiple cities in the U.S., in Oxford, England and in Villa Guardia, Italy.

Speaking at the event, Mr. Cozadd said, "This new manufacturing and development facility is an investment in Ireland and also an investment in our growing global infrastructure, which will enable us to more closely oversee and control the process of bringing high quality products to patients. It is particularly meaningful for us to open it in Ireland, close to our global corporate headquarters in Dublin," said Mr. Cozadd. "We were encouraged to come to Roscommon because of the excellent track record of this community in supporting the pharmaceutical industry and the pool of local talent available. We would like to acknowledge the local community, the Roscommon Country Council and IDA Ireland for their continued support and collaboration, and note the remarkable pro-business environment in Ireland that facilitates investments like this one."

Speaking at the event, Minister Mary Mitchell O'Connor said, "I'm delighted to be present today to mark the official opening of Jazz Pharmaceuticals' first manufacturing plant in Ireland. Having a global pharmaceutical company of this calibre establish such a facility in Co. Roscommon is hugely significant, demonstrating serious commitment by the company to the region. The jobs created when the facility is operating at full capacity will be of great benefit to the local area and economy."

"Today's opening and significant investment by Jazz Pharmaceuticals is hugely important for Monksland. It is a testament to the talent and expertise of the people of Roscommon. We welcome the new facility and greatly appreciate the investment and loyalty to the region shown by Jazz Pharmaceuticals and to the people of Roscommon," said Minister Naughten.

Barry Heavey, IDA Ireland's Global Head of Life Sciences said, "IDA Ireland is very pleased to see this significant and strategically important development for Jazz Pharmaceuticals come to fruition. It demonstrates Ireland's ability to support manufacturing for this sector in regional locations and confirms the company's commitment to expanding its presence in Ireland."

Industry and Business
Promoting Manufacturing Excellence

Posted on 21 July 2016.

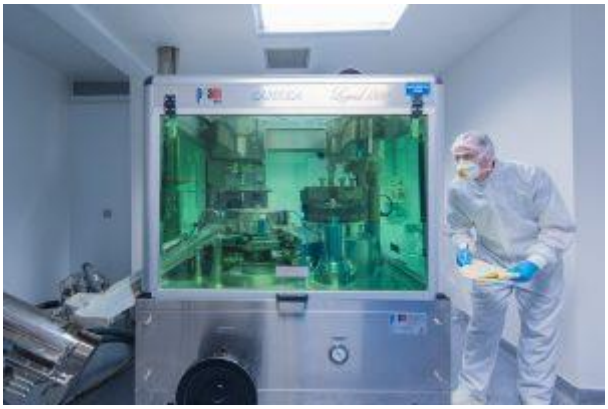
Chanelle Group Accelerates Export Growth

Chanelle Group, which is the largest Irish-owned manufacturer of human and veterinary pharmaceutical products in Ireland, is undertaking a €70 million investment programme to accelerate the company's growth and respond to the evolving needs of its customers worldwide.

Headquartered in Loughrea, County Galway, Chanelle Group currently employs 375 people worldwide. The 15 acre site at Loughrea incorporates two manufacturing plants, three research and development centres, warehousing and offices. The company also operates two sales offices in the UK, a commercial office in India and a fourth R&D centre in Jordan.

Established in 1983, Chanelle has since developed into a €100 million turnover business, which exports to over 80 countries worldwide. The enterprising company is still 100% owned by its Founder and Managing Director Michael Burke.

Chanelle manufactures both human and veterinary pharmaceuticals. Its products in human medicine treat a number of conditions including high blood pressure, allergies, Alzheimer's disease and depression. In animal health, Chanelle manufactures a number of products for small and large animals including anthelmintic (anti-worming), antibiotics, sedatives, NSAIDS Ectoparasiticides and anti-Epileptic Drugs.



Chanelle provides a range of services to its customers including research and development, registration and production of generic pharmaceuticals for both human and veterinary pharmaceuticals. The company provides an end to end solution from development right through to raw materials and finished goods.

Chanelle's state-of-the-art manufacturing facilities currently have the capacity to produce 3 billion tablets, 2.5 million liquids and 2 billion capsules per year for human and veterinary products.

International Focus
Chanelle's key markets are the EU, which generates about 85% of group business, Australia, New Zealand, Japan, South Africa and the Middle East. The company has over 1,700 animal health licenses registered in the EU – the largest number of registered veterinary licenses of any company in the EU – and a further 500 licences outside the EU. Chanelle holds over 800 product licences for human health products worldwide. Indeed, the company's extensive product licenses portfolio reflects its international focus.

Chanelle supplies 10 of the top 12 multinationals in the world with both human and veterinary products. The dynamic company is continuing to expand its customer base in all countries that it currently exports to.

Development
Founded in 1983 by Mich ael Burke to provide a veterinary distribution service in Ireland, Chanelle commenced manufacturing its own generic Animal Health products in 1985 before expanding into the UK in 1992. The company moved into the research, development and manufacture of generic human medicines in 2000 with the establishment of Chanelle Medical, and eight years later further expanded its overseas business with the creation of Chanelle Vet UK to provide veterinary medicines to Veterinary Practitioners in Britain. Also in 2008, the company established an R&D laboratory in Jordan to concentrate on new product development for human and veterinary medicines.

"In the past five years revenue has grown 100% and employment has increased by over 200 people. This growth has been driven by research and development of new products and the expansion into new markets," says Michael Burke. "We invest over €8 million annually in research and development and this investment will continue."

€70 Million Investment Programme
The €70 million investment programme now being implemented by Chanelle at its headquarters in Loughrea will allow the company to continue to grow in international markets. A 30,000 sq ft manufacturing plant, currently under construction, will supplement the existing 220,000 sq ft facilities. The new plant, which is expected to be finished in spring 2017, is being built specifically to meet Chanelle's growing requirements for the EU and US markets.

In addition to significantly expanding manufacturing capacity at its Loughrea headquarters, Chanelle is also investing in further enhancing its research and development capabilities.

"The investment will allow the company to double production capacity at our Loughrea manufacturing facility and effectively meet the global demand for our market-leading pharmaceuticals and the new products in development," explains Michael Burke.

The €70 million investment by the Chanelle Group is viewed as a vote of confidence in Ireland as a world class manufacturing location and as a leading centre for research and development in both human and veterinary pharmaceuticals.

"The regulatory standards in Ireland are very high and this stands to the company when seeking registration of new products in other countries, particularly in the EU and outside the EU," points out Michael Burke. "The country's highly educated workforce is extremely advantageous. The majority of the jobs the new investment will generate are expected to be third level graduates."

Organic Growth
"The recent investment is a key landmark in fulfilling Chanelle's vision as the company is committed to growing organically," says Michael Burke.

He adds: “The company expects to launch 75 new products to our existing markets in the next five years as well as expansion into new markets including the United States, Central and South America. A further 175 new jobs will be created bringing total employment in Chanelle Group to over 550 people. Revenue is expected to increase by a further 65% over the next five years.”

Meeting Changing Market Requirements
The investment will ensure that Chanelle remains well placed to capitalise on the changing requirements of the global human and veterinary pharmaceutical products market. In human pharmaceuticals, one of the biggest factors impacting the medical sector is the ageing demographic. In animal health, the growth of companion animals is having a dramatic effect on the pharmaceutical industry with a growing demand for product types such as antibiotics, anti-inflammatory drugs and parasiticides.

“As these trends grow, the need for a more cost effective solution that generic medicine provides will also grow and Chanelle is working on new innovative products to meet this demand,” he remarks.

The Chanelle Founder and Managing Director concludes: “The company is committed to working on new innovative products for the generic pharmaceutical industry. Already, Chanelle expects to launch 75 products over the next five years and this is key to shaping the company’s growth and expansion in to new and existing markets.”

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Posted on 08 July 2016

Glan Agua

Glan Agua creating 60 jobs for Galway

Glan Agua a company specialising in waste water treatment is to create 60 jobs in Co Galway.

The company is doubling its existing workforce with an expansion of its Irish and UK headquarters.

Glan Agua was established in Ballinasloe in 2008 and is a subsidiaries of Mota-Engil which is expanding its operations in the Republic through the two companies and creating a UK and Ireland headquarters.

The company is a provider of design, construction, commissioning, operation and maintenance services within the water and wastewater sector.

Mota-Engil chief executive Gonçalo Moura Martins said: “Mota-Engil is reaffirming its commitment to this market and our intent to continue to invest in this country in order to be a leader in the technical areas in which we operate.

“We are also committed to developing career opportunities and training for young local engineers to expand our activity not only in Ireland but also in the UK.”

IDA Ireland chief executive Martin Shanahan said the project “adds a new client business to IDA’s growing engineering base in Ireland and delivers a quality investment for East Galway which is a key regional location for IDA, creating an extra 60 high value jobs”.

Minster for Jobs Mary Mitchell O Connor said she was “delighted” the move would benefit Loughrea and the surrounding areas.

"One of my priorities as Minister is creating an environment where job growth can thrive, particularly in rural Ireland," she said. "I believe only a strong economy supporting people at work can pay for the services needed to create a fair society."

Minister of State for the Office of Public Works and Flood Relief Sean Canney said the jobs would be a "significant boost" to the region.

"It is great to see this company expanding, creating extra jobs which will be a significant boost to Loughrea and the wider region," he said.

"It's very positive for a town the size of Loughrea to win an investment like this. It shows that companies can locate in regions once the necessary infrastructure and skilled workforce is available."

As part of the expansion, Glen Agua is relocating its administration and manufacturing base from Ballinasloe to Loughrea.

All existing staff will move to the new plant, some 30km away from the original headquarters.

The company is seeking a number of civil, mechanical and environmental engineers in the initial stage of its expansion, with all jobs coming on stream over a five year period.

Industry and Business
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Posted on26 July 2016

SANOFI

Pharma giant creating 40 new jobs for Waterford

Sanofi is enacting a name-change at its Waterford plant, bringing in 40 new staff as it changes the site's name from Genzyme Waterford to Sanofi Waterford.

"Since Sanofi acquired Genzyme globally in 2011, the Waterford operation has been increasingly closely-integrated within Sanofi Industrial Affairs so this is the logical next step as we plan for the future and build on the track record of achievement and growth here since 2001," said Ruth Beadle, site head at Sanofi Waterford.

Already thought to be employing over 600 people, in 2013 €44m was put into a new campus on the south coast to increase production of its insulin product Lantus – this expansion is ongoing.

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seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Posted on 27 July 2016.

€27 million in funding secured for Irish energy research projects under Horizon 2020

Irish research institutions and industry have consistently won funding for energy-related research under the EU Horizon 2020 programme with over €27 million in funding secured to date. As the programme's National Delegate, the Sustainable Energy Authority of Ireland (SEAI) has been supporting many of these organisations in their Horizon 2020 bids, as well as providing additional research funding.

Horizon 2020 is the EU's largest research and innovation programme with an energy research budget of €6 billion for the period 2014 to 2020. SEAI, with Enterprise Ireland, helps identify opportunities for Irish research institutions and industry in the programme. The Irish energy research community is reaping the rewards from active participation in the programme and, in doing so, is addressing some of the main challenges facing the energy system.

Commenting on Irish participation in Horizon 2020 energy programmes, Dr Eimear Cotter, Head of Low Carbon Technologies, SEAI said: "*It's fantastic to see such support for Irish projects in the area of energy research and renewable energy technologies. SEAI is helping to build national energy research capacity through its Research, Development and Demonstration Programme from which many researchers proceed to European funding. It is particularly pleasing to see Irish SMEs perform well with companies such as NVP Energy and Exergyn successful in drawing down both national and EU funds to support the commercialisation of their products".*

Ireland has also been successful in securing funding in large-scale energy-related projects. RealValue, a consortium led by Glen Dimplex, won €12m for its energy storage project which will see physical demonstrations of its technology in Ireland, Germany and Latvia. SEAI, with Enterprise Ireland, will work with Irish participants to continue to identify large-scale funding opportunities for Ireland in the energy sphere.

For more information on the national support structure for Horizon 2020, see www.horizon2020.ie.

About SAS and JMP

JMP is a software solution from SAS that was first launched in 1989. John Sall, SAS co-founder and Executive Vice President, is the chief architect of JMP. SAS is the leader in business analytics software and services, and the largest independent vendor in the business intelligence market. Through innovative solutions, SAS helps customers at more than 75,000 sites improve performance and deliver value by making better decisions faster. Since 1976 SAS has been giving customers around the world THE POWER TO KNOW®.

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Posted on 20 July 2016.

Pfizer creating 350 new jobs

Pfizer has announced that it will be creating up to 350 new jobs with its latest multimillion euro expansion of its Grange Castle Campus in Dublin.

The pharmaceutical company is planning to build a five-storey biopharma manufacturing unit , adding more than 34,500sq m to its current footprint on what is already one of the largest biotechnology plants in the world.

The expansion will take between 24 and 27 months to complete once excavation begins and will employ 1,250 construction workers.

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