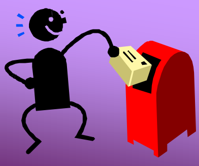
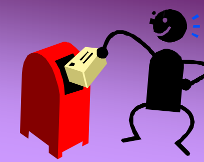


# SAFEX NEWSLETTER

No. 30, 3rd Qtr. 2009



## CONTENTS





## *This is your Captain Speaking*

### What does the crew say?

Unfortunately the first contribution from our CEO's did not materialise as we had hoped due to a series of unforeseen events. However, we hope to have the first contribution for you in the next Newsletter. In anticipation of our CEO's views and philosophies it may be worthwhile to obtain a shop floor perspective of HS&E and how it is managed. You have undoubtedly received comments or gone out to hear what people on the shop floor think. Over the years I have also picked up those views. Will you allow me to share two such views? They are randomly selected; the only thing we changed is the names of the people concerned.

Danny was a spinning machine operator and had been with the factory for a number of years. "You know there is one thing I can't understand about management," he said one day. "You keep telling us safety starts with us, the operators. Not once has any one asked me for suggestions or ideas about making our job safer. We keep seeing new developments around here and it is good to make improvements. But why don't you discuss your proposals with us before you implement them? We have been here a long time and have seen things that may help with those improvements. I could easily think this talk about workers being so important in safety means nothing. It is something Management says when things go wrong and they want to pass the buck onto us."

What Danny was saying to me was if I sincerely believe he and his colleagues have an equal responsibility for safety they should see it in my actions.

Then there was Sam. He had recently started with the company and had a cockiness and confidence about him typical of the newer generation of employee. Listen to what he said: "When I went through my training period I was taught a lot of things about safety. But what I found in practice is often different to what the instructor taught me. I sometimes wondered if the instructor had ever worked here. The old hands tell me I must not worry too much about the training stuff. 'What matters here is production. Just keep your head down and stay out of trouble and you will be alright,' they say. It doesn't make sense to me. We work with dangerous stuff and I would have thought safety must be number one. Yet, what managers say and what they do seem to be two different things. In the end we have to believe that what managers do is what's important."

As I left Sam I thought to myself: How many times have I not passed something on my rounds that I should have corrected there and then? When we spruced up the plant for an upcoming audit, what message did that send to the workforce? Whenever a worker has to work with inferior or broken equipment, especially protective equipment, does that not say something about how we rate safety? How often do I include safety in my team talks or do I just talk about problems such as quality, production or maintenance? Do I recognize and reward people's safety efforts sufficiently.

It made me think – what about you?

# *Incident Reporting*

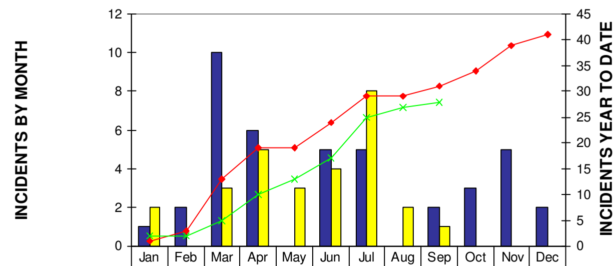
## Monitoring our Reporting Performance

***"Make every incident count – please report it!"***

Incident reports provide SAFEX with the means to extract learning points from the experiences of its members. By applying these learning points Members can prevent a recurrence of similar incidents. Because of the importance of incident reporting we track our performance using the following charts:

**All the incidents reported**. This chart compares all the incidents (non-member plus member incidents) reported to SAFEX every month during this and the previous year. The number of incidents reported in 2008 was down by a ⅓ compared to 2007. Therefore, 2008 provides a significantly lower base for comparing this year's performance. The year to date (YTD) totals for the two years are very similar. Every incident not reported is a lost learning opportunity. Remember, it's never too late to report an incident.

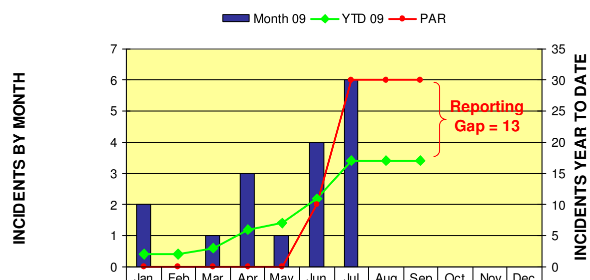
**ALL INCIDENTS REPORTED: YTD 2009 vs 2008**




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month 08 | 1 | 2 | 10 | 6 | 0 | 5 | 5 | 0 | 2 | 3 | 5 | 2 |
| Month 09 | 2 | 0 | 3 | 5 | 3 | 4 | 8 | 2 | 1 | | | |
| YTD 08 | 1 | 3 | 13 | 19 | 19 | 24 | 29 | 29 | 31 | 34 | 39 | 41 |
| YTD 09 | 2 | 2 | 5 | 10 | 13 | 17 | 25 | 27 | 28 | | | |

**Member incidents reported**. Incidents which Members experience are properly investigated. This enables us to extract the learning points from them. Therefore member incidents (MI's) give us the best learning opportunities. For that reason we track them separately in the chart alongside. The chart also shows an indicator we called PAR (a golfing term). PAR is an estimate of how many MI's are occurring based on the severity of the MI's reported. The gap between the number of MI's reported and PAR is our Reporting Gap. The Reporting Gap suggests that there are about 13 MI's which have not being reported. These are learning opportunities which are going to waste.

**MEMBER INCIDENTS REPORTED: YTD 2009**

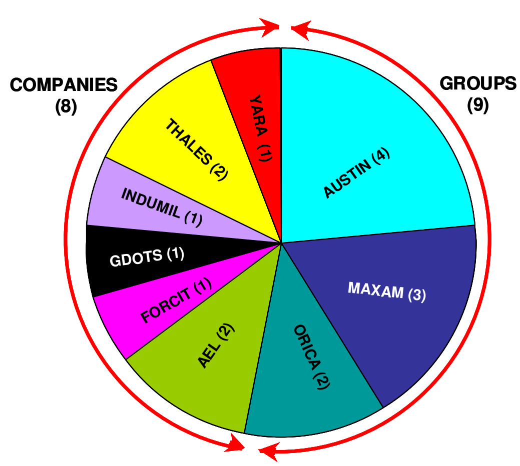



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month 09 | 2 | 0 | 1 | 3 | 1 | 4 | 6 | 0 | 0 | | | |
| YTD 09 | 2 | 2 | 3 | 6 | 7 | 11 | 17 | 17 | 17 | | | |
| PAR | 0 | 0 | 0 | 0 | 0 | 10 | 30 | 30 | 30 | | | |

**Member incident contributors**. This chart identifies those members who have taken the trouble to report their incidents. It shows the number of incidents each of these members has reported relative to the total number of MI's we received. The chart distinguishes between Groups and Companies merely to indicate the performance of the two membership categories. Each of these categories has about the same number of operating units.

SAFEX is indebted to these members for making the effort to report their MI's.

**MEMBER INCIDENTS REPORTED: YTD 2009**



## *Know the Expert Panel*

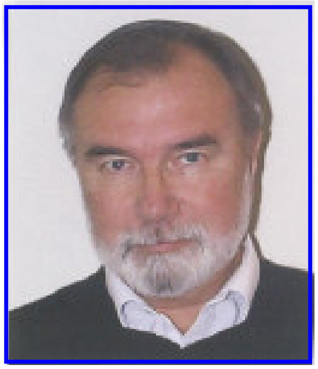
**The Expert Panel comprises individuals who were nominated by members and approved by the Board. Such an individual must be associated with the explosives industry and have acquired expertise in specific fields. He must also be willing to make the same available to SAFEX members on a commercial basis which is agreed between the expert and the member. SAFEX merely "connects" the Expert and the Member who has a need and does not get involved in the detail arrangements.**

**To access the services of a SAFEX Expert, a client Member accurately defines the need it wishes the Expert to address. This requirement is captured in a Brief which is e-mailed or faxed to the Secretary General. The Member will be notified of the details of Experts that could meet this need. It is then up to the Member to select an Expert and enter into an agreement directly with him.**

### Frank Barker

**PERSONAL**

**Position:** Principal
**Company:** FT Barker Consulting
**Location:** Denver, Colorado
**Education:** BSc (Chem) - Manitoba (1967)
**Affiliations:** SAFEX, ISEE, CSEE
**Languages:** English, French



**CAREER OUTLINE**

**With AECI/CIL/ICI/Orica**

- **Research / Development Chemist and Manager**
- **Production Manager**
- **Corporate Safety & Emergency Planning Mngr**
- **Global SHE&E Manager, Orica Mining Services**
- **Executive team member, Latin America, North America**

**EXPERTISE**

- **SH&E reviews of explosives operations risk management**
- **Certified Auditor (SH&E, ISO, PSM)**
- **Incident investigation (TOP-SET) and Root cause Analysis**
- **Training (SH&E Mngt including behavioural safety, risk assessment, accident investigation , etc.)**
- **SH&E system development & implementation at small / large sites**
- **Environmental legacy management**

**TYPICAL ASSIGNMENTS**

| | |
|---|---|
| 1988 to 2008 | Management of safety training. SH&E audits, Significant Risk Audits |
| 2000 to 2008 | SH&E Due Diligences, Environmental Legacy program management |
| 1993 to 2008 | Field safety program development and implementation |
| 1997 to 2008 | Serious incident investigations and reviews |
| 1999 to 2006 | Global audit and hazard study management |
| 1995 to 2008 | ISO 9001:2000 direction and program management |
| 1999 to 2007 | SH&E Leadership and Behavioural Safety Training |
| 2005 to 2008 | Periodic Hazard Studies on field sites, explosives and IS plants. |
| 1995 to 2008 | Crisis planning and program management |
| 2006 to 2008 | Global SH&E integration (due to acquisition) across 35 countries |
| 2008 | Risk Assessment training SAFEX congress-Madrid |

# Research Notes from CERL

## Chemical Analysis Applied to Explosives Regulation

**Dr Phil Lightfoot**



### Introduction

Our laboratory, CERL, comprises one half of the Explosives Safety and Security Branch (ESSB) of Natural Resources Canada. The other half of the Branch is made up of the Explosives Regulatory Division, which administers Canada's *Explosives Act* and regulations. One key area where CERL provides technical assistance to the regulators is in the authorization of explosives products. At the request of Canada's Chief Inspector of Explosives, a selected small fraction of the explosives samples that have been submitted for authorization are sent to CERL for testing. The samples cover a wide variety of explosive products, including commercial blasting explosives, initiating devices, fireworks, ammunition and safety and rescue devices.

The main objectives of the authorization testing at CERL are to ensure that the submitted article:

i) is constructed, packaged and labelled properly.
ii) contains the appropriate type and amount of explosive ingredients.
iii) functions safely and as intended by the manufacturer.
iv) is safe for transport and storage.

The chemical analysis we carry out at CERL focuses on verifying the second of the elements above, i.e., we check if the materials in an article are those that are supposed to be there, in the approximate ratios and total amounts declared by the manufacturer. This is admittedly a rather laborious and costly step, which many countries do not include in their authorization protocols. We believe, however, that the confirmation of the chemistry of the explosive components is essential to the validation of the associated performance and safety tests. After all, if the contents of the article tested are very different from those declared, then the sample tested is presumably not representative of the product to be placed on the market. How then can one use the results of the tests to judge the suitability of the article for authorization? In addition, there is an obligation to ensure that the submitted articles do not contain any toxic or environmentally-harmful substances (e.g. lead), or any combinations of chemical ingredients that would make the explosives unstable or excessively sensitive to initiation (e.g. sulphur + chlorate). Experience has shown that it is far from unusual for articles submitted for authorization to contain prohibited materials or to display chemical compositions very different from those declared by the manufacturer.

So as not to alarm the SAFEX community unduly, I should add that the majority of problems we uncover at CERL using chemical analysis relate to fireworks. In fact, over the last four years, over half of the fireworks tested at CERL have failed to meet Canadian standards in one way or another. In addition, I should be clear that the requirements for declared formulae are not very stringent. For example, the limit for undeclared chemicals is 0.5% by mass of the composition. The manufacturer usually defines acceptable tolerances for the chemical composition. In the absence of manufacturer's tolerances, default tolerances are used that vary with weight percent of the constituent (e.g., (5.0 ± 1.2)% for a minor constituent to (60.0 ± 3.0)% for a major constituent).

In addition to its use in product authorization, we employ chemical analysis in a number of other areas, such as accident investigation or research projects, so having a good analytical capability in place is a definite advantage to us in much of our work.

In what follows, we describe in more detail some of the analytical capabilities at CERL, illustrated by a number of examples that we hope will be of interest to SAFEX members.

## Skills, equipment and techniques

The chemical analysis of explosive ingredients requires personnel who are not only knowledgeable of the principles and techniques of analytical chemistry, but also experienced in the safe handling of explosives. In order to analyse chemical compositions, it is necessary to take apart explosive products. Simple products such as packaged explosives are trivial to sample. However, taking apart a detonator, for example, requires much more care and attention. We take X-rays of devices beforehand to verify their construction and carry out some disassembly operations remotely. An example of such a device is a firework shell and Figure 1 shows a typical X-ray image of it before disassembly.

There is also a requirement to have a variety of analytical instruments, which will enable the analyst to correctly and efficiently identify and quantify both the inorganic and organic components of the explosive compositions. Over the last few years, we have gradually built up an analytical laboratory and now have the following analytical instrumentation at our disposal:

- i) Ion Chromatograph (IC) with chemical suppression and conductivity detection;
- ii) Inductively Coupled Plasma Optical Emission (ICP) Spectrometer;
- iii) Wavelength Dispersive X-ray Fluorescence (XRF) spectrometer;
- iv) Gas chromatograph (GC) with flame ionization and electron capture detectors;
- v) High Performance Liquid Chromatograph (HPLC) with photodiode array and single wavelength ultraviolet and visible (UV-Vis) absorption detectors;
- vi) Fourier-Transform Infrared (FT-IR) Spectrometer;
- vii) Table-top, Scanning Electron Microscope (SEM) equipped with backscatter detector for imaging conductive and non-conductive samples at 50-10,000X magnification. The SEM is also equipped with an X-ray Fluorescence detector for elemental analysis;
- viii) Optical microscopes with digital image acquisition capabilities;
- ix) Automatic titration equipment, including a Karl Fischer titrator for the determination of water content;
- x) Pycnometers and sieves for the determination of density and particle size distribution;

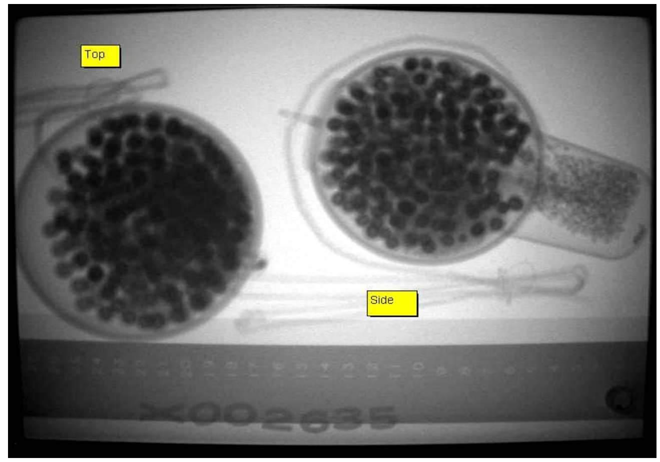



*Figure 1: X-Ray image of fireworks shells prior to disassembly*

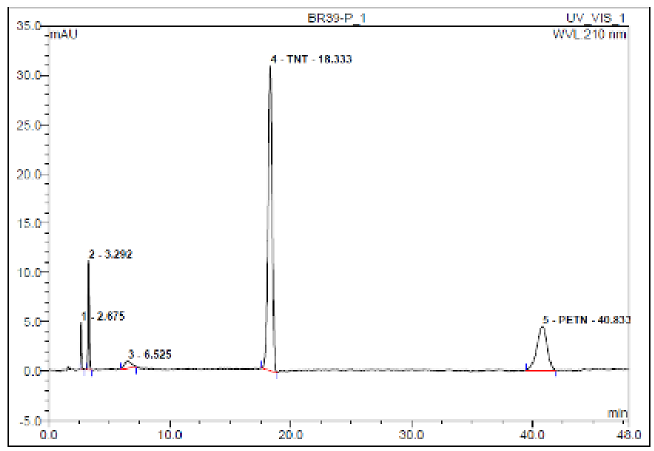



***Figure 2: HPLC chromatogram of Pentolite booster composition.***

## Examples

***Analysis of Molecular Explosives by High-Performance Liquid Chromatography and Gas Chromatography***

CERL has two methods for quantitative organic analysis. High Performance Liquid Chromatography (HPLC) is used to identify and quantify a number of organic explosives, such as HMX, TNT, RDX and PETN, just to name a few. The HPLC system uses a specialized analysis column that allows for the separation of the 14 explosive compounds listed in the U.S. Environmental Protection Agency's Method 8330 [1]. As part of the authorization process, HPLC has been used to confirm the amount of HMX in shock-tubing and levels of TNT, PETN, RDX and HMX in Pentolite and Comp-B booster compositions. The chromatogram in Figure 2 shows the separation of the components of a Pentolite booster sample. In a fairly recent case, the level of RDX in a Composition B booster was significantly lower than declared by the manufacturer (1.5% found versus 23.0% declared). The root of the issue was that the manufacturer was using demilitarized explosives in the manufacture of the boosters, without good control over the raw materials.

A gas chromatograph (GC) equipped with an electron capture detector (ECD) and a Flame Ionization Detector (FID) provides CERL with the ability to quantitatively determine a broader range of explosive-related organic compounds than can be detected by HPLC, such as nitroaromatics – TNT and RDX, nitroamines - HMX, glycols, oils and waxes. We have used GC to determine the level of the marking agent 2,3-dimethyl-2,3-dinitrobutane (DMNB) in plastic explosives. DMNB, a high vapour pressure compound, is added to flexible explosives during the manufacturing process to facilitate detection by instrumental means at airports and other public venues. At the present time, DMNB must be present at a level of 1% in plastic explosives, such as C-4 and sheet explosive, before they can be authorized for manufacture, use and transportation in Canada.

***Analysis of Inorganic Salts by Ion Chromatography***

An instrument which has proven to be extremely useful for the analysis of pyrotechnic compositions and blasting explosives is the Ion Chromatograph (IC). At the present time, a chemically-suppressed IC system, equipped with automatic eluent generation and conductivity detection is used at CERL to routinely determine anionic species, such as nitrate, chlorate and perchlorate, in aqueous sample extracts. The retention time and peak area are used to identify and quantify the individual anions. Figure 3 below shows the separation of twelve different anions using a Dionex AS-20 separation column and gradient elution with potassium hydroxide.

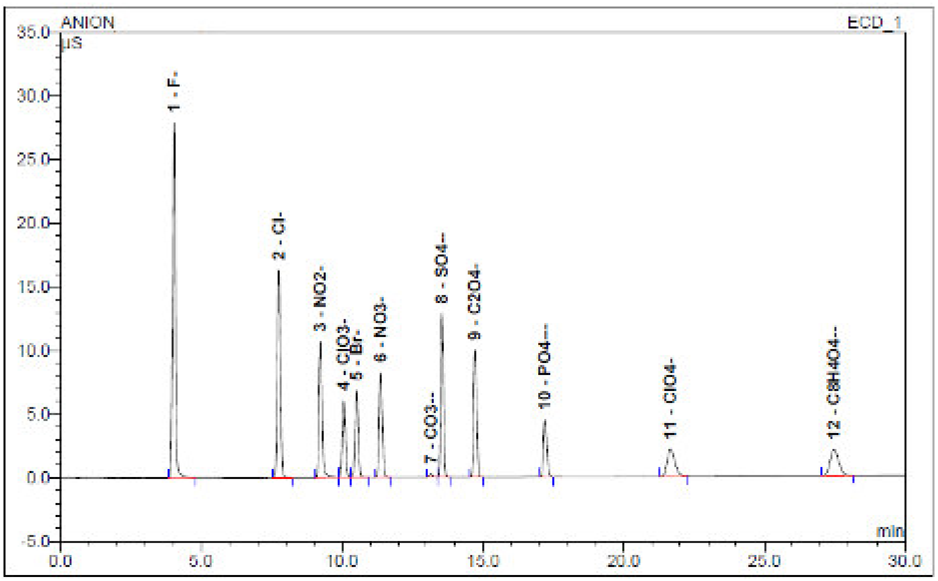



*Figure 3: Analysis of multiple anions by Ion Chromatography*

***Elemental Analysis of Fireworks Compositions by X-Ray Fluorescence and Inductively Coupled Plasma Optical Emission Spectrometry***

Most of the samples submitted annually to CERL for authorization testing, consist of consumer and display fireworks manufactured in China. The fireworks industry is indeed very creative and often comes up with new products. The articles vary significantly in size, construction and designed effect. The net explosive content of a fireworks article can also vary, ranging from a few grams for a small consumer article to well over a kilogram for a large display shell. Fireworks articles can contain multiple pyrotechnic compositions with each composition producing a specific type of effect. Multi-tube articles, such as cakes, may contain as many as a dozen different pyrotechnic compositions.

In many instances, it is not practical for CERL to conduct a detailed, quantitative chemical analysis on each pyrotechnic composition contained within a fireworks article. This would require an enormous effort and would prove to be too costly both for CERL and the submitter.

As a compromise, we initially perform a qualitative elemental analysis on recovered fireworks compositions using the Wavelength Dispersive X-ray Fluorescence Spectrometer (XRF). This rapid and non-destructive technique provides a list of elements present in the composition. This enables the analyst to confirm that the composition contains the expected elements and highlights the presence of undesirable elements such as lead, cadmium, mercury and arsenic.

The XRF spectrum of a sample of a copper-oxide-based crackle composition recovered from a fireworks article is shown in Figure 4. In this case, the detection of non-permitted lead in the crackle composition prompted the performance of a detailed chemical analysis. A portion of the composition in question was digested with hot acid and diluted to a known volume. The acid extract was then analyzed with the Inductively Coupled Plasma Optical Emission Spectrometer (ICP), which is capable of simultaneously measuring emission wavelengths from 175-785 nm and quantitatively determining the concentration of up to seventy-three elements. The results of the ICP analysis of the acid digests revealed that the crackle composition contained 10% lead, which was well above the permissible limit of 0.5% specified in our standards.

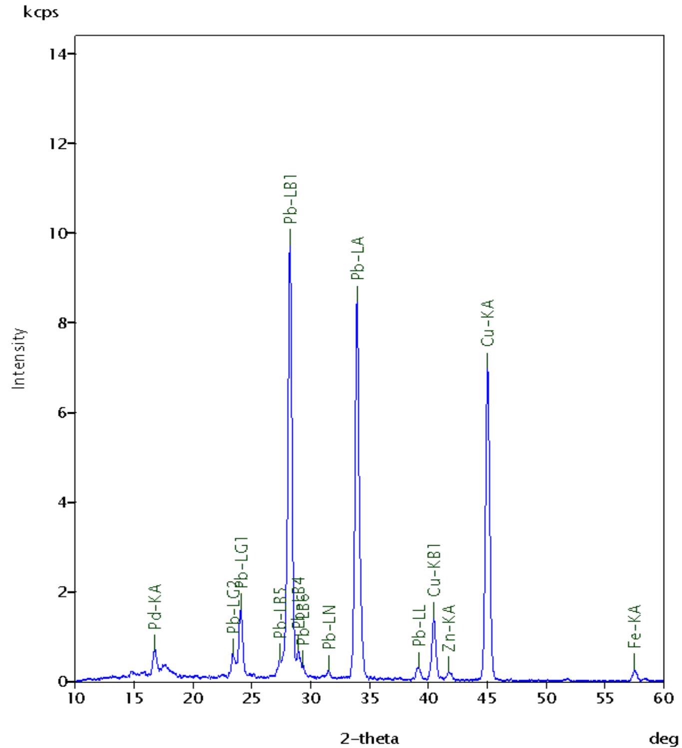



***Figure 4**: XRF spectrum of a copper-oxide based crackle composition from a fireworks article, showing the presence of significant quantities of lead.*

Since April 2004, more than 1000 fireworks compositions have been qualitatively analyzed by XRF at CERL. Approximately 2% of these compositions were found to contain unacceptably high amounts of lead.

***Identification of Unknowns by Fourier Transform – Infra-Red Spectrometry***

At CERL, the technique of Fourier Transform Infrared spectrometry (FT-IR) allows for the rapid identification of unknown samples through the use of spectroscopic software and comparison with in-house reference samples and an explosives materials database. There is little or no sample preparation required because of the Attenuated Total Reflectance (ATR) accessory, which is especially useful for obtaining spectra of difficult samples, as is often the case in the analysis of explosive materials. In Figure 5, a typical FT-IR spectrum is shown,

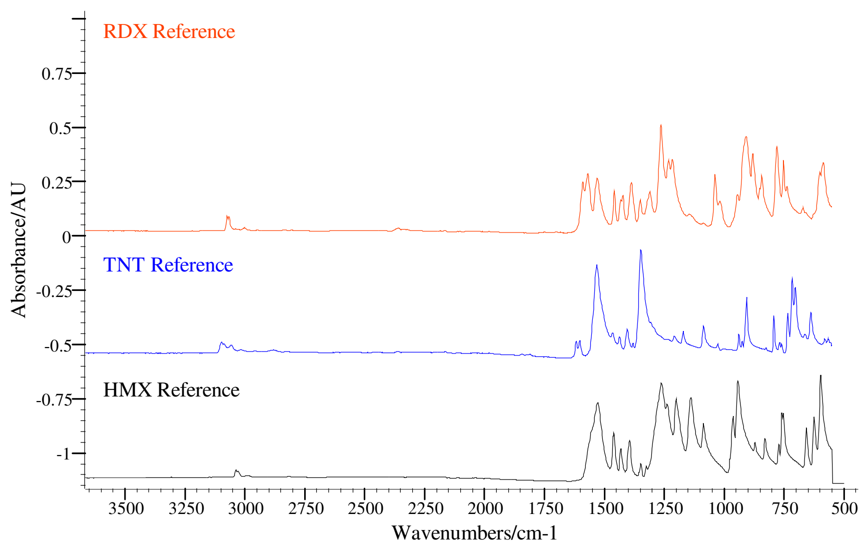



***Figure 5**: FT-IR spectra of RDX, TNT and HMX reference standards.*

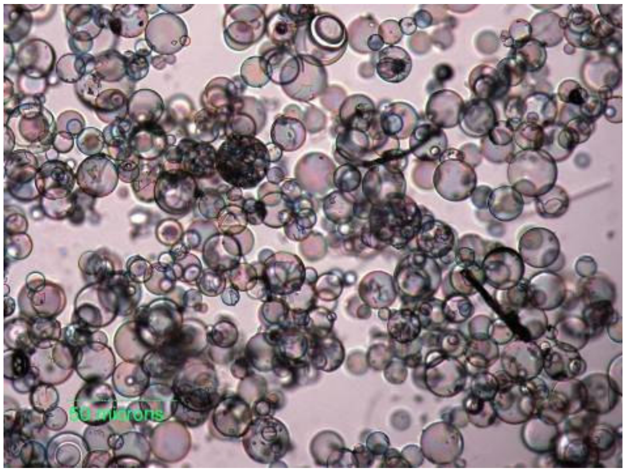


**Figure 6: Stereomicroscope view of glass microballoons from an emulsion explosive**

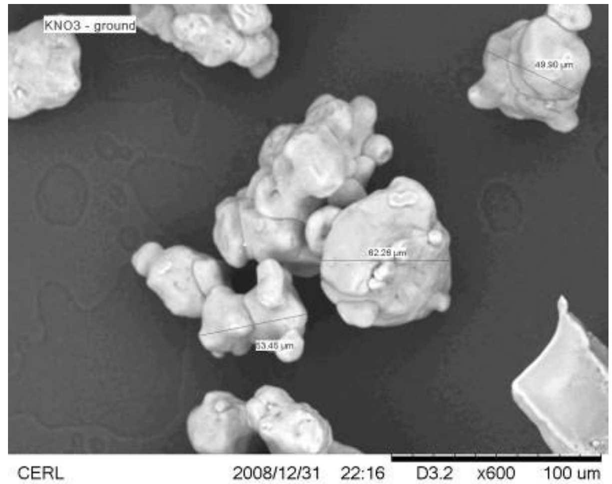



**Figure 7: View of ground potassium nitrate particles used in the manufacture of improvised explosive compositions.**

with an overlay of common explosive compounds – RDX, TNT and HMX.

The FT-IR analysis capability was particularly useful for the analysis of unknown materials related to an explosives shipping incident. It was suspected that improperly packaged or mishandled packages of secondary explosives had been damaged and explosives had been spilled in the hold of a cargo vessel. FT-IR rapidly identified the materials as molecular explosives and appropriate corrective measures were taken to avoid a re-occurrence of the incident.

***Particle Characterization using Microscopy***

Periodically, it is necessary to examine the physical state of explosive components as the size and morphology of the explosive particles can often be linked to the performance and hazards of an explosive article, as well as an aid in identifying an unknown material.

Figure 6 shows an image of glass microballoons, which were recovered from an emulsion explosive that had failed to detonate with the recommended initiator. The image was acquired with a stereomicroscope equipped with a digital camera. Although there were broken microballoons present in the sample, the vast majority of the microballoons were intact. The observation suggested that the breakage of the microballoons was not the reason for the failure to detonate. This work was done on behalf of an explosives company to help resolve a customer complaint. Optical microscopy is quick, simple and can be extremely useful, but it provides a poor depth of field and has a practical limit of magnification of approximately 1,000X.

CERL is equipped with a table-top Scanning Electron Microscope (SEM), which enables the examination of samples at up to 10,000X magnification. In addition, the SEM has a higher depth of field and produces images with an almost 3-dimensional effect. The SEM can be operated under both high and low vacuum conditions, the latter being particular useful for the examination of non-conducting or vacuum-sensitive samples. The SEM has been used at CERL to examine a variety of explosives-related samples including oxidizer salts, metallic granules, voids, pyrotechnic compositions and even molecular explosives. The image processing software of the SEM facilitates the measurement of particle dimensions. The SEM is also equipped with an Energy-dispersive X-ray Fluorescence Detection System (EDS), which permits the qualitative, elemental analysis of micron-sized particles.

Since 2008, our organization is responsible for the regulation of explosive precursor chemicals in Canada, i.e., chemicals that are not classified as explosives themselves, but that can be used to make explosive mixtures. As a result of these new responsibilities, we are actively engaged in work on improvised, or homemade, explosives. These materials are often mixtures of powders and it is important to be able to characterize the powders well: the particle size distribution can be very important, for example. Figure 7 shows the SEM image of potassium nitrate particles that were used to make an improvised explosive mixture.

## Conclusions

The purpose of this short article was to introduce some of the analytical capabilities we make use of at CERL, along with some examples of how they are used for explosives work. One of the main reasons for writing about this particular subject was that we make more use of chemical analysis for product approval in Canada than in most other countries and we are regularly asked why this is so. A second reason was to expand a little on the many uses we find for our analytical capabilities outside of the regulatory work. Because of our regulatory requirements, we have built up a capability which is probably more extensive than available to most of the SAFEX stakeholders, so we hope that we may have provided some ideas about how chemical analysis might be put to good use in the industry. If there are readers who are interested in setting up a chemical analysis capability in their own company, we would of course be happy to advise where we can.

## References


[1] US EPA Method 8330, Nitroaromatics and Nitrosamines by High Performance Liquid Chromatography (HPLC), Revision 0, September 1994.


# *Our Explosives Regulatory World*

## Obtaining Explosives Transport Approval in the USA


**Ben Barrett**



Ben Barrett, an Expert Panel member, is an independent consultant specializing in regulation of explosives. DG Advisor, Ben's consultancy, is dedicated to participation in the development and modification of international dangerous goods regulations and helping clients comply with US and international regulations. Ben also provides training in the handling of dangerous goods including that required by ICAO.


Explosives transportation in the USA is controlled by the Pipeline & Hazardous Materials Safety Administration (PHMSA), an agency of the US Department of Transportation (DOT). DOT is the competent authority for the US. No person, domestic or foreign, may offer for transportation or transport an explosive in the US unless it has been tested, classified and approved by the Office of Special Permits and Approvals of PHMSA. The procedures for obtaining an approval are given in the Code of Federal Regulations, Title 49 (49 CFR) Part 173 Subpart C. PHMSA calls these regulations the Hazardous Materials Regulations (HMR). The DOT may recognize Department of Defense or Department of Energy approvals but must acknowledge them in writing. In the context of this article use of the "DOT" acronym will refer to PHMSA.

The transport of certain explosives is forbidden in 49 CFR 173.54. Examples include certain sensitive formulations, such as ones containing chlorates or fireworks with yellow or white phosphorous; leaking or damaged packages or articles; unstable propellants; liquid explosives not specifically authorized; loaded firearms; fireworks with a detonator; explosives specifically forbidden in the dangerous goods list; explosive articles with their means of initiation installed except as provided in 173.56; and explosives failing the classification tests for Division 1.1.

Unlike most dangerous goods, which can be self-classified and offered for transportation without involvement of the DOT, new explosives must be approved in writing by DOT before shipment takes place. "New explosives" include existing products made by an entity not previously producing them. DOT considers a product made by the same company but in a different facility to be a new explosive which requires a new approval. Any change to the formulation, design or process requires a new approval. Testing may be waived if the manufacturer can submit a certified explosives lab report showing no difference in safety to a currently approved explosive. This is termed an "analogy" in the industry. Analogies still require a new written approval, only the testing is waived. Analogies are granted based on a new product being bracketed in formulation and design by previously approved explosives. DOT may require that the laboratory recommending the analogy be the same lab that recommended the new explosive. Typically manufacturers should submit families of products of similar design; the fastest and slowest products are tested, and the ones in between, i.e. "bracketed", are approved by analogy.

Explosives may be packed in any packaging listed in the packing instructions. These are aligned with the packing instructions of the international modal regulations and UN Model Regulations. Many explosives approvals include a packing note limiting the packaging to the configuration which was tested. Therefore a manufacturer may choose which packaging they want, but having made that choice they may be stuck with it unless they get another approval for a different packaging. New explosives must be examined by a certified laboratory approved for the purpose by DOT, according to the procedure set forth in Subpart H of 49 CFR Part 107. Explosives may also be approved by certain specified agencies of the Department of Defense (DOD) and Department of Energy (DOE). To avoid a conflict of interest, the labs must not manufacture or market explosives, or be financially dependent on such an entity. Four independent labs are currently approved:

- Bureau of Explosives
- New Mexico Tech
- Safety Consulting Engineers
- Safety Management Services

To get the necessary materials to the laboratory for testing, the labs are authorized to issue one time transport approvals with tentative classifications. Packages must be marked "Sample for laboratory examination", the net weight of the new explosive and the tentative shipping name and identification number.

Unapproved explosives may also be transported by the manufacturer for developmental testing. In this case the new explosive may travel from the manufacturer to the test range when it is not a forbidden or

U.S. Department of Transportation

400 Seventh Street, S.W.
Washington, D.C. 20590

Pipeline and Hazardous Materials Safety Administration

The US Department of Transportation Competent Authority for the United States

**CLASSIFICATION OF EXPLOSIVES**

Based upon a request by ABCD Company, Primers "R" Us Facility, 1234 Any Street Pyrovia City, Alpinine Province, ARGENTINA, the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). A copy of your application, all supporting documentation and a copy of this approval must be retained and made available to DOT upon request.

**U.N. PROPER SHIPPING NAME AND NUMBER:**
Primers, cap type, UN0044

**U.N. CLASSIFICATION CODE:** 1.4S

| REFERENCE NUMBER | PRODUCT DESIGNATION/PART NUMBER |
|---|---|
| EX2005011114 | Shot Shell Primers (D/N V 209) |

NOTES:
This classification is only valid when the primers are packaged as follows: Inner Packaging - Trays, plastic with recessed cavities, each containing not more than one hundred (100) primers uniformly segregated apart in up to a 10x10 array covered with slip-over cardboard or paperboard sleeve enclosures. Intermediate Packaging - Box, cardboard or paperboard, each containing not more than ten (10) inner packagings in up to five (5) layers. Outer Packaging - UN 4G fiberboard box, each containing not more than five (5) intermediate packagings.

**DATED:** March 5, 2005

Approved by:

Bob Richard
Deputy Associate Administrator for
Hazardous Materials Safety

Tracking No: 2005020702 Page 1 of 1

***DOT issues a written approval before explosives may be transported in the US.***

**U.N. PROPER SHIPPING NAME AND NUMBER:**
Primers, cap type, UN0044

**U.N. CLASSIFICATION CODE:** 1.4S

| REFERENCE NUMBER | PRODUCT DESIGNATION/PART NUMBER |
|---|---|
| EX2007020114 | Shot Shell Primers |

NOTES:
This classification is only valid when the primers are packaged as follows: Inner Packaging - Trays, plastic with recessed cavities, each containing not more than one hundred (100) primers uniformly segregated apart in up to a 10x10 array covered with slip-over cardboard or paperboard sleeve enclosures. Intermediate Packaging - Box, cardboard or paperboard, each containing not more than ten (10) inner packagings in up to five (5) layers. Outer Packaging - UN 4G fiberboard box, each containing not more than five (5) intermediate packagings.

***An example of a Packing Note and EX# on a US DOT approval***

1.1A explosive; is shipped as a 1.1 explosive; is transported in a motor vehicle operated by the manufacturer; and is accompanied by a person in addition to the driver who is qualified by training and experience to handle the explosive.

Certain exceptions exist to the requirements for testing and approval:

- ANFO only requires the Cap Sensitivity Test (UN 5(a) test).
- Fireworks meeting American Pyrotechnics Association (APA) Standard 87-1 only require thermal stability testing to receive an approval.
- Sporting ammunition not exceeding 50 caliber may be self-classified by manufacturers as 1.4S.

Additionally, the DOT may issue an approval or letter of acceptance on the basis of an approval issued by a foreign competent authority, i.e. reciprocity. DOT may wish to see the supporting test data on which the foreign approval was based.

Fundamental tests required for explosives include sensitivity testing for impact and friction, thermal stability and the small scale burning test. A substance is forbidden for transport if it:

- Fails the drop (impact) test. Different criteria are given for liquids or solids
- Has a friction sensitivity equal or greater than dry PETN
- Fails the thermal stability test at 75°C (167°F)
- Explodes in the small-scale burning test

Articles are subject to the 12 meter drop test, in which case they are forbidden if they ignite. Dynamite is forbidden if it: does not have a specified level of antacid uniformly mixed with the absorbent material; loses more than a specified amount of the liquid explosive in the centrifuge test; or loses any liquid in the leakage test.

Series 6 tests are also required to assign a division to an explosive. These tests assess whether there will be a mass explosion, hazardous projectiles, radiant heat, and propagation from one package or article to the next. The competent authority, in this case PHMSA, may waive, add to or modify the required tests. The UN Manual of Tests & Criteria explains this in Section 1.1.2.

It should be noted that the Manual of Tests and Criteria is not a concise formulation of testing procedures that will unerringly lead to a proper classification of

*UN 12m drop test: If there is an ignition, the product is forbidden for transport.*

**(Courtesy Safety Explosives Engineers, Inc.)**

products. It therefore assumes competence on the part of the testing authority and leaves responsibility for classification with them. The competent authority has discretion to dispense with certain tests, to vary the details of tests, and to require additional tests when this is justified to obtain a reliable and realistic assessment of the hazard of a product. In some cases, a small scale screening procedure may be used to decide whether or not it is necessary to perform larger scale classification tests. Suitable examples of procedures are given in the introductions to some test series and in Appendix 6 of the Manual.

Explosives which receive an approval from PHMSA are issued an EX number. This means "explosive number" with the only recognized term being "EX number". It does not mean "exemption". EX numbers are simply a file number for internal tracking at PHMSA. They may be assigned to individual products or to families of products. One EX number is assigned to each lab report. A DOT approval may contain multiple EX numbers.

EX numbers are required to be marked on the package for explosives shipments per 49 CFR 172.320. There are some exceptions to the marking requirement:

- A product name may be used instead if it is associated with the EX# on the DOT approval
- The marking requirement is waived if the EX# or product name is place in the shipment documentation
- Packages containing more than one product only need to have 5 EX#'s marked

EX numbers must be placed on ICAO Shipper's Declarations when making air shipments in the Authorizations column.

# *Explosives Eco-talk*

## Meet VESP – a Partner in the Sustainable Disposal of Explosives Materials

**Hans Wallin**

**The impact explosives and explosives manufacture has on the Environment fall squarely in the SAFEX domain. We are as interested in the experiences members of the SAFEX community (Members, Associates and Expert Panel) have in minimising explosives' environmental impact as in safety and health. While most of our explosives incidents concern the safety and health impact, we are eager to learn about the environmental side of our activities. By way of this Feature we want to encourage readers to let us have contributions which create awareness of this facet of our operations as well as assist our industry to behave with environmental sensitivity and responsibility.**

**We have been introduced to the work of VESP (www.vesp.se) and BIOREX (www.biorex.se ) through our association with KCEM, a Corporate Associate of SAFEX. Hans Wallin has kindly sent us this Paper about the establishment of VESP. It was presented at the Fifth International Disposal Conference in Katrineholm, Sweden in November, 2008.**

### Introduction

The 21st century has just begun and it is difficult to understand that as recently as 10,000 years, or about 400 human generations, ago civilisation started. Rachael Carson's "Silent Spring" (1962) was an early warning of the ecological problems that accompany the widespread application of chemicals (mainly pesticides) and the warning she sounded has been heeded in several ways.

Environmental concerns are now high on the world's agenda. Global concern over environmental issues has increased substantially in recent years. Starting with the Stockholm environmental conference 1972 followed by The Earth Summit in Rio de Janeiro in 1994 and in Johannesburg in 2004 underlined the importance of sustainable development and its relationship with environmental protection. Governments all over the world work on strategies for sustainable development. The explosives sector must also develop sustainable, ecologically correct methods for disposal and re-use of energetic materials which meets the challenging environmental targets necessary to save our planet.

### What is VESP?

Vingaker Energetic Science Park (VESP) is a non-profit organisation based in the Vingåker commune in Sweden. It is intended to provide a platform and network centre for research and development of sustainable and environmentally correct methods for disposal of explosives material and articles. VESP will serve as a full scale laboratory for research and development in cooperation with the Universities of Mälardalen, Linköping and the royal institute of technology in Stockholm. The possibilities for European cooperation with universities such as Cranfield University UK and Biochemical Institute are under exploration.

In collaboration with KCEM, Universities, research organisations and private companies, VESP will focus on:

- Building and maintaining a network
- Preservation of experiences, information and competence
- Transition of experiences and competence to new generations
- Fostering and training new generations of explosive specialists
- Research and development of technique related to sustainable ecologically correct methods for disposal and re-use of energetic materials
- Remediation of land contaminated with energetic materials
- Arranging national and international conferences
- Support researchers and organisations working with related questions

## Why was VESP established?

**The wake up call**

Rachel Carson's 1962 bestseller "Silent Spring" questions our attempts to control the natural world around us. She illustrated human incompetence to make decisions without understanding the complex relationships and interactions that is fundamentals for life on earth. Already in 1954 Rachel Carson said: *The more clearly we can focus our attention on the wonders and realities of the universe about us the less taste we shall have for destruction.* Around this time the alarm sounded for the necessity to be careful with our environment on this planet.

**Early environmental initiatives in Sweden**

From 1965 a debate started concerning the consumption based economy and the increasing quantities of garbage. A common way to get rid of chemical waste was dumping in sea and lakes. Since the Second World War Sweden had dumped excessive ammunition in old mines, lakes and the Baltic Sea. A growing concern from environmentalists started a process that led to an idea of a world conference on the environment. During this process a number of actions were taken by the Swedish government including:

- Law that forbids dumping of waste in lake and Sea valid from 1970.
- Start of the Demil facility Vingåkersverken
- Arranging the first World conference upon Environment
- Starting a program "Keep Sweden tidy"

**The fall of the Soviet Empire 1989**

The new era that started in 1990 prompted the clean-up of large quantities of war equipment and ammunition that was no longer needed. It was quite easy to get rid of mechanical materials such as vehicles and guns. However, the atomic weapons, chemical weapons and bacteriological weapons posed a different problem. In addition there was more than 20 million tons of conventional ammunition stored on both sides of the former iron curtain that had to be dealt with. The quantities are so big that 18 years after the fall of the Soviet Empire there are still more than 10 million tons to be neutralized. Materials from those stores are also leaking out to conflicts in Africa and other wars where weapons are used.

**Demilitarisation is expensive and military budgets do not provide for them**

Today we know that environmentally correct methods for destruction of ammunition are to be used when we take care of this unfortunate legacy. Happily the day has now dawned that makes it is unacceptable to leave dangerous materials and polluted land or water and forget about them.

**Handling of explosives and especially to take care of old ammunition is dangerous**

Organisations do not have memories they only, in the best cases, have registers and minutes over what has occurred earlier. It is only individuals that have memory and individuals sometimes forget and the do not live for ever. As ammunition produced from 1900 is very stable for aging and will have explosive properties for hundreds and in some times 1000 of years. It is therefore of crucial importance to maintain competence, drawings and technical documentation for coming generations.

**Life on our Planet is part of a complex system.**

2008 politicians and other leaders have cope with a lot of questions and take the right decisions in order to lead the nations through

- Financial Challenge
- Climatic Challenge
- Environmental Challenge
- Ecological Challenge
- Sustainable solutions
- Transition of knowledge
- Fostering new generations

International cooperation is

fundamental in order to meet these challenges. We all realise that the situation calls for a lot of different actions which must be taken to create a sustainable society. Since the time of Alfred Nobel Sweden has had a long industrial tradition in handling Explosives. It is therefore appropriate that the area around the lake Mälaren where the Nobel industrial empire was started around 150 years ago is the focus of this initiative.

## Conclusion

Given this motivation and in line with the identified mission those responsible will now continue to establish Vingåker Energetic Science Park to realise its mission and search for interested partners from all over the world.

# *Safety Snippets*

## Lone working assessment and solutions

**Ashley Haslett**

In April this year Irish Industrial Explosives (IIE) approached SAFEX Members for information about the use of a "lone worker alarm" in a production facility. IIE had seen the need for this type of alarm in situations where individuals are working alone specifically in a detonator environment. In such a situation it would be useful if those individuals had a panic button or alarm that they could wear on their persons and activate when they are in difficulty.

As promised in the last Newsletter, **Ashley Haslett, Operations Director of Irish Industrial Explosives Ltd** provided us with the following summary of the issues they face and how they proposed to tackle them using some of the ideas which SAFEX members submitted.

A number of Members kindly responded to our request for information with known solutions, suggestions or even a nil return. SAFEX gratefully acknowledges the following people for their interest and willingness to contribute to this problem: Enrique Barraincua (MAXAM); Jorge Carbajal (Austin Bacis); Maurice Bourgeois (GD-OTS Canada); Janusz Drzyzga (Nitroerg); Michale du Plessis (Expert Panel); Rahul Guha (Solar); Martin Held (Austin International); Ernest Hodgson (RDM); Michel Honore (Titanobel Belgique); Noel Hsu (Orica); Erode Mahadevan (Visfotak); Joahn Maher (Thales Australia); Thomas Mann (MAXAM Deutschland); Hans Meyer (FEEM); Claude Modoux (Poudrerie d'Aubonne); Serge Morales (SNPE); Mike Rogers (Expert Panel); Helen Muller (Orica Asia Pacific); David Schelbach (Orica USA); Sigmund Sofienlund (Nammo Raufoss); Soltanabadi (PCI); William Spiteri (SASOL Nitro); Peter Swinton (Expert Panel); Takaaki Torikai (Kayaku Japan); Mervyn Traut (Expert Panel); and Dave White (EPC-UK).

As Safety Management Systems develop, continuous improvement arises through risk assessment and subsequent on-going risk reduction plans. Within the explosives manufacturing industry, we naturally initially focus on the higher risks such as process design and control, adherence to operating procedures and potential bad practices or high consequence influences. We also seek out "quick wins" that reduce risk through simple and cost effective changes. Our safety standards and performance improves, but that isn't, and shouldn't be the end of the process. On reviewing what previously may have been assessed as a moderate and acceptable risk, certain tasks or areas become the focus of attention for improvement.

Within Irish Industrial Explosives, the hazard and likelihood of a significant injury occurring due to lone working was previously seen as moderate. It had never contributed to a serious injury in the past and other risks were assessed as higher. At that time, it wasn't where we needed to focus. We're now at the point in our development where it is one of our higher risks in relation to our overall risk exposure.

Having reached this point, it was recognized that all of the activities where we experience lone working, are activities carried out throughout the explosives industry globally. These included the assembly of explosives and detonator orders, quarry face profiling, shotfiring and some instances of plant maintenance.

The issue of lone working must have been solved before within the industry and the ideal place to find the solutions was from the members of SAFEX International. The Association exists to help protect people and property against dangers and damage by the sharing of experience in the explosives industry. A request for guidance from other manufacturers was promptly answered by many Members of the SAFEX community (see above). We are grateful to SAFEX International and each respondent for their support and advice.

The devices recommended included;

i) Lone worker / man down alarm
ii) Intrinsic radios
iii) T Pass Lone Worker Monitor
iv) Lone worker push button systems

Having obtained the information as to what has been tried and tested in different applications, an assessment was conducted to identify the advantages, disadvantages and limitations when used in the various applications for which we were seeking a solution. When this information was linked to the risk assessment for the various activities, taking into consideration the specific circumstances, the most appropriate solution in each case became evident. For us, the following technological solutions are being priced, prior to implementation:

**Assembly of detonators orders**

The installation of CCTV with an associated microphone is proposed. The images and sound will be monitored by an on-site security guard. This will provide visual and audio confirmation that the lone worker is safe. It was also considered to be the most appropriate solution due to potential security implications. An intrinsically safe radio will also be provided.

**Assembly of explosives orders**

We also believe the installation of CCTV with an associated microphone would be most appropriate. Again, the images and sound will be monitored by an on-site security guard. This will provide visual and audio confirmation that the lone worker is safe. An intrinsically safe radio will also be provided.

**Profiling & Shotfiring**

In this case we are considering the introduction of a lone worker/ man down alarm where electric detonators are not used. This would be linked to a mobile phone system and independently monitored at a secure monitoring station. The system operates automatically in the event of unconsciousness. This solution was also considered to be the most appropriate due to potential security situations

**Plant Maintenance**

The preferred solution in the case where Maintenance Engineers are working in circumstances that result in them working alone would be the introduction of a lone worker/man down alarm. It would be linked to an on-site base station and monitored on-site. The system operates automatically in the event of unconsciousness. An intrinsically safe radio shall also be provided.

Once these additional measures have been implemented and are operating effectively, we will have reduced the risk associated with lone working. However with continuous improvement – what's next!

## *Inbox @ SAFEX-International.org*

**From time to time we receive e-mails from members of the SAFEX community on a variety of issues. It is important we share such experiences and insights and if necessary debate them. Our quarterly Newsletter may just be the forum for doing so.**

**We therefore invite ALL readers to drop us a line at secretariat@safex-international.org if they want to raise an explosives health, safety or environmental issue or comment on any of the opinions received from our correspondents.**

## Use of UV Detectors in Fire Prevention

**SAFEX recently issued an Investigation Report concerning a fire on a conveyor belt carrying dynamite from the bulk feeder through a tunnel to a large diameter cartridging machine. Fortunately, the operator noticed the fire, switched off all the equipment and alerted workers who evacuated the danger area. They left the dynamite to burn**

**without attempting to extinguish the fire. After about 20 minutes all the dynamite was burnt out and the rest of the fire extinguished with water. Maurice Bourgeois (GD-OTS Canada) wondered whether the member considered installing a UV detector or temperature rise sensor to stop the conveyor. It can then activate a deluge system to prevent propagation on the belt from one area to the next.**

**Janusz Drzyzga (Nitroerg) commented**:
The installation of a sensor or sensors to detect temperature rise is tricky. It is very difficult to pin-point places that should be controlled. Moreover the sensor will show that something bad has already happened and it may be preferable to prevent the initiation of such an event in the first place. For example, if the fire was initiated as result of heat build-up from slippage of the conveyor belt on the rollers, we should monitor it. In this case the preferred solution could be to monitor the difference between the rotational speed of the conveyor rollers as this would indicate slippage of the belt.

**Maurice Bourgeois (GD-OTS Canada) agrees but goes on to add**:
We use UV detectors in our propellant rooms which will activate in about 0.5 sec or even less the wet deluge system if the slightest spark is visible to the UV cameras. But obviously, as Janusz says it is preferable to work on the root cause of the problem. On the other hand, if it is necessary to prevent propagation of the fire UV detection is the fastest reacting fire protection system for explosives fires in our experience.

## Disposal of Pyrotechnic Material on Burning Grounds

**SAFEX recently notified members of an incident in which waste pyrotechnic material caught fire unexpectedly on a Burning Ground. Two employees were quite seriously injured and admitted to hospital with burns to their faces and necks**.

**Maurice Bourgeois (GD-OTS Canada) commented**:
Before the waste pyrotechnic powders leave any of our operating buildings for the burning ground, they are placed in antistatic bags with heating oil or diesel fuel. The pyro-powders are wetted and phlegmatized in this way. At the burning ground the bags are placed in clean burning pans and opened so that they do not make a cake or ball. it is important not to leave a ball of powder in the pan that has the critical dimensions for transitioning to detonation The drenched powder is therefore spread in the pan and exposed to the ignition source which is operated remotely. Usually the burning ground operator will add some diesel to the pan so that the ignition source lights the diesel and is not on top of the pyro-powder or slurry.

This may not be the most ecological acceptable solution but it is in our view the safest. The diesel fuel or heating oil generates less smoke while burning because of the oxidants present in the pyro-powders. Furthermore with the oil drenched powder there is less risk of friction or static ignition of the powder and also the powder does not fly off in the wind. We also use burning pans which are emptied of their ashes and prevent spontaneous or inadvertent ignitions due to fire-brand hidden in the cinder or the sand patch. Some companies put straw beds in the burning pan to absorb any shock waves that may could rebound on the hard surface of the burning pan and amplify the noise and overpressure.

## Employee Fitness for Work

**The recent Safety Alert on this topic was issued by the Explosives Inspectorate of Queensland, Australia and referred to a mining incident. It discussed the duty of managers and supervisors to ensure that all employees are fit for work at all times. The topic is as relevant to explosives manufacturing operations and it prompted Erik Nilsson (KCEM) to draw on his experience as a former regulator to comment**.

**Erik Nilsson wrote**:
The combination alcohol/drugs and working with explosives is not good to say the least. It has been a problem in our industry in the past and probably continues today. When we updated the Swedish

regulation about 10 years ago we wrote a special section about it (paragraph 7.2.2):

*"Handling of explosives in connection with manufacturing may not be carried out by anyone who, for reasons of illness or fatigue or the effects of alcohol or any other drug or substance cannot be expected to carry out his duties in a safe way."*

When we updated the Swedish Explosives Regulations we could add 30 years of experience to the old Regulations. The technical part of the Regulations is in many cases based on accidents or near-accidents. We tried to write the Regulations in such a way that they assist manufacturers. We therefore introduced a set of Recommendations to support the Regulations. The relevant comment in this case reads:

*"Considering the risks that are always involved in the handling of explosives, it is necessary to place high demands on the judgement and attentiveness of the staff. A person who is under the influence of alcohol or other intoxicating substances may therefore not participate in the manufacturing of explosives. Anyone who, due to illness, fatigue or suchlike is unable to participate in the manufacturing in a safe way shall refrain from participating in it. A person who has a dangerous job is himself mainly responsible for judging his suitability to do it."*

Erik has kindly provided an unofficial translation of the Swedish Regulations and Recommendations which the Secretariat will be happy to send to any interested reader.

**SAFEX International** thanks the following for their contributions to this Newsletter:

- **Frank Barker,** SAFEX Expert Panel member
- **Dr Phil Lightfoot,** Manager, Canadian Explosives Research Laboratory
- **Ben Barrett,** SAFEX Expert Panel member
- **Hans Wallin** (KCEM)
- **Ashley Haslett** (IIE)
- Our correspondents: **Maurice Bourgeois** (GD-OTS); **Janusz Drzyzga** (Nitroerg); and **Erik Nilsson** (KCEM)

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