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# SAFEX NEWSLETTER no.56

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## FROM THE SECRETARY GENERAL'S DESK

We are already at the end of the first quarter of 2016! The depressed commodity prices globally have put the mining industry and suppliers under severe pressure. In a lot of countries companies are battenning down the hatches, reviewing cost structures and business models. The industry is taking strain, but should be ever wary of any potential impact of change on their safety systems. Now is the time to be very alert and not allow safety gremlins to creep into operations-lack of basic safety principles could be the cause of the ruin of a company. The cost of any event is prohibitively high and the potential effect on the whole industry is not insignificant. I thus call on all Safety Practitioners and Managers to ensure that attention to detail, training and safety audits receive priority attention. It is here where SAFEX can play a role to assist, through our eLearning Portal, the Basis of Safety Module greatly enhances the knowledge base of managers and supervisors. The Expert Panel, of which details are available on the website, can assist with training, risk assessment, expert advice and auditing.

The upcoming Congress will be dedicated to training in Incident Investigation (a bulletin published in this Newsletter by Andy Begg gives more detail on the training event), Workgroup Sessions on Remediation, Emulsion Manufacture, Explosives Transport, Ammonium Nitrate and the Track and Trace of Explosives. Incident Reporting, sharing and learning from each other is scheduled for the last two days. Utilise these opportunities and remain one of the safest industries in the world!

Thus far five Incident Notifications were issued to the industry:

IN01-16 – AELMS, HMX/Aluminium Powder Explosion

IN02-16- MAXAM, Propellant Deflagration

IN03-16- Kilgore Flares, Propellant Deflagration

IN04-16-AZOT, HMX/Aluminium Powder Deflagration

IN05-16-Chemring, Propellant Deflagration



## CONGRESS XIX

NEXT CONGRESS

15-20 May 2017 at the  
Scandia Marina Hotel

If by chance you haven't received a copy please let me know and I will rectify the situation.

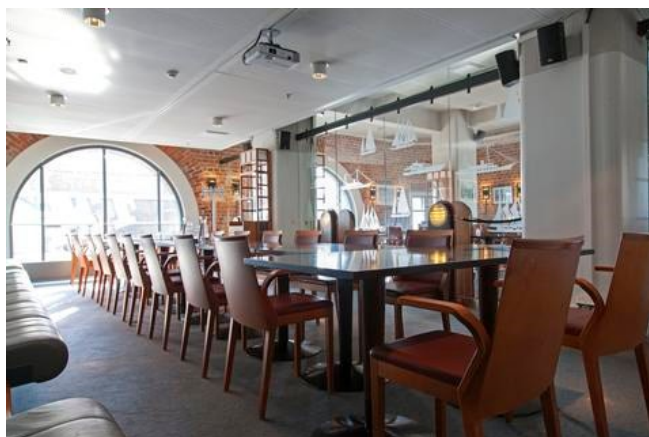
In this edition of the Newsletter the notes and articles are exclusively presented by the SAFEX Board of Governors. In this manner they are showing their commitment to safety in the industry-let's applaud them for taking time out of their busy schedules (all of them are volunteers) to show that SH and E are our top objectives and thus make us one team! As a result those loyal members who has submitted articles for this issue will be accommodated in the June Newsletter.

Terry Bridgewater collates the industry safety statistics annually for SAFEX. This is presented and as you will see there is a small but representative number of members participating, I thus urge you to participate as well-this makes the statistics more meaningful over a wider base.

The Board of Governors had their annual meeting in Las Vegas on 31 January 2016. Apart from discussing the important managerial issues to maintain SAFEX as the strategic safety entity in the industry, a large amount of time was utilised to make decisions around and discuss the Congress in Helsinki, Finland in May 2017. The Congress will be held at the **Scandic Marina Hotel and Conference Venue** in the harbour area of Helsinki-centrally located in the city. The process to populate the Pleanary Sessions with quality presentations has commenced with a call for papers. The response from the industry was overwhelming .A call for abstracts to be submitted by end May has also been issued to potential authors .These abstracts will be used to choose the presentations for the Congress open and Closed Day Sessions.



**Scandic Grand Marina Hotel and Conference Venue**



**Dining and Conference Facilities**

Two new Company Members and one Corporate Associate Member were confirmed and welcomed to the SAFEX Community:

- Forges de Zeebrugge a member of the Thales Group, Belgium and
- Di Pharma a member of the Biazzi Group, Switzerland.
- The Corporate Associate Member, the PAMSAD Organisation from Turkey .

The vacant position on the Board representing the African continent was filled by Colin Wilson from South Africa. Colin is introduced in this Newsletter and welcomed to the Board of Governors. SAFEX wishes Colin success as Governor and Convenor of the Emulsion, Explosives Transport and Remediation Workgroups.

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## SAFEX Incident Statistics Network January 2016 by Terry Bridgwater

### BACKGROUND

SAFEX is focused on high hazard operations and collects incident data and reports for incidents that occur during the handling, processing or transportation of explosives.

At the Board meeting in February 2012 a proposal was discussed to look at less serious incident data relating to general occupational incidents. Often weaknesses here can be a precursor to more serious incidents and the data might also allow us to see good practice and provide a network for sharing.

It also allows the participants to benchmark against each other and with other related industries and to monitor progress over time. Additionally, if we see one company who report very low incident rates then we can ask them for information about their success.

This is occupational safety data rather than process safety data and the group has discussed extending the scope to include near misses (or near events) but to date it has not been possible to identify a robust measure for process safety near misses.

We have now collected four years of data and this paper summarises the results and findings and compares the SAFEX community performance with other industries. In accordance with the original rules of the programme, the participants receive the full data set with details of each member but others, including the Board, only see the overall summary.

Incident rates are calculated using the US OSHA formula.

### RESULTS

The companies participating in the programme are:

- Arabian Explosives;
- Austin International;
- Chemring Group;
- Davey Bickford;
- EPC Group;
- Kayaku;
- Rheinmetall;
- Titanobel (new in 2014).

No fatalities were reported by the participants in the year which compares to two in 2012, two in 2013 and three in 2014.

The participant companies supplying data employ a total of 8,964 people and there were 70 lost time incidents in 2015. This gives a rate of 0.79 incidents per 100 employees which is a slight increase on previous years.

2012	2013	2014	2015
0.74	0.66	0.66	0.79

## BENCHMARKING

The data has been compared against the most recent industrial injury and illness data collected and published by the US Bureau of Labor Statistics. They collect up to 80,000 submissions from companies all over the US and compile them using the standard industry codes. Comparable or complimentary industry sectors are included in the following table:

Sector	LTI
Chemical manufacturing	0.50
Explosives manufacturing	0.30
Small arms ammunition manufacturing	1.10
Ammunition (except small arms)	0.30
Oil and gas extraction	0.50
Coal mining	2.20
Metal ore mining	0.90
Non-metallic mineral mining and quarrying	0.70
General freight trucking	2.30
Electrical power generation, transmission and distribution	0.50
Natural gas distribution	0.90
Guided missile and space vehicle parts	0.20
Machine shops	1.20
Electrical equipment, appliance and component manufacturing	0.60
Aircraft engine and engine parts manufacturing	0.40
Engine, turbine and power transmission equipment manufacturing	0.70

**Ref: Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2013 available from: <http://www.bls.gov/iif/#tables>**

This suggests that the SAFEX participants are generally within the broad range of industrial performance and perhaps a little better than some.

## INCIDENT TYPES

Lost time incident types in 2015 were similar to previous years:

Quantity of lost time injuries resulting from:	Total
Energetic event	2
Slip, trip or fall	22
Strain or sprain	16
Repetitive strain	2
Laceration / graze / puncture wound	10
Crush	2
Struck against object	1
Struck by object	7
Chemical burn or adverse response to a substance	1
Stress	0
Burn	3
Other	4
<b>Total number of lost time injuries</b>	<b>70</b>

*Please contact Terry on : [terry.bridgewater@chemring.co.uk](mailto:terry.bridgewater@chemring.co.uk) if you would like to participate.*

## The Competent Chemist

**By Andy Begg**

When I joined the Research Department of ICI Nobel Division in 1970 I had a degree in Pure Chemistry and my prior work experience had been as a labourer in a creamery making cheese during summer vacations. I knew nothing about explosives other than the ones we made as kids when we stuffed weedkiller and sugar into any bit of metal pipe we could find, lit some kind of fuse thing made from a drinking straw and stood back. We all survived with no lost fingers although it came close on at least one occasion. So now I start working in ICI as a Senior Research Chemist in explosives because I have a degree in chemistry.

I immediately start working on PETN crystal shape as this is important for the new PETN plant that is being commissioned in the company – the PETN is mainly used in detonating cord and crystal shape is critical to the flow of the PETN in the feed hopper to the spinning machine. I fiddle about with recrystallizing the PETN from acetone in a piece of laboratory equipment made up from what was in drawers and cupboards. I put the PETN in an oven

to dry without knowing anything about the thermal stability of PETN. Not only that ,but I am quickly trained in shot firing so that I can take responsibility for the team of 3-4 laboratory personnel who regularly go to one of our off-site testing grounds where we detonate charges of 20kg. We load the vehicle with explosives, detonators, firing box and a nice packed lunch and off we go through the local town to get to the testing site.

I was given no training in explosives other than the shot firing, but I was able to take responsibility for the several laboratory people and working with explosives because I had a degree and therefore was deemed to be a "Competent Chemist". Fortunately I was surrounded by very experienced laboratory personnel who could – and would – keep me right and say to me when unloading the R&D Department vehicle after being to the test site :“No, you can’t put detonators in that magazine because it is for explosives!” I learned much from those laboratory personnel about basic explosives good practice – and bad practice. I was lucky. Over the years I like to think I learned a great deal about explosives from my colleagues and managers – but it took a long time.

How many people today do we employ in positions of responsibility for explosives operations/activities because – as I had – they have a good educational background or business experience and therefore must be “competent”? From what I have seen over the years as I travel around I think the answer has to be “Quite a few”. One of the many examples I observed that comes to mind was a couple of years ago when visiting a PETN nitration process accompanied by the Depart-



ment Manager and the Plant Manager – both relatively new to their positions but “competent” as managers. There was a power cut and the safety systems automatically dumped the nitrator contents into a drowning tank containing the appropriate quantity of quenching water. Everything worked as it should. I asked my hosts if it was possible to restart the nitration without the drowning tank being emptied and re-filled with a fresh charge of quenching water. Silence and embarrassed looks from my hosts. A plant operator came to their rescue and advised that it was not possible to re-start as there was a sensor in the drowning tank linked to the nitration “start” system that would not allow a re-start under those conditions. This is worrying, don’t you think?

So what to do?

When we employ someone to take responsibility for any potentially hazardous operation/activity, we have an obligation to make sure they have the appropriate competency for that role and not just a good education. I was lucky, as were the people I was responsible for – but I would stress that relying on luck is not good enough.

**Training and education in basic explosives safety is a “must be given” to new personnel whether they are in R&D, Production, Engineering etc.**

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## Introducing the new Governor : Colin Wilson

**Current Position:** Company Compliance Manager at AEL Mining Services; a member of the AECL Group.

**Professional background:** Colin joined AEL in 1983 as an engineer-in-training and gained extensive experience in explosives manufacture, research, mining operations and business management.

**Role:** Colin was appointed Business Director Surface and Massive Mining in 2006 and advanced to Executive: International, heading up AEL’s international growth strategy in all markets outside the African continent. He then assumed his current position as the Company Compliance Manager in November 2015.

Having been with AEL for 32 years, Colin brings with him well-rounded explosives and mining experience. Colin’s experience in engineering, manufacturing, R&D and mining operations will ensure AEL mitigates associated risks. In our business, compliance to stringent standards in safety, health, environment and quality is a non-negotiable and a deviation could lead to loss of life and/or loss of licence to operate.




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## Compliance in the Age of Evolved Explosives Products and Technology – Balancing Expectations By Colin Wilson

Having worked in various roles in AEL over the past 32 years, initially in manufacturing & engineering to R&D; mining and broad international frontline operations; and more the recently ap-

pointed Company Compliance Manager ,I would like to share my observations of a concerning culture of compliance somewhat riddled with complacency. There are a number of contributing factors, whether right or wrong, key amongst which appears to be the “perceived inherent safety” built into explosives products as technologies and formulations have evolved.

The industry needs to maintain global standards for explosives manufacturing and blasting operations ,that vary from region to region. In some regions and/or countries no clear legislative regulations exist, thus everyone is left to their own standards. A key consideration is acknowledging that any related incident anywhere in the world that points to blatant non-compliance has bearing on the entire industry. The question remains: How should industry players ensure compliance standards are upheld in the manufacture, supply and use of explosives whilst ensuring varied stakeholder expectations are met?

### **Compliance to what & who is responsible?**

Safety, Health, Environment and Quality (SHEQ) are generally companywide functions as is found in the larger producers, thus offering a security component to business sustainability. This largely ensures organisations operate in accordance with applicable legislation across all regions.

The culture of ensuring that production and products comply with the most stringent safety standards, regulations and legislation must be well inculcated. Through industry body associations and peer group auditing, companies can continue to be involved in shaping the blasting industry, its standards and its future trends.

### **Responsibility and accountability:**

For an organisation to maintain its “Licence to Operate” it must comply with applicable legislation in order to limit the risk of loss in the form of penalties or being subjected to reputational damage. As a result, it is the responsibility of each individual to ensure that their areas of responsibility comply fully with the required legislation across all operational areas. In regions or countries where legislation is unclear, company higher standards must be introduced thereby exceeding country minimum standards.

### **How to instil a culture of compliance without compromising profitability?**

Across industry there is a constant drive towards creating an awareness of the fundamentals of each process on bench and across operations for compliance to standards. Employees are thus expected to maintain that delicate balance between compliance and not compromising profitability across the whole value-chain of a business. Incumbents are expected to be au fait with operational risks and procedures. The challenge arises where, when driven by targets and tight deadlines, it is possible that employees consider foregoing certain compliance procedures in order to meet stakeholder expectations which could have dire consequences.

Ideally, compliance to standards should be a non-negotiable, however, at times corners maybe cut for the benefit of profit. It is incumbent on industry players to ensure no negligent behaviour is tolerated. However, the blatant reality could be that incumbents feel disempowered to challenge status quo, pressures and stakeholder expectations and could end up subjecting themselves to unsafe acts to meet expectations. What therefore are we as industry doing to ensure the empowerment of employees to feel secure enough to walk away from an environment and an act that defies compliance to standards?

## Prioritising safety over profitability

We know that the objective of business is to make a profit. This could lead to the pressure of prioritising output at the expense of compliance, standards and operating procedures. Therefore, training of industry personnel including customers, to enhance knowledge and understanding of the rules of compliance and regulations is key. Through training, all stakeholders can be empowered to challenge management decisions that could jeopardise operations and reputation in terms of compliance. Employees are often under immense pressure to deliver.

The dilemma we seem to be facing as an industry is, with the advent of advancements in explosives technology comes the perception of “safer” blasting products that improve productivity and are cost competitive allowing us to forego some of the stringent standards that governed the industry. This must by no means overshadow the need to comply with the fundamentals and basics of blasting safety which also needs to be revised on an on-going basis. Compliance needs to be balanced and afforded due consideration, as all the important fundamentals that drive our businesses and industry. None is more important than the other.

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## LEADING SAFETY

By Enrique Barraincúa

At MAXAM we are firmly committed to continuing our advance towards the goal of zero accidents of any kind and, therefore, we have launched a global initiative addressed to the MAXAM leaders, named LEADING SAFETY.

It is an ambitious programme that aims at cultural development worldwide, reaching through the whole organization from top to bottom.

The backbone of the programme is that the evolution of an organization implies, necessarily, a transition from the current stage, at which most companies are set right now, to a more ambitious one. And this change has to be qualitative. For those who are familiar with the theory shown in the DuPont Bradley curve, it seems to be obvious that the improvement in safety requires the overcoming of the so-called “dependent” phase. Here, the effort is focused on making sure of the fulfillment of the rules by means of vigilance and supervision. And, although it is true that this system, by itself, can provide good results, it is undeniable that it is not taking advantage of the full potential of individuals and teams. When trying to work in anticipation and to detect unsafe acts and conditions before we even have a near miss, we must rely on people’s proactivity.

The concept of “Leading Safety” tries to use individual capabilities in order to reach a situation in which employees not only do not need supervision, but are also capable

of dealing with any unsafe acts by their peers in a successful way. This requires enormous doses of training and practice, and the deepest commitment of everyone involved.

It is also a progressive process in which not all individuals advance at the same pace. That is the reason why the most gifted will reach an interdependent phase and will be able to take care of those still stuck in the dependent one.

The idea is that, when a critical mass is reached, the efforts that are currently focused on supervising and detecting unsafe acts will be better used discovering unsafe conditions and improving the quality of the risk assessments. Obviously, this will need time and a change of paradigm.

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## SAFEX Congress 2017

### Incident Investigation training

by Andy Begg

The investigation of incidents is an unfortunate but necessary role that many of us undertake. However, there is considerable value to be gained from the thorough investigation and reporting of all incidents.

Not only will this help prevent a recurrence of the same incident but it should also provide much valuable information about the hazards and safe management of the



particular operation and also many related operations.

Incident history and database research are revealing that (explosion) incidents are repetitive within the industry. Amongst a variety of reasons, it is often found that an incident investigation is too superficial and does not identify the actual root causes (quite frequently underlying (SHE) management system issues) leading to the sequence resulting in an incident.

The purpose of this training workshop is to lead the participants through the various stages of the investigation process from the immediate action to be taken via the selection of a competent and independent investigation team, steps of the investigation to the follow-up on the investigation report.

For the particular case of an explosion or fire, the investigation team is often faced with a scene of total destruction. This is quite unlike the scene that normally confronts a team investigating non-explosion incidents where the post incident scene will look very similar to that immediately prior to the incident.

Thus, a part of the training will focus on technical investigation and deal with causes (pre-explosion) and post effects of explosion events. Participants will work in group exercises to practice with the learning material provided.

The following personnel would benefit from this Incident Investigation training:

- Senior technical managers involved in incident investigation
- Plant supervisors and managers

## Historical lessons learned on Electrostatic in handling Explosives

By Vladimir Dodukh, Nikolay Karmazinov, Yury Zhukov

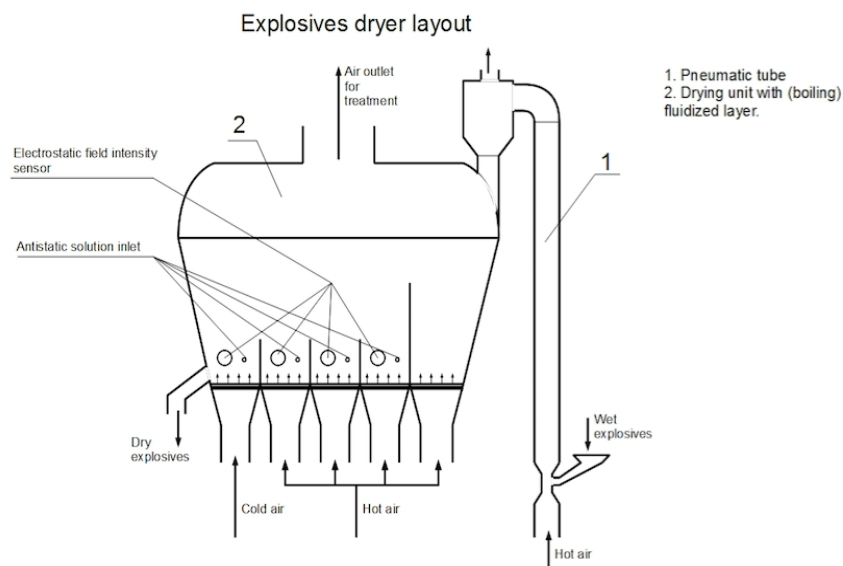
(Presented by Alexandr Chernilovskiy)

There is very little information available on the incidents with explosives in Russia.

We wanted to shed light on one of the incidents being very informative in terms of approaches to tackling safety issues in explosives manufacturing.

In 1972 an explosion occurred in a high explosives drying plant in Siberia. The building was completely destroyed. A huge funnel was the only structure left standing. Metal and other engineering structures were scattered for hundreds of meters. Five people died.

Drying was continuous in two consecutively connected units: a pneumatic tube (1) and the dryer with a fluidized bed.



Wet explosives from the vibrating hopper were continuously fed into the pneumatic tube, where in the cyclone air was separated and the explosives were transferred to the drying unit with the fluidized bed to be dried and cooled.

The units had earthing systems. An antistatic solution was added to the dryer to eliminate potential electrostatic charges. Dangerous electrostatic levels were controlled by monitoring any recorded electrostatic intensity. Dryer sections were separated by movable partitions.

One of the possible causes reviewed by the investigation committee was initiation by electrostatic discharge. During the inspection of the blast site the committee found a spare partition for the drying unit that was not in compliance with the drawing. There was no hole for connecting a special vibration resistant earthing wire!

A similar earthing design, however, was successfully used at other plants. Obviously, the committee immediately suspected that the partition in the exploded unit might not have been earthed. That could be a direct indication of accumulated static leading to electrostatic discharge.

Further, the cause and development of the explosion process was absolutely clear. Due to electrostatic charging of the powder explosives the partition accumulated significant electrostatic energy, sufficient for causing deflagration of the product. The aggregate state of the matter led the deflagration to detonation.

This assumption was proved by simulating the situation when a non-earthed partition accumulated an electrostatic charge from the inert powder. On the outside of the drying unit the discharge from the partition was used to ignite the explosive substance. Thus the committee's conclusion was experimentally proved.

The tragic incident described is yet another consequence of insufficient knowledge of electrostatic protection.

Further research was focused on solutions to minimize electrostatic in the drying units. The R&D team tested the system of corona discharge in combination with eliminating static from the arresters by blowing ionized air. Ionization was generated by explosion proof radioactive sources. Safety was controlled by measuring the current of corona discharge. Maximum value was to be 5 milliamps.

This method of eliminating static proved to be efficient but rather complicated and not absolutely safe in terms of radioactive hazard in case of an explosion.

The decision was made to eliminate static using passive techniques.

Arresters were installed in the dryer. Ionized air was fed to facilitate boiling of the fluidized layer of explosives. Static was eliminated through these arresters and the current of corona discharge was controlled.

The arresters were blown clear with air to prevent dusting and adhesion of explosives particles.

If necessary antistatic solution was added to the drying unit. The dosing of the solution was controlled automatically and adjusted in accordance with the current of the corona discharge.

This system has been successfully used to date.

This is one of the examples of a systematic approach to risk assessment of electrostatic impact in handling explosives and designing equipment and protection systems for explosives manufacturing.

A comprehensive study covering long-term research has been published in Russia by N.Karmazinov and V.Kulepov.

/Phenomenon of electrostatic: monograph/ N.Karmazinov, V.Kulepov. Nizhny Novgorod State Technical University named after R.Alekseev – Nizhny Novgorod, 2013/

## How to prevent « Burnout » at work?

### By Thierry Rousse



Burnout is a word that we hear quite frequently during daily life, and most of us know what it means.

Having a “**Burnout**” seems to have become a mass phenomenon receiving constant media attention. More and more people are missing work due to “**Burnout Syndrome**.”: « Burnout » can concern a significant number of employees, and the main part of the time, the employees concerned are very professional, and they like their job. But in some circumstances during their life, they can loose control of the situation and they are trapped in a nightmare where they are unable to get out alone, most or part of the time. And when they eventually get out, they are very often severely impacted by the experience.

I would like through this article to contribute more information about preventing « Burnout ». The objective is to highlight to all of us the importance of the role we have to play in the prevention of Burnout. We can do something to prevent it, (not easy for sure, and not every time) but even if we succeed once in our life in preventing an employee from suffering from Burnout, it makes it worth doing.

The objective of this article is much more focused on the time just before the Burnout happens.

The parts composing this article are :

- Reminder of the burnout
- Preliminary signs before the burnout
- Detecting minor signs
- Analysing Minor Signs
- Strategy to help the employee concerned

#### Reminder of the burnout

Burnout is a state of emotional, mental, and physical exhaustion caused by excessive and prolonged stress. It occurs when you feel overwhelmed and unable to meet constant demands. As the stress continues, you begin to lose interest or motivation that led you to take on the role in the first place.

Burnout reduces your productivity and saps your energy, leaving you feeling increasingly helpless, hopeless, cynical, and resentful. Eventually, you may feel like you have nothing more to give. Most of us have days when we feel bored, overloaded, or unappreciated; when the dozen balls we keep in the air aren't noticed, let alone rewarded; when dragging ourselves out of bed requires the determination of Hercules. If you feel like this most of the time, however, you may have burnout. Because burnout affects your productivity levels and drains you of energy, happiness and calm, it's hugely important to recognise the warning signs before it's too late. The signs and symptoms can be physical, emotional and behavioural.

### Preliminary Signs before the Burnout

The modern lifestyle means it is usual to hear sentences like « I am overwhelmed », « Too much work », « I can't do anything at this time », « too much stress », « I am under stress » etc...

So how can we distinguish from the company perspective an employee considered to be approaching « burnout ».

The key is « before he is burned out ». After he is burned out, it is too late to intervene to put him in a safe position.

The opportunity for the company is to be able to prevent the burnout . Obviously, it is very difficult to prevent it because many factors can provoke it. And once, the burnout has occurred, it is too late to prevent it.

So, I would like to describe how to recognize the time before the burnout. It is easier to stop the process before burnout happens but obviously it is more difficult to be able to predict an employee who is likely to have a burnout.

The time just before the burnout could be recognised by minor signs which need to be interpreted. Those minor signs need to be identified on time in order to have a chance to understand the that threat is getting closer to the employee and can be devastating to the health of this employee if not

checked.

The individuals' behaviour is one of the better keys to be able to understand what happens. Some minor signs through an observation of particular behaviours must be :

- Detected
- Analysed
- Shared with the management
- Then a strategy must be set up for the employee concerned

### Detect Minor Signs

Preliminary signs of burnout are like unsafe situations : It is almost something insignificant.

Some examples that can illustrate what I mean :

- Receiving just a phone call makes you irritable ,
- Just hearing the phone ring makes you nervous,
- An insignificant demand from a colleague makes you frustrated,
- The less important the request, the higher the frustration reaction of the employee.

If as manager, you have the chance to be informed or better still to be present when it occurred, then, you must be proactive and keep in your mind something happened and you must help the employee. This is part of your duty of care. Don't turn a blind eye or the route for solving will be hard and long...

### Analyse Minor Signs

This is the more difficult part: are those Minor Signs the preamble to a potential Burnout or just frustration without any further consequences.

As with an accident, never do the analysis alone. Analysis must be done by a team composed of several people. For sure, the manager of the employee concerned is part of the team, the Human

Resource is useful, the SHE officer can also be mobilized.

With an accident, the victim must be involved in the investigation where possible; however when a burnout is suspected, the employee concerned cannot be directly involved at the beginning. Just for obvious reasons: the burnout is not there and most of the time the employee concerned thinks that he will manage himself. He is stressed but it will pass. Once the major project he is involved in is completed ; once the long list of tasks is finished ; once .....That is the main problem with burnout - the employee concerned is sure that he will regain control eventually. He never can say « I will make a stop » « I need to have a rest » « I need leave my computer alone» But he must always provide more effort, spend more and more time to be get through.

### **A strategy must be set up to help the employee concerned**

So, the team must lead the employee concerned step by step to change the way he is working.

The HR Manager, the SHE Manager and the Line Manager must be in regular contact to share the information, and to report any << minor >> incident related to behaviour,...Then, it is the responsibility of the Line Manager to have a discussion with his employee concerned in order :

- To review the different subjects
- To assess which projects are under control or not
- To plan which tasks can be delayed
- To postpone some projects
- To reallocate additional resources to help the employee

The analysis can be the occasion to have a discussion between the investigation team in order to focus on :

- What is the work load ? Most of the time, it is overload. The employee has been mobilized on a difficult project with difficulties, he has too much work to do in a minimum time ? ....

- When was his last vacation ? : It could be that the employee has not taken any Vacation for a long time. Also he may continue to work weekends with a mobile, laptop email etc

We must remember that the main part of the time, the employee concerned is very professional, he likes his job, he is very good, probably better the average. So the employee concerned is thinking as follows : « My project first », « the changes I must implement as a first priority »...He never thinks of himself, he is concentrating solely on achieving his objectives whatever effort it takes.

The pressure is so high, that he cannot even think to stop. He has no time to do that, his mind is only focused on work , to complete his work, his project whatever.

The pressure is so high that if you ask him to stop for a week, he will reply « totally impossible, I can't do that ». If he stops, the level of stress will be still higher. He can't stop. Step by step, he is closer and closer to BURNOUT.

The manager when meeting his employee must keep control of the situation by respecting some rules like :

- Not putting the employee under stress or discomfort by implying the employee didn't properly manage the business
- Have an open discussion of the work load
- Propose solution
- Finally by requesting some plan for vacation and have a rest. This point is difficult to achieve if the employee is closer to burnout time . There are a lot of good reasons not to plan : the role of the manager is to be strict on that and to check in a reasonable time, some real rest will be planned and effectively done.

Preventing burnout is a win win challenge, to preserve the health of our resource, our experts and take care of their health. Preserve the health of one employee is a good way to maintain the confidence



in a company between employees and management. The manager has duties toward the employee : even if he is the boss , he must manage them to be more effective at work but preserve their health at work as well.

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## A Brief History of UN 3375 and UN Test Series 8

by Noel Hsu

### Introduction

Ammonium nitrate based emulsions, suspensions and gels, (ANEs), are the predominant intermediates for commercial blasting explosives used in the mining, quarrying and construction industries. Compared to the products they replaced: nitro-glycerine, TNT and related compounds, ANEs are significantly less sensitive and can be manufactured and transported in bulk. This paper summarises the history of ANEs in the context of its transportation classification.

### Ammonium Nitrate Emulsions

The earliest patent publication on ammonium nitrate emulsions was the US patent in 1969 by Harold Bluhm of the Atlas Powder Company, USA. However, it was not until the 1980s that ANEs became common as an intermediate in commercial blasting explosives. Water gels had been developed earlier, in the 1940s to overcome the detrimental effects of water on ammonium nitrate-fuel oil blasting agents.

The challenge facing both regulators and industry in the 1990s was the wide variability in the product classification for emulsions and slurries which, depending on the country, could be unclassified, Class 5 (oxidizer), Class 9 (miscellaneous dangerous good) or Class 1 (explosives). Furthermore, there was no testing regime for this new class of blasting agent.

In 1999 a UN working group was convened to address this issue. The output from the UN working group was a new UN number and definition for ANEs as well as a new Test Series for these substances.

ANEs, now defined as UN3375, were added into the classification flowchart for Class 1 substances (Figure 1.). The decision box identifying ANEs would need to be considered if one were to move the substance into Test Series 8. The accompanying compositional definition for UN 3375 is found in Special Provision 309 which reads:

*This entry applies to non sensitized emulsions, suspensions and gels consisting primarily of a mixture of ammonium nitrate and fuel, intended to produce a Type E blasting explosive only after further processing prior to use.*

*The mixture for emulsions typically has the following composition: 60-85% ammonium nitrate; 5-30% water; 2-8% fuel; 0.5-4% emulsifier agent; 0-10% soluble flame suppressants and trace additives. Other inorganic nitrate salts may replace part of the ammonium nitrate. The mixture for suspensions and gels typically has the following composition: 60-85% ammonium nitrate, 0-5% sodium or potassium perchlorate, 0-17% hexamine nitrate or monomethylamine nitrate, 5-30% water, 2-15% fuel, 0.5-4% thickening agent, 0-10% soluble flame suppressants, and trace additives. Other inorganic nitrate salts may replace part of the ammonium nitrate.*

*Substances shall satisfactorily pass Tests 8(a), (b) and (c) of Test Series 8 of the Manual of Tests and Criteria, Part I, Section 18 and be approved by the competent authority.*

Figure 10.2: PROCEDURE FOR PROVISIONAL ACCEPTANCE OF A SUBSTANCE OR ARTICLE IN CLASS 1

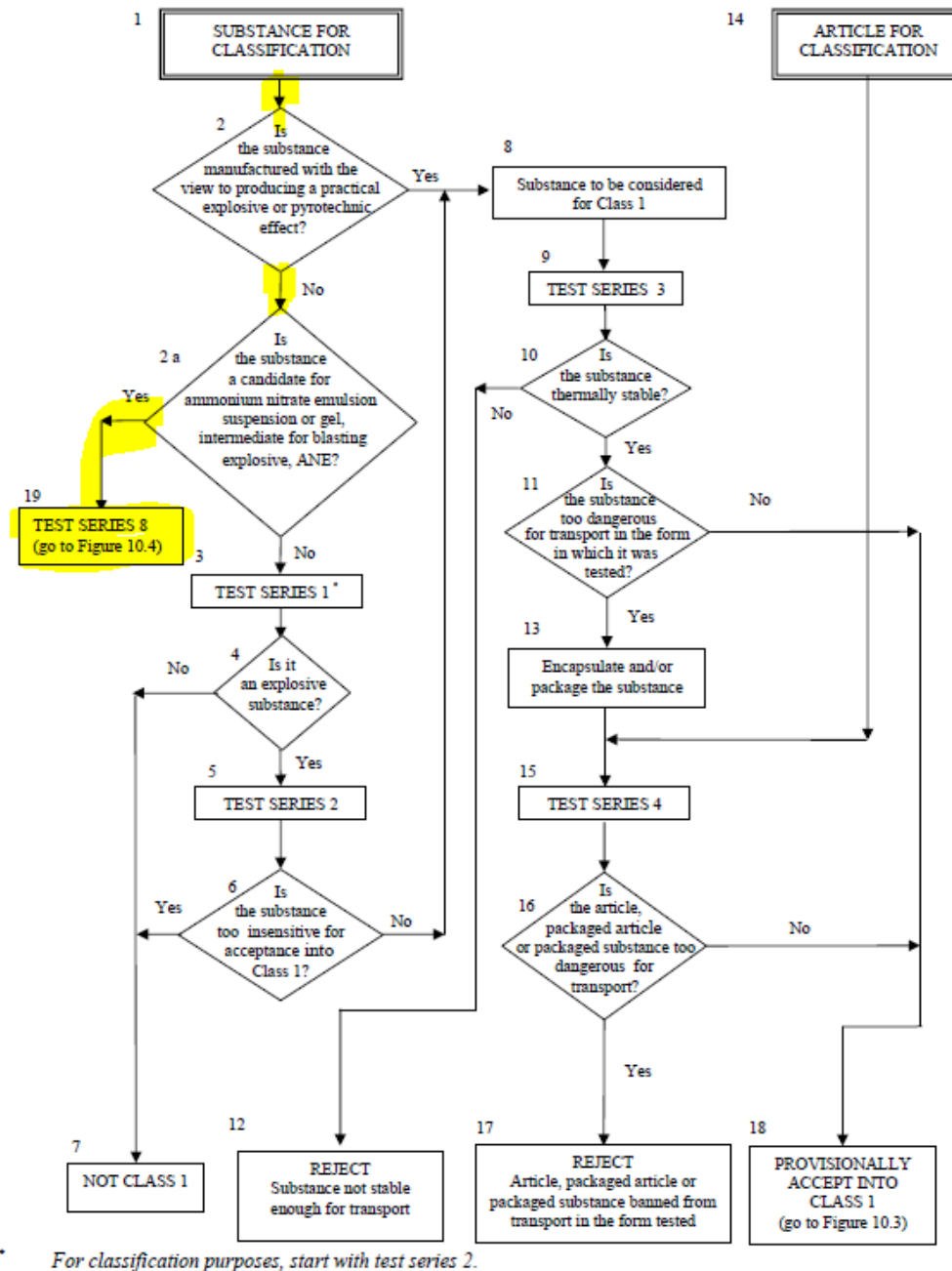


Figure 1. Flowchart for Class 1 substances

The testing regime for ANEs is Test Series 8 in the UN Manual of Tests and Criteria. The required tests are depicted in the flowchart in Figure 2.

Figure 10.4: PROCEDURE FOR AMMONIUM NITRATE EMULSION, SUSPENSION OR GEL, INTERMEDIATE FOR BLASTING EXPLOSIVES

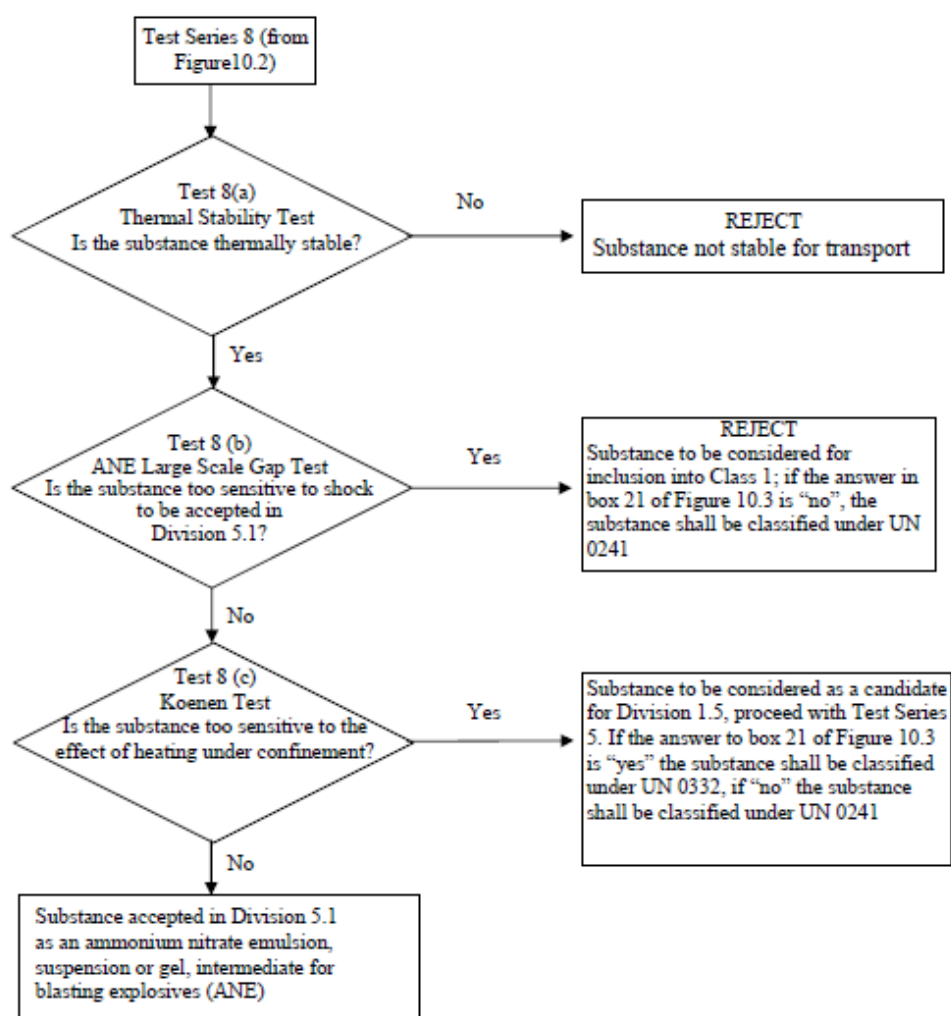


Figure 2. Test Series 8 for ANEs

These three tests were prescribed based on tests that existed for other classes of substances, and, on limited testing on ANEs. The tests aim to answer the question: Is the substance Class 5, Division 5.1 or not?

Test Series 8 (a, b, and c) intend to establish whether the substance should be Division 5.1 in the context of transportation. Test Series 8(d) is one method to evaluate the suitability for the transport of ANEs in tanks.

In addition to the tests 8 (a) through (c) there is test 8(d) – the Vented Pipe Test (VPT), in which the substance is tested in a larger mass than in tests (a) – (c). This test may be required to establish whether the substance can be transported in tanks. Note that the VPT had been used by the US Department of Transportation to determine whether an explosives of Class 1, Division 1.5 could be transported in bulk.

#### Applicability of the Koenen and Vented Pipe Tests to ANEs

ANEs were introduced into the UN Model Regulations in 2004, even though the associated Test Series 8 had limited testing of commercial ANEs at the time of its introduction into the Manual of Tests and Criteria. Industry participants from Dyno, MAX-AM and Orica carried out testing on some of their own products.

Over the years since the introduction of UN 3375 industry has subjected their commercial ANEs to Test Series 8 and noticed

that, due to the relative insensitivity of AN emulsions, some products were showing a positive result (i.e. failing) in the Koenen Test 8(c). There is a correlation between the Koenen Test and the VPT in that both tests subject the substance to intense heating under confinement; typically if a substance fails the Koenen Test it would fail the VPT.

A detailed literature review on the origins of the Koenen Test shows that this test was developed for very reactive substances, essentially primary and secondary explosives, since ANEs were not in existence when Koenen and Ide developed this test. It was observed that instead of the typical reaction times, 1 – 10 seconds, required for the substances tested by Koenen and Ide, ANEs with a water content over 10% required an order of magnitude more time, typically 120 seconds or more. This extended heating time weakens the steel of the tube used in the Koenen test. Since the result of the test is determined by how the tube fractures, the weakened steel thus gives a false positive (fail) not due to the substance alone, but also due to the material of construction of the tube.

A comprehensive paper on this research was submitted to the 39<sup>th</sup> Session of the UN Subcommittee of Experts on the Transport of Dangerous Goods (UNSCETDG).

The application of the Koenen Test to ANEs was discussed at length by the UN Explosives Working Group. The report from the working group stated that: *"The general consensus of the working group was that the Koenen test is not suitable for evaluating ANEs and that IME and AEISG should consider research into what test might be a suitable replacement. One alternative to be considered is the Minimum Burning Pressure (MBP) test."*

The VPT in effect is a scaled-up Koenen Test having all of its shortcomings with respect to testing for ANEs, namely: thick steel (relative to a transport container), high surface area-to-volume ratio compared to a transport container, and requiring at least 30 minutes of run time during which the steel will weaken as its temperature rises and as AN decomposition products such as nitric acid attack degrade the container welds to variable degrees.

Based on the recommendation by the UN Explosives Working Group, Canada submitted a proposal at the December UNSCETDG session for the MBP Test as an alternative test.

## **Minimum Burning Pressure Test**

### ***Reactivity (or lack of) of ANEs***

Test Series 8(d) is one method to evaluate the suitability for the transport of ANEs in tanks. Both the Koenen Test (8(c)) and the Vented Pipe Test (8(d)) are so extreme in their degree of confinement that they are a significant departure from the reality of containers used for ANE transport. Tanks used for ANE transport are either not pressure vessels and by definition will fail beyond a pressure of 15 PSI or 1 bar, or they have a working pressure of 25 PSI (1.7 bar), though this working pressure is reduced by fire exposure.

Incidents recorded over the last few decades show that the main hazard during ANE transportation is fire, usually initiated by an electrical source on the truck or by the truck's brakes or tires. ANEs, with their water content well over 10%, take much longer to react since the water within its bulk needs to first evaporate thereby consuming much of the heat.

There is no unequivocal evidence that ANEs, as defined by UN3375, have been involved in a transportation event that led to an explosion. There have been three events and these events raise doubt as to whether ANEs or the AN prill detonated. AN prill is a more likely substance to have exhibited this behavior as seen from the incidents documented over the years.

Arguably, the lack of certainty of an actual ANE event would lend credence to the statement that ANEs are indeed insensitive.

### ***Development of the MBP Test***

ICI began development of the Minimum Burning Pressure (MBP) test after the accident in one of its plants that manufactured water gels. The plant was owned by CIL (which was at the time 80% owned by ICI) and was located in McMasterville, Quebec, Canada. The accident took place on October 1, 1975. There was an accidental explosion in the water gel manufacturing line, thought to have initiated in the pump. The explosion resulted in eight fatalities. The need for a deeper understanding of AN based explosives was further underscored when in 1988, almost to the day (September 30) an explosion took place in CIL's research laboratory also in McMasterville. Four researchers lost their lives as a result of this accident.

In the 1990s the Canadian Explosives Research Laboratory partnered with CIL/ICI and after years of research have now developed the MBP test to its fullest extent. This test is now being routinely run by CERL.

The research by CERL has been published in many journals and show that for a wide variety of commercial emulsion products the MBP is consistent and repeatable using the testing methodology described. Their research also shows that the major factor controlling the MBP for ANEs appears to be its water content, accepting that there are other variables such as the other formulation ingredients that need to be considered.

#### ***The MBP Test versus the Koenen and Vented Pipe Tests***

The Koenen Test is used for classification of an ANE and the VPT is used for evaluating suitability for transport of ANEs in tanks. Both have criteria based on an effect: in the case of the Koenen Test it is based on how the tube fractures or fragments when the substance reacts, and for the VPT if there is a rupture of the vessel. The MBP test, in contrast, measures an intrinsic property of the substance. This value, its MBP, is by definition the pressure required for the substance to undergo self-sustained burning. It is therefore indicative of the potential for deflagration of an ANE when subject to a fire, accepting that the test measures the Burning Pressure through a localized thermal ignition event.

Substances with low MBP values will be more likely to demonstrate deflagration-to-detonation behavior than substances with a higher MBP value. As such, the criterion for classification can be set as a specific pressure, into which a sufficient safety factor has been added. In the paper submitted at the 48<sup>th</sup> session of the UN Subcommittee on the Transport of Dangerous Goods, the expert from Canada proposed a value of 5.6 MPa (800 psig) as a threshold, i.e. only substances with an MBP above 800 psig will be Division 5.1.

#### **Concluding remarks**

ANEs have been manufactured and transported for over three decades. Although there are accidental explosions with ANEs, there is sufficient doubt as to whether these substances actually caused the explosions, or in one case as to whether it is a bona fide UN3375 substance. Their relatively inert behavior is largely attributed to their high water content.

The UN Explosives Working Group will be addressing Test Series 8 and the inclusion of the MBP as an alternative to the Koenen Test in the current biennium.

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## **SAFETY PRACTICES FOR LOADING EXPLOSIVES INTO ROCK WITH Fe AND Cu SULFIDES CONTENT- POTENTIAL RISK OF REACTION OF ANFO-BASED EXPLOSIVES WITH REACTIVE ROCK IN CHILE**

**by**

**María Virginia Ramírez Anselme  
Enaex Applied Research Superintendent  
(presented by Edmundo Jimenez)**



## EXECUTIVE SUMMARY

On mine sites, the presence of rock containing Fe and Cu sulfides (reactive rock), under certain conditions, may present a potential risk of reaction with the ANFO-based explosives and, as a consequence, put the staff who works in explosive-loading areas in danger.

This is due to the fact that reactive rock may generate an exothermic reaction with ANFO-based explosives which can range from explosive decomposition, deflagrations or premature detonations. This can result in the evacuation of the compromised area, and other negative effects that affect the safety of the people and mining operations<sup>1</sup>. These instances occur when certain factors which favor this chain of reactions converge.

Currently, we have devoted efforts to the identification of rock (reactive rock) which present the potential risk of exothermic reaction with the ANFO-based explosives in order to minimize the possible risks for those who work in mining operations, and also, we have carried out the following experiments to determine this type of rock: a) establish the reactivity of ANFO with the mineral; b) establish the initial reaction temperature with the explosive product; and c) establish the sleep time with the explosive product. This last trial is an adaptation of the one described in the Australian code of Practice, Elevated Temperature and Reactive Ground (AEISG). Experiments a) and b) are adaptations of those described by the U.S. Bureau of Mines.

Based on these trials, it is possible to determine one of the potential risk factors of the rock or the reactive rock and, in this way, take better decisions during the loading activity. The possible results from these experiments are: a) non-reactive rock; b) non self-sustained reactive rock or c) self-sustained reactive rock. The rock with self-sustained reactivity are the ones with highest potential risk of reaction with the explosive, which is why it is essential to identify these areas and implement the corresponding preventive measures.

Cases that have occurred in Chile and the world have been studied in order to be able to determine the risk factors with which a reactive rock reacts exothermically with the ANFO-based explosive.

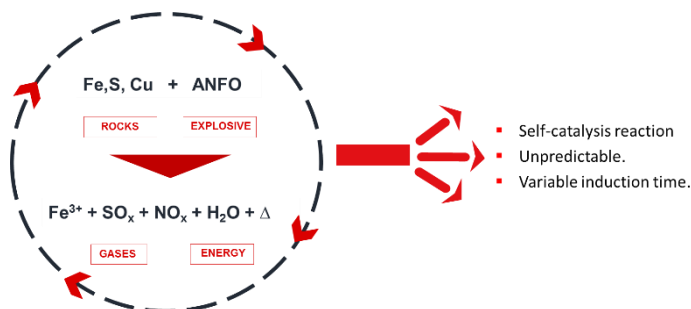
Currently, good practices for the prevention and action against reactive-rock events are being developed and implemented, providing more safety for the global blasting process.

One very important conclusion to highlight is that, when facing a situation with presence of reactive rock, it is necessary to address the operation as a comprehensive process and not to minimize it only to the use of a special explosive.

## 1.INTRODUCTION

### 1.1.Reaction of rock with Fe and Cu sulfides content with potential risk of reaction with ANFO-based explosives

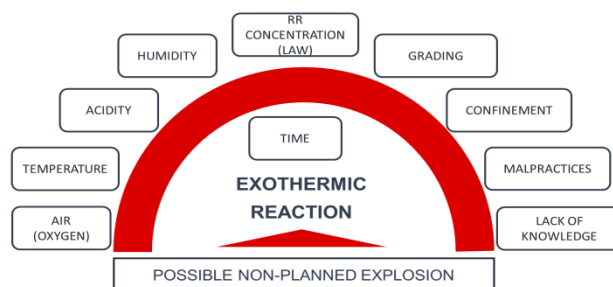
It refers to those reactions which can generate spontaneous exothermic reactions when coming into contact with explosives under certain physicochemical conditions:



### 1.2.Risk factors and consequences

Reactive rock may generate an exothermic reaction with ANFO-based explosives, producing hazardous situations which are produced when certain factors converge which favor this chain of reactions:

#### RISK FACTORS



## 2.EXPERIMENTS TO CHARACTERIZE REACTIVE ROCKS

### 2.1.Reactivity Trial

The objective of this trial is to determine if the sample rock react with ANFO when there is an external source of heat. This experiment is an adaptation of the one described by the U.S. Bureau of Mines<sup>iii</sup>.

The following three conclusions can be drawn from this experiment:

- non-reactive rock: the sample does not react to ANFO. When it reaches 200°, ANFO thermally starts decomposing;
- non self-sustained reactive rock: the sample reacts with ANFO, but there must always be an external heat source to sustain the decomposition or
- self-sustaining reactive rock: the sample reacts with ANFO and it can also sustain itself without the need of an external heat source (self-catalysis). Rock with self-sustaining reactivity are those with higher risk potential of explosive reaction and, for this reason, it is important to identify these areas and to implement the necessary and adequate safety measures.

### 2.2.Sleep Time Determination

This experiment is based on the Australian code (AEISG)<sup>ii</sup>. It consists of determining the time that the explosive product can be in contact with the mineral.

The methodology consists of mixing a sample of the mineral, the explosive product and a solution of  $\text{Fe}^{2+}$ , with  $\text{Fe}^{3+}$  acting as accelerator. Each reactor is maintained at the constant temperature of the temperature measured in the mining pit (which depends on the mine) and, if it is equal or inferior to 25°C, then it is carried out at that temperature (25°C), while the variation of temperature is measured inside the reactor. The reaction is interpreted when there is a minimum variation of 2°C of the isotherm registered. The sleep time corresponds to 25% of the time that the reactor remained without showing any change in temperature.

## 3.SOME CASES



#### 4.CONCLUSIONS AND RECOMMENDATIONS

The results obtained from the cases that positively reacted in relation to reactive rock have allowed us to determine the risk factors and the way to control them, starting from the knowledge base of the “reactive” rock with ANFO and its behavior depending on which explosive will be used (sleep time), offering safer blasting plans.

Taking into account good practices from the United States and Australia, we have adapted these protocols to follow under the current conditions in the Chilean mining industry. The following points describe some adaptations that have been carried out:

1. Development of a work plan along with the Department of Geology of the mining company, in relation to the identification of areas with a potential risk of reaction of the explosive by means of the conducting of laboratory tests to measure reactivity and sleep time under the specific conditions of the mine to be evaluated.
2. The Department of Drilling and Blasting will incorporate this plan to their program in the medium and short term so as to generate a preventive (not reactive) plan.
3. We are developing a standard method for measurement of the control parameters of drilled wells with potential risk of reaction.
4. The loading and blasting of areas with potential risk of reaction are dealt with under the specific procedure for loading of explosives with potential reaction.

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**ARTICLES FOR NEWSLETTERS**

This is a reminder that through the Newsletters we share knowledge in the areas of Safety, Health, Environment and Security pertaining to the Explosives Industry. SAFEX thus call on all members to submit articles on these subjects within their own companies and countries. **The deadline for articles for the June Newsletter is 10 June 2016 and I look forward to your support .**

**Your Contact:****Dr Pieter S J Halliday****Secretary General, SAFEX International****Home office**

49 Market Street, Johannesburg North, 2188 Randburg. South Africa

(Tel): +27 11 704 1743 | Mobile (Tel): +27 82 556 5351 | (Fax): +27 11 704 1743 |

(E-mail): [secretariat@safex-international.org](mailto:secretariat@safex-international.org)