Process Safety
and
Industrial Explosion Protection
Session 1: Safety Management

Chr. Jochum

**Chemical Parks Formation, Responsibilities, Management, Legislation**

Chemical parks are trendy because they allow using the advantages of sites with integrated production facilities for multiple companies. However, compared with "classical" single user sites a number of new interfaces as well as legal issues have to be considered.

J. P. Gupta, Indian Institute of Technology

**20 years after Bhopal – Effects on Process Safety**

The Bhopal Tragedy of 1984 has resulted in a worldwide movement of making the chemical industry safer. It has been 20 years since the tragedy and the process industry has moved a lot forward in safety. The results of such mammoth efforts will be presented and what further steps need to be taken.

U. Euteneuer, North Rhine-Westphalia State Environment Agency

**Short comings in safety cases identified during the review process**

Plant safety experts appointed according to the German Federal Immission Control Act have to submit a report about relevant results of safety reviews and consequences for the improvement of plant safety every year. The presentation deals with relevant findings of the evaluation of these reports.
Session 2:  Quantitative Risk Analysis

K. Dixon-Jackson, Ciba SC

QRA Advantages-Disadvantages and Experience in Practice
The advantages and disadvantages of numerical quantification of risk (QRA) in chemical processing is compared to that of qualitative risk assessments. The pitfalls and errors of numerical methods are described and the advantages of a focus on the necessary outcomes of any analysis are discussed in detail. The methodologies compared are quantified fault-tree analysis and an in house check-list versus process step systematic analysis.

S. Medonos, Petrellus Limited

QRA in various industrial sectors – Current position, SAFERELNET
The paper provides an overview of the application of QRA in various industries. QRA uses “rule sets” to predict the effects of accidental load. The Paper presents more realistic rule sets in accordance with the “Guidelines for the Design and protection of Pressure Systems to Withstand Severe Fires” (UK 2003). The QRA techniques will be summarised and the state-of-the-art identified as a result of the SAFERELNET initiative.
Session 3: Safety Legislation

A. Markowski, Technical University of Lodz

Polish Experience in Fulfilment of Seveso II Directive
The realisation of the requirements of Seveso II Directives in Poland comprises the systematic approach. Major Accident Prevention Policy, Safety Report, Contingency Plan and so-called Adopting Program were elaborated jointly and they were based on risk assessment. Case studies and problems will be presented.

M. Christou, S. Duffield, JRC Ispra

Results and Recommendations of the New Working Group on Land-use Planning in the Context of Major Accident Hazards
Although the European Commission has produced relevant guidance on this subject the European Parliament and Member States have asked the Commission the re-visit this problem and produce a more detailed and prescriptive guidance. The paper will describe the work of the new technical working group that has been formed to address this problem.

M. Reunanen, J. Sarsama & M. Maskuniitty, VTT Industrial Systems

An approach to carry out a boiler plant hazard assessment
The Finnish pressure equipment legislation was recently renewed. According to the new legislation, a boiler plant hazard assessment must be carried out in certain boiler plants. The paper presents the hazard assessment requirement, an approach to fulfil it, and experiences based on some case studies.
Session 4: Inherent Safety

J. P. Gupta, Indian Institute of Technology

Inherent Safety Measurement Indices
Inherently Safer Design (ISD) has been recognized as a pioneering approach towards making the chemical process industry significantly safer. In this paper, we will compare the various indices, their applicability and further developments needed. Having an agreed simple index would definitely increase the use of ISD approach in a significant manner and thus help make the process industry safer.

H. Winter, DSM TechnoPartners

Potential Hazard Index: Linking process hazard evaluation and inherently safer design
Although the potential benefits of the concept of Inherent Safer Design (ISD) were recognized, ISD still does not belong to common practice. The paper describes a method Process Hazard Inventory and Evaluation (PHI&E) to link process design and process hazard identification and to transform a potential hazard into a hazard potential by calculating a Potential Hazard Index (PHI) and to subsequently reduce the PHI by using ISD.

F. Somboli, Segibo srl

EWDS (Early Warning Detection System) for the early detection of runaway initiation
The paper presents a device for the early detection of runaway initiation using only temperature measurements and based on the calculation of the divergence of the system, which is the runaway criterion using state space reconstruction technique. The device has been tested under isothermal, isoperibolic and reflux conditions in batch reactors. Finally, the results from testing at several chemical companies are illustrated.
Session 5: ATEX Directives

R. K. Eckhoff, University of Bergen

A critical view on the treatment of combustible powders/dusts in the European Union ‘ATEX 100a’ and ‘ATEX 118a’ directives with special reference to design and use of electrical apparatuses

The paper will discuss weak points in ATEX Directives to clarify more clearly the differences between powders/dusts and gases/vapours. In particular, the Directives must differentiate between the ways in which gas clouds and dust clouds are generated and sustained in practice. In addition, it must include open and smouldering dust fires as a hazard. The ATEX 137 Directive must include combustible dust layers/deposits that can give rise to open or smouldering fires, in the definition of “hazardous areas”.

J. X. Bouillard, F. M. B. Mercier, L. Perrette, INERIS

ATEX Directives: Practical concerns

Explosions involved in runaway reactions or incombustible solvent expansion (ex steam explosions) are not strictly speaking covered by these pieces of regulation but depend on general health & safety at work, chemical substances, or major hazard control (i.e. Seveso) regulations. The paper presents the French approach and includes also the French application for dusts in silos.

H. Bothe, Physikalisch-Technische Bundesanstalt

Borderline cases of Directive 94/9/EC for non-electrical equipment

Frequently conformity assessment certificates are asked for products that are not equipment, protective systems or components in the sense of the directive. Such products—if they could become an ignition source or may influence zone classifications—are to be considered in the explosion protection document. Other questions (e.g. equipment with internal explosive atmosphere) will be discussed.

R. Rogers, Inburex GmbH

Standards in Support of the ATEX Directives

The new standards which have been recently developed for non-electrical equipment will be described. In particular, the requirements resulting from the standard prEN 13463 “Control of ignition sources (b)” will be discussed.

http://europa.eu.int/comm/enterprise/atex/infor.htm

The ATEX Standing Committee, Interpretation of ATEX Directive
Session 6: European Research on Explosion Protection

K. Holtappels, Ch. Liebner, V. Schröder, Federal Institute of Materials Research and Testing (BAM)

Hydrocarbon oxidation processes at non-atmospheric conditions – EC-project SAFEKINEX
The project will develop test methodology for explosion indices at non-ambient conditions, a validated data base on them and on many other explosion indices as a function of pressure and temperature. Further, models will be developed, enabling prediction of behaviour of reactive systems and predicting explosion parameters.

S. Hawksworth*, R. Rogers*, C. Proust*, M. Beyer+, S. Schenk, J. Gummer & D. Raveau*
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+ INBUREX GmbH, 59067 HAMM, Germany

Mechanical Ignition Hazards in Potentially Explosive Atmospheres – EC-project MECHEX
This paper reports the findings of the project to investigate the ignition of explosive gas and dust atmospheres by friction, impact and sparks. Work will be reported on: measurements of the temperatures produced during frictional rubbing and impact in relation to power or energy dissipated; detailed studies of the ignition of dust layers by hot bodies; simulation of incendive metal sparks by the laser heating of particles.

O. R. Hansen, T. Skjold, B. J. Arntzen, GexCon AS

DESC - A CFD-Tool for Dust Explosions
The paper will explain the methods used and physics modelled, and also show examples of performance. The tool is expected to offer a better way of designing safe and optimal vent configurations of process flow systems. Parameters like vent location, relief pressure and inertia, initial temperature and pressure will be modelled. The turbulence generated either from dust transport or explosion expansion flow, will also be calculated, and effects like pressure piling and multi-compartment explosions can be considered.
Session 7: Explosion Protection

M. Molnárné, V. Schröder, Federal Institute for Materials Research and Testing (BAM)

Evaluation of fire and explosion hazards of gas mixtures using explosion diagrams
An important method to prevent fires and explosions is to avoid explosive fuel-air mixtures. For this purpose the exact knowledge of the explosion range is required as a function of the combustible, oxidizer and inert gas concentrations. Frequently triangular diagrams are used in order to display the explosion range. This paper describes how to use the TRIANGLE software for flammability diagrams. Furthermore a calculation method for the flammability of gas mixtures is shown.

O. R. Hansen, B. Wilkins, GexCon AS

An experimental study on oil mist explosions
Explosions in liquid sprays and aerosol particles differ from gas explosions in various ways, both ignitions, dispersion and combustion mechanisms may lead to sometimes increased hazards for aerosols compared to gas. Still in risk assessments gas is normally used to represent low flashpoint aerosols, whereas explosion risk from aerosols with flashpoint above room temperature is often ignored. Experiments in laboratory scale and larger scale were performed to learn more about the phenomena.

G. Astbury, Avecia Limited

Area Classification of Laboratory Fume Cupboards and the Use of Non-Certified Electrical Equipment
In order to solve the problem that arises on assessing the risk from non-certified electrical equipment, a system of inspection and assessment has been developed. This classifies the equipment into two categories - "Unsuitable" and "Not unsuitable". A decision tree can be used to screen out unsuitable equipment, or determine acceptable positions within the fume cupboard. Examples are presented with a rationale as to their suitability for use in a potentially flammable atmosphere.
R. Schwab, BASF Aktiengesellschaft

Examples for Safety Devices Against Backflow in Chemical Plants
Damages caused by backflow and failures in machines show, that safety arrangements are necessary while chemical plants are designed. In BASF used methods for pump and compressor protection and their ambiance are shown.

S.B.H. Schönfeld*, A. Dudlik*, S. Schlüter*, T. Neuhaus, H.M. Prasser**, Fraunhofer Umsicht, **Forschungszentrum Rossendorf

Due to control process, start-up and shut-down processes as well as operational disturbances in a process plant flow rate fluctuation and pressure surges occur, which can lead to damages of plant’s equipment up to leakage of pipe system. The results of the experiments as well as the methods of prevention will be presented.

E. Rietzschel, Gas Products Consultancy

The process safety aspects of high pressure acetylene for use in chemical synthesis
Acetylene is used from cylinders in which the acetylene has been under pressure dissolved in a solvent. The paper will address safety issues as well as accidents which have occurred and deal with the engineering aspects, describe the potential consequences of non-containment and deal with the “ignition” sources causing the decomposition reaction to start and mitigation of these.

N. J. Duijm, Risø National Laboratory

Risk issues of toxic solid substances
Within the framework of the Seveso-II, risk assessments have to be performed for industries using or storing substances that are classified as potentially hazardous. The potential hazards of toxic or environmentally damaging solids are less obvious. To address risk assessments attempts have been made to extend hazard indexes ("Dow", "Mond" or "Inherent Safety" indexes) to include the assessment of classified solids.

M.N. Boers, R.J.A. Kersten, A.F.L. Creemers, G. Opschoor, TNO Prins Maurits Laboratory

Characterisation of toxic and flammable gas production related to chemical reaction hazards
An important aspect in assessment of chemical reaction hazards is the analysis of possible toxic or flammable products that are formed in the process of an uncontrolled chemical reaction. To screen materials for both reactive properties and the type of generated compounds, TNO modified standard equipment with an FTIR analysis section. Examples of application and a discussion on the possibilities and limitations will be presented.

A. van den Braken, R. Bollen, Akzo Nobel Safety Services

Chemical Reaction Hazards in the modern chemical industry – Are specifications sufficient?
The chemical industry is nowadays driven by cost reductions. The number of accidents from unanticipated reactions seems to increase. Is this a trend or a consequence?

D. Oberhagemann, ESMG European Safety Management Group

S2S – A Gateway for plant and process
Members of the networks Safetynet, Harsnet and PRISM have developed a new network SAFETY TO SAFETY (S2S). S2S will analyse the future RTD strategy on process safety, give structured and evaluated information, develop interactive safety guidelines and training tools and provide a means to monitor various texts of legislation and standardisation that have been voted for or are in preparation stages.