

Chemical Reaction Hazards Update

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Contents at a glance

- PreVent Launch - Process reaction evaluation and venting methodology, product launch.
- Chemical Reaction Hazards and DSEAR (Dangerous Substances and Explosive Atmospheres Regulations, 2002). The first UK regulation to specifically include the assessment of reaction hazards. We outline the implications for the UK chemical industry.
- Laboratory Update. Interesting projects recently completed or in progress within our laboratories.
- Case Study. Even simple processes can go wrong! An example of an incident in a very simple chemical process.
- New Chilworth Datasheets. 5 technical datasheets have been published covering explosivity, thermal stability, adiabatic calorimetry, reaction calorimetry and vent sizing.

Chilworth Launches PreVent at the "Theatre of Dreams"

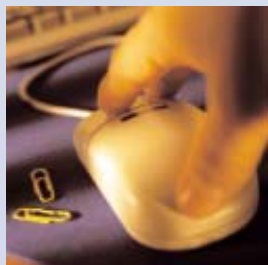
The launch of our new process reaction evaluation and vent assessment service, **PreVent**, was well received, particularly by members of the HSE who were in attendance. It was held on 7th Dec at Old Trafford, Manchester and formed part of our afternoon seminar on Reaction Hazards & DSEAR Compliance offered to a small number of existing clients.



Based on our customers desire for a low cost, short form screening procedure, **PreVent** has been especially devised to provide the data they need for DSEAR / CAD compliance.

To learn more about PreVent see the lead story on the inside front page of this brochure.

To reserve your place on our next FREE seminar at the Theatre of Dreams, Manchester and obtain a first hand appreciation of your compliance obligations in respect of chemical reactions and how PreVent can form part of your solution strategy, please complete the faxback form on the back page.



www.chilworth.co.uk

If you are short on time and would like further information on PreVent or other Chilworth products or services, you can download copies of all our product literature and technical articles directly from our website at www.chilworth.co.uk.

Additionally by registering on our website you will automatically receive new technical articles and datasheets as and when they are published (approx. 4-6 a year).

Chemical Reaction Hazards Update

PreVent: A Cost Effective Vent Sizing Methodology

How many chemical companies (particularly in the fine chemical and pharmaceutical sectors) operate a single product in a single dedicated plant? ... not many! This observation is supported by a UK HSE survey in 1997. Of the vessels surveyed which contained exothermic chemical reactions, less than 50% were used for a single product, the rest were multi-product reactors.

In addition to the difficulties of running multi-product reactors you can add the need to rapidly scale-up new or modified processes and the high number of processes conducted in any particular reactor, and it becomes clear that ensuring your basis of safety for each process could be an overwhelming task.

Chilworth Technology have developed PreVent (Process Reaction Evaluation & Venting Methodology) to specifically address the assessment of exothermic reaction hazards, thermal instability hazards and the specification and design of emergency relief systems

(or other bases of safety). The systematic PreVent methodology builds on existing, and well proven, screening methods to substantially reduce the cost, complexity and time-frame for the assessment of reaction hazards and specification of safety systems.

For more information on PreVent or to reserve a place on our FREE seminar in March 2005, please complete the feedback form on the back page.



Chemical Reaction Hazards and DSEAR

The Dangerous Substances and Explosives Atmospheres Regulations (DSEAR), 2002 are now fully in force in the UK. This is the UK implementation of the EU CAD (Chemical Agents Directive) and ATEX (Explosive Atmospheres Directive) Directives that have been implemented in all EU member states.

Within the UK, Statutory Instrument 2776 (DSEAR) clearly defines a dangerous substance as "a substance or preparation which because of its physico-chemical or chemical properties and the way it is used or is present at the workplace creates a risk...". Furthermore, a hazard is defined as "the physico-chemical or chemical property of a dangerous substance which has the potential to give rise to fire, explosion, or other events which can result in harmful physical effects of a kind similar to those which can be caused by fire or explosion, affecting the safety of a person".

The Approved Code of Practice for DSEAR goes further: "Where it is intended to carry out chemical reactions it will be necessary to carry out a chemical reaction hazard assessment as part of the assessment required by Regulation 5. This should provide sufficient information on the reaction kinetics, quantities and rates of heat and any gas generation to allow the plant to be designed safely with the correct process controls

and operating conditions. This should include, as necessary:

- materials of construction
- vessel design pressure
- agitator configuration and speed
- reactant feed controls
- safe operating temperatures and pressures
- heat transfer and cooling rates
- process instrumentation and interlocks, and
- process venting.

Both normal operation and the effects of foreseeable process faults should be considered during the safety assessment."

Does your company investigate reaction hazards and instability to an acceptable level and can you demonstrate that your plant can cope with the consequences of loss of control? If the answer is "no", or you are not sure, then please feel free to contact us for a free and confidential advisory service. If appropriate, one of our technical specialists can visit your site to discuss the implications of the new regulations and provide guidance on the acceptability of your current hazard assessment procedures.

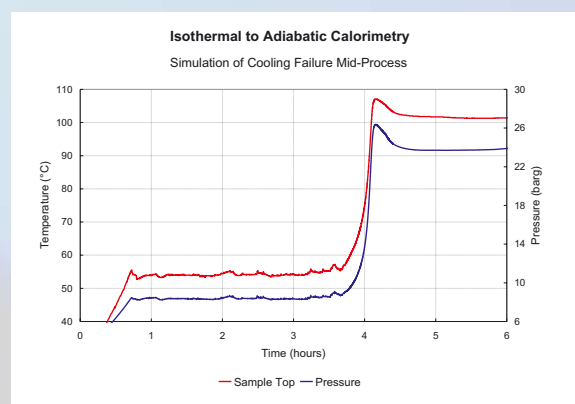
Laboratory Update

Within our reaction hazards laboratory, we pride ourselves on the versatility of our equipment (and staff!) in meeting the ever changing and diverse needs of our customers. An example of this versatility is provided in our recent development of our Adiabatic Dewar Calorimeter systems used for runaway simulations. This development enables the unit to be operated as a standard batch or semi-batch reactor simulating normal processing operations utilising temperature control to be followed within the space of 10 seconds by conversion to full adiabatic operation. As far as we are aware, no other adiabatic calorimeter can be operated in this way.

The benefit for our customers is we can directly simulate the consequences of a runaway reaction that occurs when cooling is lost mid-way through a semi-batch or addition controlled reaction. The system was utilised to study the runaway reaction potential of a batch vinyl chloride polymerisation process when cooling and agitation fail part-way through the batch cycle. In such a case, it is important that the composition tested for the runaway phase includes partially formed product having the same structure and activity as that

found in the industrial plant, artificial re-constitution using fully formed product is not acceptable. Conventionally, the reaction would have been performed in an isothermal vessel and then transferred to the adiabatic calorimeter at the appropriate point of conversion. However, given the time taken and hazard of this transfer (particularly with the toxic and volatile nature of vinyl chloride), the simple "one-pot" reaction is much safer and more effective.

We are continually developing ways of extending the capability of our laboratory equipment and would welcome the opportunity to solve any problem that you may have related to reaction hazards or instability.



Case Study: Even simple processes can go wrong!

Several years ago, we investigated an incident in a very simple chemical process, involving the semi-batch addition of an acid into an alkali to manufacture a salt solution. This is probably the most simple of processes... so what happened?

The 10 m³ vessel containing the alkali solution was being stirred during the addition of the acid. However, on the day in question, the agitator stalled. The decision was made to continue the feeding of acid into the reactor using a recirculation line to induce agitation.

Once the agitator was fixed, it was re-started (towards the end of the semi-batch addition). Almost instantaneously, the sight-glass was blown from the top of the vessel causing more than 6000 kg of very hot, partially neutralised, alkali to be ejected as a two-phase stream. The operators were injured (mainly burns) but fortunately made a full recovery.

Even the simplest processes require assessment for potential reaction hazards. Acid/base reactions are known to be exothermic, (the extent of activity being dictated by the concentration of the species involved),



but are normally instantaneous. In the current case, the more dense alkali phase was not adequately mixed by the recirculation line causing stratification of the acid during addition. Once the agitator was re-started, the phases instantly homogenised, and hence reacted, causing an extremely rapid pressure and temperature rise which were well beyond the capability of the reactor relief system.

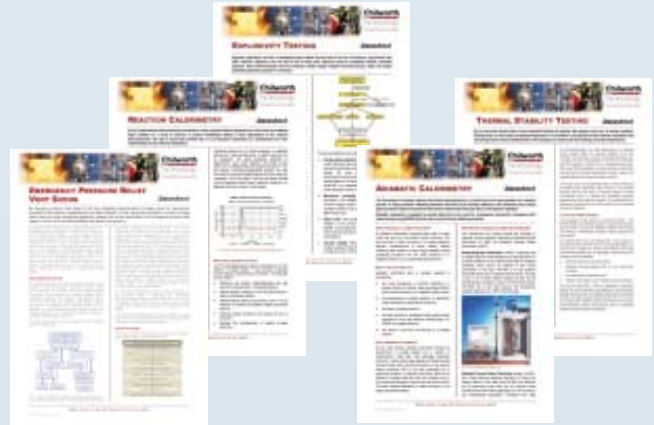
New Datasheets on Reaction Hazards and Thermal Instability Topics

New datasheets available from Chilworth covering five reaction hazards and thermal instability topics. The datasheets are intended to provide a brief overview of each topic and provide guidance to our customers on approaches that should be taken or methods that should be employed when tackling specific situations. The new datasheets cover:

- Highly energetic materials
- Thermal stability testing methods and method selection
- Reaction calorimetry
- Adiabatic calorimetry
- Vent sizing

The datasheets are freely available to download from

our website at www.chilworth.co.uk or alternatively we would be pleased to provide a hardcopy version on request (please complete the feedback form below).



FAXBACK - FEEDBACK

Please faxback to +44 (0)23 8076 7866

Dr/Mr/Ms/Miss/Mrs: Job Title:

Company Name:

Address:

..... Postcode: Country:

Tel: Fax:

Email:

My Interests:

Please register me for the next PreVent seminar on Wednesday 2nd March 2005

Please send me hardcopy datasheets for: (remember all datasheets can be downloaded from our website)

Explosivity Testing Vent Sizing

Adiabatic Calorimetry Reaction Calorimetry

Thermal Stability Testing

I would like a FREE and confidential telephone conversation with a process safety specialist

I would like a FREE and confidential meeting with a process safety specialist next time one is in my area

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