Chilworth Technology
the experts in process safety

TESTING FOR EXPLOSIVE POTENTIAL

Datasheet

Explosive substances can have a devastating impact on people and plant. Whilst we know this to be true of munitions, pyrotechnics and other "tailored" explosives, this can also be true of many other chemicals used for completely innocent, unrelated purposes. Some pharmaceuticals and fine chemicals contain highly energetic functional groups, which can impart potentially explosive properties to a molecule.

Although you may not intend to develop a potentially explosive substance, it is critical to identify, test and apply a suitable handling methodology for materials that may possess these characteristics. This is achieved by conducting a structured evaluation of the material, after which if the material does contain explosive properties, an extensive classification procedure needs to be followed, particularly if the material is to be traded or moved off site.

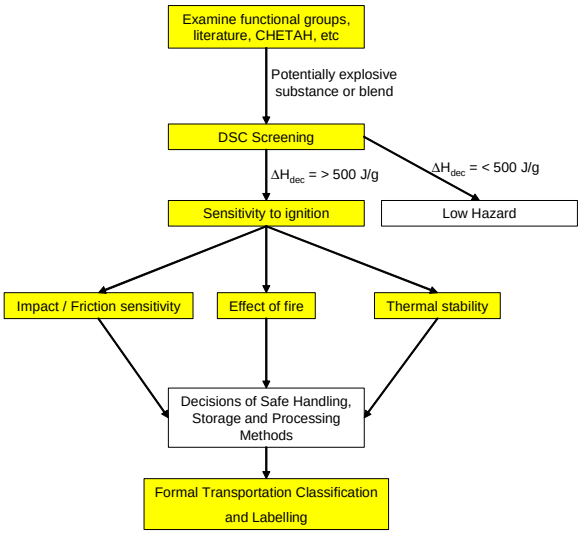
HOW DO I SPOT EXPLOSIVE POTENTIAL?

In the first instance, the easiest way of identifying potentially explosive compounds is to examine the functional groups present. The most common functional groups which impart "energetic behaviour" can be readily identified (these include, peroxy-, nitro-, azide-, etc). The desktop review can be supplemented with simple computational calculations to predict thermodynamic properties based on material structure. The CHETAH® program supplied by the ASTM (American Society for Testing and Materials) is one such tool that can be used for this purpose.

It is important to remember that not only single substances can possess explosive properties but blends of oxidising and combustible materials can present an equal level of danger. Whilst the classification of explosive substances is a pre-requisite for compliance with transportation regulations, data must also be available for safe handling and processing of energetic substances and blends.

TESTING FOR EXPLOSIVE BEHAVIOUR

If a material contains energetic functional groups, preliminary testing should be performed on the smallest possible scale so that the potential hazard can be assessed safely. The following flowchart demonstrates a typical testing route to determine whether formal classification is required.



The key characteristics that require assessment are:

- **Energy release potential**: This is normally quantified using Differential Scanning Calorimetry (DSC), which uses small quantities of material (1 – 40 mg) to crudely assess the onset temperature of thermal decomposition whilst providing quantitative data on the energy release of the reaction. If the energy release is above 500 $J.g^{-1}$, explosive behaviour is possible and further testing should be undertaken.
- **Mechanical sensitivity of the material**: The sensitivity of the substance or blend to impact and frictional energy sources, should be quantified using standard methods such as the BAM Fallhammer and BAM Friction tests.
- **Effect of fire**: The consequences of exposure of the material to fire should be determined to identify whether a mass explosion hazard will exist. The USA small scale burning test is typically used to assess this characteristic.

- **Thermal stability**: Whilst the thermal stability is crudely assessed using DSC, more accurate data on the thermal limits of the material is often required. Accelerating Rate Calorimetry (ARC) is often used for this purpose, as it is particularly sensitive when assessing the detectable onset temperature of a reaction.

Once data has been collated on the substance or blend, decisions can be made for safe handling, processing (i.e. drying and milling), storage and transportation.

Formal Classification

Once the explosive potential of a substance has been identified further testing may be required for formal classification (according to UN Transportation of Dangerous Substances Directive). This can include determination of the effect of heating under confinement (Koenen Tube test), the potential to propagate a deflagration (Time/Pressure test) and/or the potential to propagate a detonation (UN Gap test).

What Chilworth Can Provide

Our fully equipped laboratories and consulting staff are available to assist in selecting the most appropriate test (or tests) for any specific application. Once we understand your needs and specific plant situation, we will tailor a package of tests to assess the potential for explosive properties in your material (or blend). By understanding your needs we ensure that unnecessary tests are not performed.

The test data provided by Chilworth is supported with a comprehensive technical report that outlines the rationale behind each test, the safety margins that should be applied and concludes with recommendations regarding safe processing conditions (made by one of our Process Safety Specialists).

If formal transportation tests are required as per the UN Transportation of Dangerous Goods recommendations, we have the capability to perform these to the requirements of Good Laboratory Practice (GLP). We have an experienced Dangerous Goods Safety Adviser (DGSA) on staff to provide expert advice on transportation requirements. We can also provide labelling and notification information as required under the Dangerous Substances Directive and CHIP (Chemical Hazard Information for Packaging and Supply).

Information on explosive material classification is available on request.

faxback

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

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My particular interests are:-

Inherent Safety and Applicable Legislation ..... ☐

Hazard Analysis and HAZOP..... ☐

IEC61508/11 and SIL Determination..... ☐

Functional Safety Management & Assessment ..... ☐

Mechanical Relief Design (DIERS) ..... ☐

Training ..... ☐

Incident Investigation / Expert Witness..... ☐

Hazardous Area Classification..... ☐

ATEX / DSEAR Audits ..... ☐

Chemical Reaction Hazards ..... ☐

Dust/Gas/Vapour Explosion Hazards..... ☐

Electrostatic Hazards / Problems..... ☐

I would like a FREE telephone conversation with a consultant about a process safety matter..... ☐

I would like a FREE visit from a consultant next time one is in my area ..... ☐