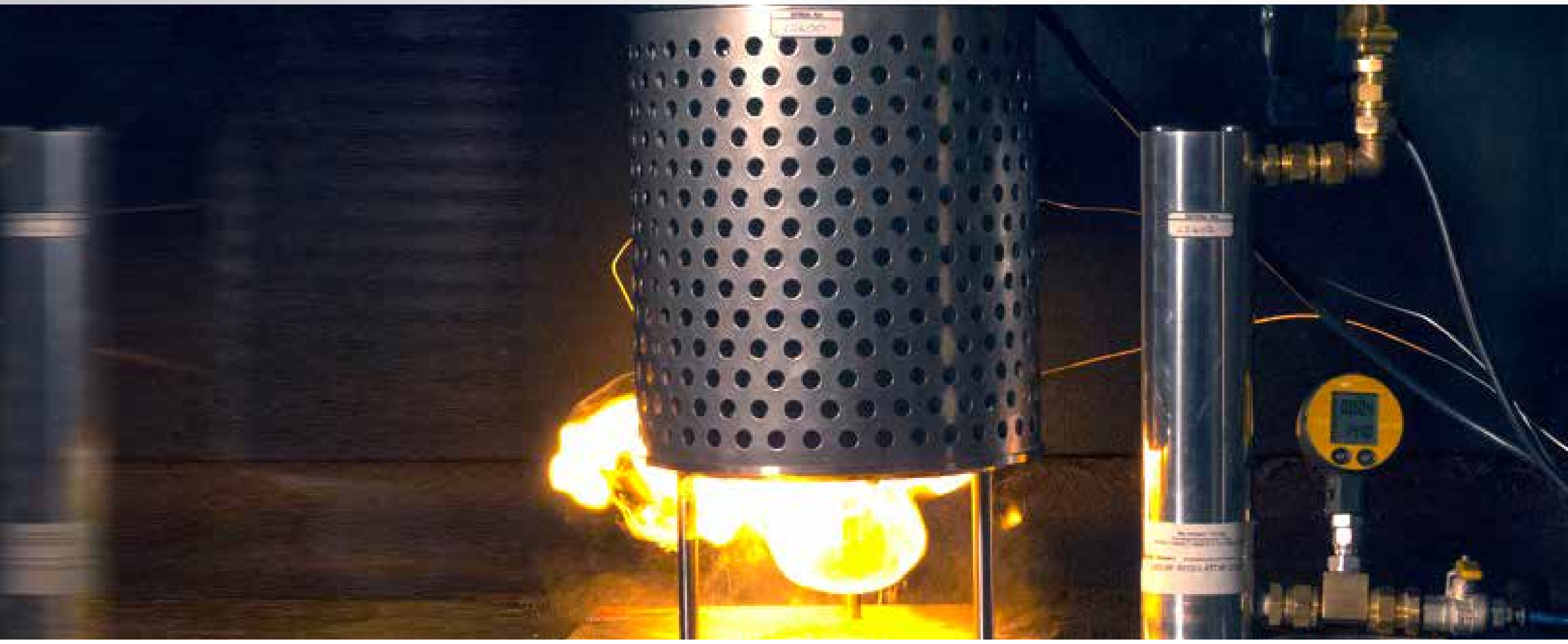

FOCUS ARTICLE

Approaches to the Collection of Process Safety Data

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Excellence in process safety performance requires an integrated approach to addressing programs, culture, and competency. One important aspect of competency is having a wealth of the right information available, and accessible, to support and underpin the overarching safety management system. This includes both asset information (P&ID's, vessel register, instrumentation, piping and physical equipment inventory, safety systems (including safety instrumented functions), etc) and process information (batch manufacturing records, quality / IPC procedures, raw material information, material safety data, process safety data, etc). Whilst the requirements for asset information and most process information is reasonably prescriptive – and hence can be reliably audited and assured - the specification of required process safety data is far from prescriptive. This often leads to ineffective or inefficient systems and can completely undermine otherwise excellent process safety management systems.

Process safety data includes information on the relevant properties of materials in the context of the Basis of Safety. For any given unit operation – and indeed, any given piece of equipment – the basis of safety can be different for different materials and processes. This potential "ambiguity" poses the biggest challenge to corporations in ensuring robustness in the basis of safety – and the process safety data requirements that underpin it.

In our experience, organisations go about the collation of process safety data in one of several ways, as described below.

Approach 1: Complete Dataset

Some organisations place a blanket requirement to procure a complete set of data on all materials and processes, irrespective of the basis of safety.

Approach 2: Prescribed Dataset

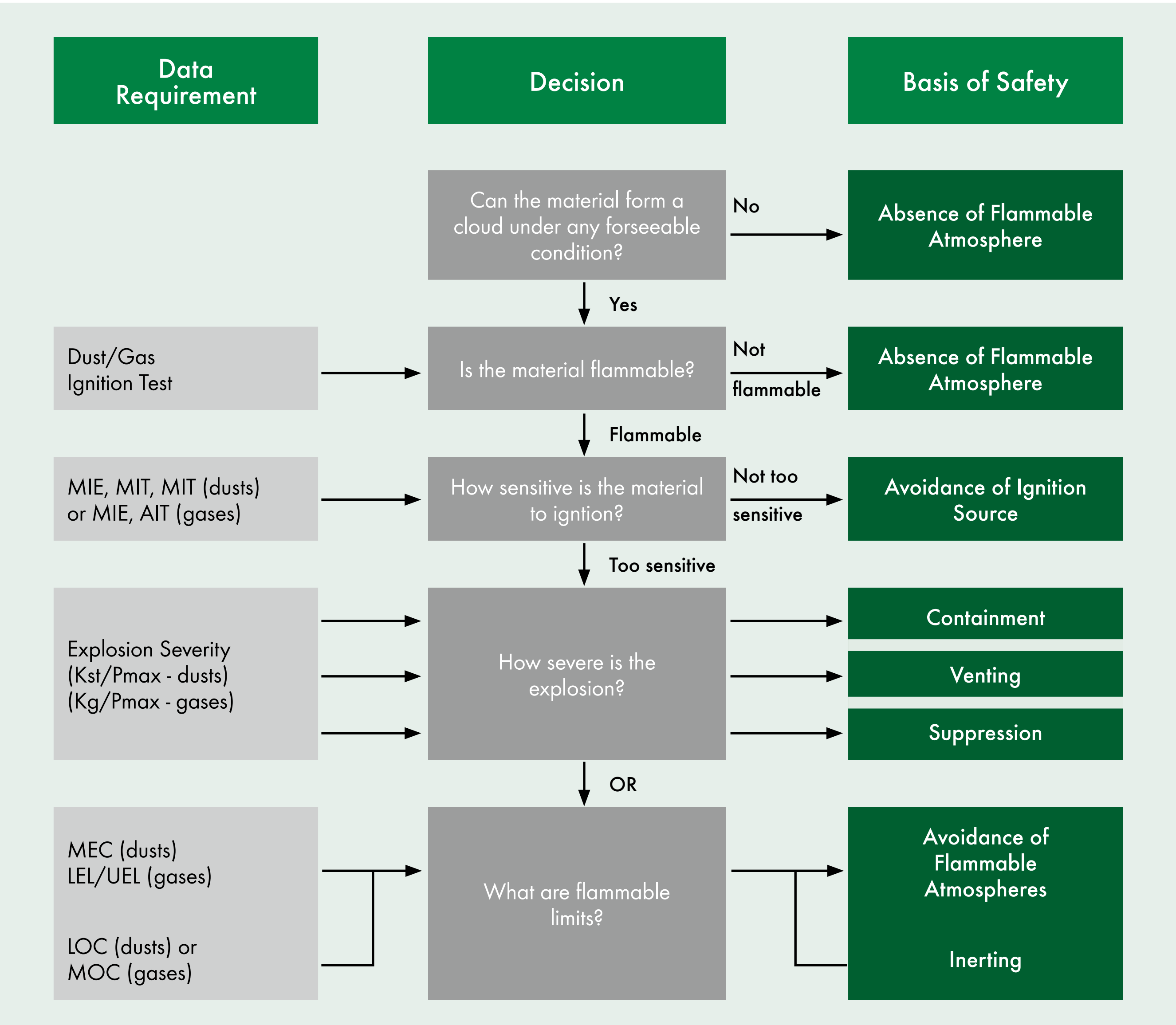
It is not uncommon to find organisations that have a prescribed "list" of data requirements for new or existing materials or processes. The list is often generated from knowledge of typical plant configurations where they are (assumed to be) consistent across a multinational organisation. The specific tests are dictated by the requirements of the Basis of Safety.

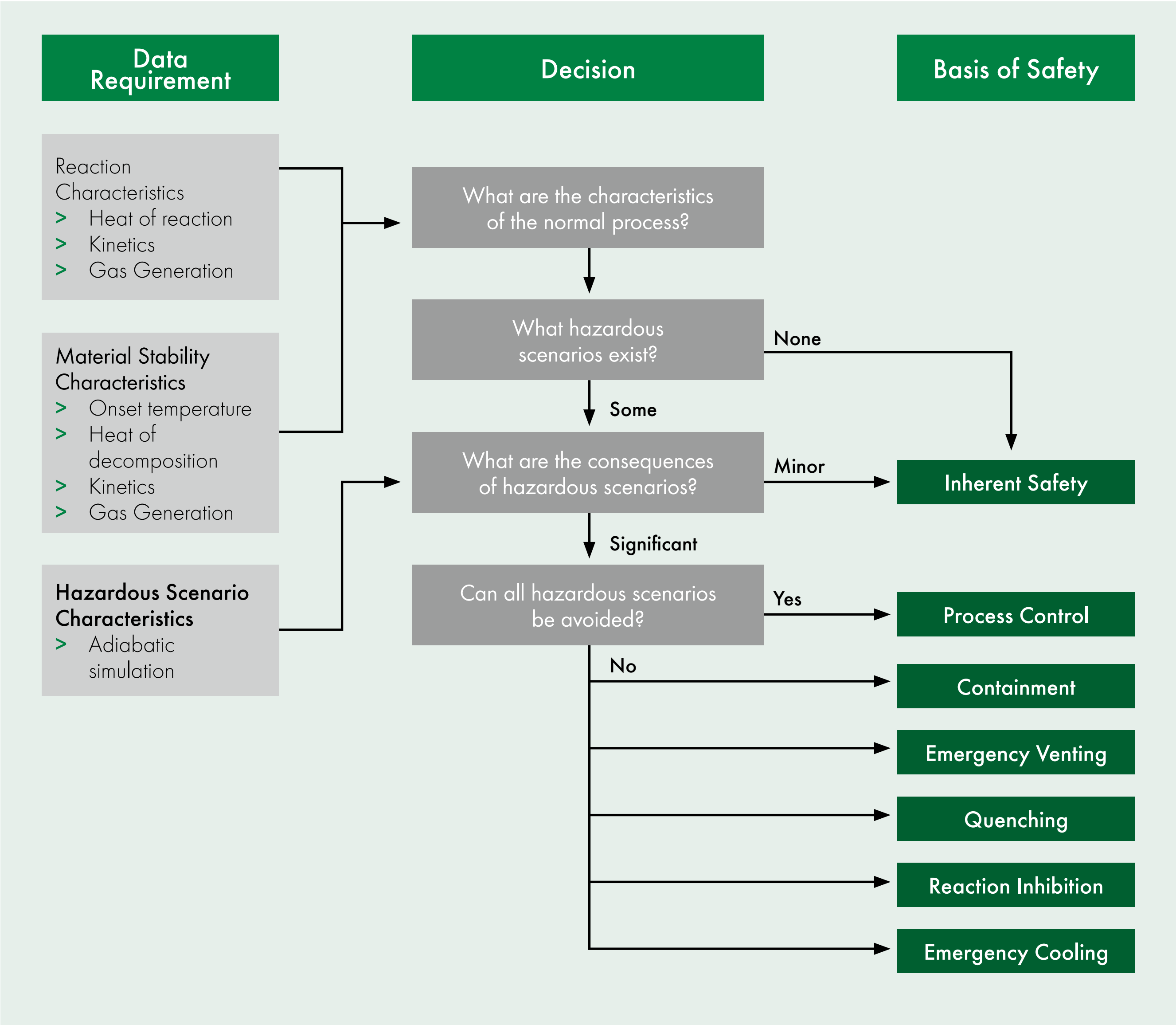
Approach 3: Flowchart Approach

In acknowledging that the Basis of Safety may vary between different handling or processing plants, some organisations use a flow chart to guide material testing towards an ultimate basis of safety. Examples of such flow charts can be found in Figures 1 (for dust/gas/vapour explosion risks) and 2 (for runaway reaction and thermal instability risks). Abbreviations are explained in the glossary at the rear of the paper.

Approach 4: Tailored (Case-specific) Approach

Having no prescribed dataset is not uncommon with data requirements for new materials / processes / plant equipment being identified on a case-by-case basis. Where appropriate procedures are followed by competent personnel (ie. those with relevant subject matter expertise), this can be highly effective and targeted. However, across an organisation its robustness becomes a function of local competency and hence it can be prone to inconsistency and resulting variable outcomes.





Approach 5: Prescribed Data + Situational Data Approach

Several key parameters plus selected additional parameters according to processing methods and risks are usually required to define a basis of safety. The key parameters provide initial characterisation of the hazards of the materials / processes involved. This data is utilised in a preliminary risk assessment – the outcome of which may be a requirement for further test data for specification of the basis of safety.

A 6th Approach

is to assume worst case material / process properties and design and implement safety measures accordingly. While simple, this leads to extreme inefficiencies.

Some assessment of the advantages and disadvantages of each approach to process safety data collection is provided in Table 1.

Of the approaches referenced, the tailored approach, where testing is based on the specific situation and what issues need to be addressed, provides the most relevant data in the most efficient test program. This approach requires design of the testing program by competent professionals who are able to assess the specific facility and equipment in advance of any testing or risk assessment, and

Approach	Advantages	Disadvantages
1. Complete Dataset	> All bases covered at Day 1 > No requirement for retesting for additional parameters (i.e. supports all bases of safety) > Transferable as a complete package to customers	> Inefficient and potentially expensive > "Data blindness" – too much data with important information not clear > Complacency that "having all the data makes you safe"
2. Prescribed Dataset	> Reduced, targeted testing package – can be more cost effective > Works well for consistent plant and process operations and basis of safety philosophy	> Stops the organisation thinking about data requirements. > Non-standard / changed operationsmay require different data > No "complete package" of hazards data for suppliers or customers
3. Flowchart Approach	> Reduced, targeted testing package – can be more cost effective > Encourages "thought" on the Basis of Safety – but encourages data consistency to underwrite it	> Non-standard / changed operations or equipment may require different data > No "complete package" of hazards data for suppliers or customers > Origin of the flow chart may be lost over time – people don't continually question its continued validity > Complacency > Requires re-evaluation for plantchanges
4. Tailored (Case-specific) Approach	> Reduced, targeted testing package – can be more cost effective > Demands rigorous, independent assessment on the basis of safety for all operations	> No "complete package" of hazards data for suppliers or customers > Requires re-evaluation for plant changes > Strongly dependent on availability of local competence and subject matter expertise > Potential for inconsistency in application
5. Prescribed Data + Situational Data	> Reduced, targeted testing package – can be more cost effective > Demands thought on the basis o safety for all operations > Two-step process consistent with the basis of safety development process (characterisation, risk assessment, basis of safety specification)	> Strongly dependent on availability of local competence and subjectmatter expertise for situational data specification > Requires re-evaluation of situational data for plant changes > Can be more time consuming due to two-step nature of the process > Can require testing that isn't necessary in the specific situation
6. Assume Worst Case Characteristics	> Robust and reliable, provided the worst case selection is correct	> Potentially extremely expensive > Requirement for stringent control systems and maintenance may adversely impact plant efficiency and effectiveness > Compromised if the assumed worst case is not the real worst case

then refine data needs based on initial data acquired. If data requirements are not specified by competent professionals, this approach can result in incomplete or inappropriate data.

The prescribed plus situational approach is the next best choice for striking the balance between robustness, effectiveness and efficiency. The initial prescribed data meets the needs of highlighting the process safety characteristics of the material / process and feeds and informs the risk assessment phase of scale-up. This data must be collected in ALL cases. The subsequent situational data requirements derive from the outcome of the risk assessment which focuses on the additional data requirements necessary to specify the basis of safety. The approach is best described schematically in Figure 3.

In Conclusion

There are a variety of strategies that may be used for the collation of process safety data, but getting the right data in the most efficient way requires knowledgeable professionals who understand what data is needed to assess risks and design appropriate mitigation measures.

DR. STEPHEN ROWE

Stephen Rowe manages the activities of the UK headquarters of DEKRA Process Safety (Chilworth Technology Ltd). He has a career background in the assessment of chemical reaction hazards and the laboratory assessment of a full range of process safety hazards including dust, gas and vapour flammability and explosives characterization. He is an experienced trainer and regular contributor to national and international process safety conferences and symposia. As a manager, Stephen Rowe focuses on building successful teams and growing the organization in a customer-centric manner. He oversees and is actively engaged in the company's quality and safety management systems (ISO9001 and OHSAS18001).

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Process Safety Management (PSM) Programmes

> Design and creation of relevant PSM Programmes
> Support the implementation, monitoring, and sustainability of PSM Programmes
> Audit existing PSM Programmes, comparing with best practices around the world
> Correct and improve deficient Programmes

Process Safety Information/Data (Laboratory Testing)

> Flammability/combustibility properties of dusts, gases, vapours, mists, and hybrid atmospheres
> Chemical reaction hazards and chemical process optimization (reaction and adiabatic calorimetry RC1, ARC, VSP, Dewar)
> Thermal instability (DSC, DTA, and powder specific tests)
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> Regulatory testing: REACH, UN, CLP, ADR, OSHA, DOT
> Electrostatic testing for powders, liquids, process equipment, liners, shoes, FIBCs

Specialist Consulting (Technical/Engineering)

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> Reactive chemical, self-heating, and thermal instability hazards
> Hazardous area classification
> Mechanical equipment ignition risk assessment
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