Application to PVC powder of European Directive 1999/92/EC "on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres" ("ATEX Directive")

The risk of PVC dust explosion is extremely low. This is demonstrated by the absence of any explosion reported in the relevant sections of the PVC production plants of ECVM member companies: drying, storage, packaging, loading, transport and by the fact that no PVC dust explosion has been reported by current insurers and insurance brokers of ECVM member companies

However, like all organic materials, PVC is flammable and hence an explosion risk assessment should be carried out in all cases when handling PVC powder may cause the formation of a cloud of dispersed PVC, be it inside or outside equipment items.

In all cases where it is impossible to be certain that application of the appropriate design rules will prevent formation of such a cloud of dispersed PVC, it is necessary to apply the measures imposed by Directive 1999/92/EC [1, 2]. PVC properties, equipment characteristics and type of on-going operation have to be taken into account. Examples of equipment and operations to be considered in a risk assessment include silos, pneumatic transport, mixers, milling and grinding equipment, air filters, buildings in which the equipment is present, filling operations, start up or shut down, cleaning and maintenance.

In view of the large amount of energy required to cause the explosion of PVC dust dispersion in air, simple prevention measures are sufficient to effectively avoid any risk of explosion. This includes but is not limited to:

- ✓ Design of the installation:
  - ➢ Absence of non conducting equipment (consult good practice guidelines for ensuring conduction continuity and grounding when using flexible fitting made out of insulating material)
  - ➢ Correct grounding of all equipment. Prevention of electrostatic charges
  - ➢ Absence of exposed ignition points in the neighbourhood of PVC resin/dust, such as e.g. hot surfaces and open flames
  - ➢ Protection against lightning
- ✓ Procedures:
  - ➢ Handling and mixing procedures should be such as to minimise dust cloud formation.
  - ➢ Good housekeeping to avoid dust accumulation. In particular, dust should not be allowed to accumulate inside or on top of electrical switchgear.
  - ➢ Moving parts should be inspected regularly to ensure free operation without overheating
  - ➢ Work permits (ensure the working area is free from PVC dust, avoid formation of dust clouds, prevent the use of tools or methods that could be an ignition source)..

When these prevention measures are implemented, it is possible to justify the use of non ATEX compliant equipment and the absence of protective systems in classified zones. According to Directive 1999/92, Annex II, this decision has to be documented

by a risk analysis and included in the explosion protection document. This decision has been implemented by some ECVM member companies. It remains however under the responsibility of the company operating the equipment.

These considerations are also underpinned by the publication referred [3], classifying powdered solids into 5 categories, depending on the minimum energy required to cause an explosion. PVC is below the lowest risk category, which is defined by a minimum ignition energy between 100 and 1000 mJ and by a minimum ignition temperature above 500 °C. Applying the prevention measures recommended for this lowest risk category therefore provides an additional safety margin.

The above mentioned recommendations only apply to dispersions of pure PVC in air. The mixing of PVC powder with additives could create a powder blend with explosion properties different from those described above. In particular polymeric powder additives have their own propensity to dust explosion while other volatile additives will modify the ignitability of the gas phase. The safety of such operations is under the sole responsibility of the compounder or converter carrying out the operations. If other flammable materials (e.g. additives or gases other than air) are involved in the handling process, the person responsible for the activity must seek advice from the manufacturers and must carry out an additional risk analysis in order to determine which other substances may contribute to the explosive atmosphere, to assess the explosion characteristics of this mixture and to take the appropriate measures imposed by Directive 1999/92/EC.

References

1. Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).
2. Non-binding Guide of Good Practice for implementing of the European Parliament and Council Directive 1999/92/EC on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
3. "*Is your dust collection system an explosion hazard*", by Vahid Ebadat. Chemical Engineering Progress CEP, October 2003.

APPENDIX

SOME VALUES MEASURED FOR THE MAIN RELEVANT CHARACTERISTICS OF PVC DUST

The results listed below were obtained during laboratory tests. They give an indication of values that may be expected, but do not purport to cover all possible cases

Explosion characteristics according to VDI 2263	**E-PVC**	**E-PVC**	**S-PVC**
Average particle size	50 µm	15 µm	120 µm
Max. rate of pressure rise (dP/dt)	93 bar/s	44 bar/s	80 – 100 bar/s
Auto-ignition temperature	> 220°C	> 220°C	> 220°C
Maximum explosion pressure – P max.	6,9 bar	8,4 bar	6 – 7 bar
Minimum ignition energy – E min.	> 1000 mJ	> 1000 mJ	> 1000 mJ
Volume dependency of max. rate of pressure rise –Kst (bar.m/s)	72	168	13 - 30
Dust explosion class – St	1	1	(*)
Ignition temperature	> 500°C	> 500°C	> 500°C
Lowest explosion limit	125 g/m³	45 g/m³	125 g/m³

(*) The result (0 or 1) depends on the particle size and testing method. For example, US results show that test results fell into Class St 1 when evaluated in a 20 litre test chamber, whereas suspension resin samples retested in a 1 cubic meter test chamber led to results indicating no explosion risk, falling into Class St. 0

In view of this uncertainty, each company is reminded it is responsible for the information it includes in its safety data sheets