Safe Handling of PARALOID™ Impact Modifier and Processing Aid Powders
This brochure is a general guide to assist Dow’s customers in safely using, handling, storing and disposing of PARALOID™ Impact Modifiers (IM) and Processing Aids (PA) in powder form. This brochure provides a general overview of these products, including their possible health and physical hazards, and provides information on hazard assessment and prevention, dust explosivity hazards, and proper storage and handling procedures. This brochure is intended to give general guidance only, and outlines the general precautions that should be observed in safely using and handling PARALOID™ impact modifiers and processing aid powders under typical use.

For information on a specific product, and prior to using or handling PARALOID™ Impact Modifiers (IM) and Processing Aids (PA) in powder form, consult the latest version of the Safety Data Sheet (SDS) for that product. For an SDS, contact the Dow Customer Information Group (www.dow.com).

PARALOID™ Impact Modifiers (IM) and Processing Aids (PA)

Hazards Summary

1) PARALOID™ powders are combustible solids; they will burn if ignited.
2) PARALOID™ powders may form an explosive mixture if dispersed into air. The information below on dust explosion hazards discusses these issues in depth.
3) Repeated or prolonged contact with the skin can cause slight irritation.
4) PARALOID™ powders can cause irritation to the eyes.
5) PARALOID™ products are capable of producing airborne dust during normal handling and processing. Respirable particles can irritate the respiratory tract if exposure is repeated or prolonged.
**General Information**

PARALOID™ IM and PA are high molecular weight organic polymers that are provided in free-flowing powder form. They are stable materials, but will undergo decomposition with release of monomers at temperatures above 230°C. They are white in color, may have a slightly sweet odor, and are not soluble in water.

**Packaging**
PARALOID™ IM and PA are sold in small, 20 Kg bags, and in bulk bags, termed Flexible Intermediate Bulk Containers (FIBCs) approximately 480 to 817 Kg. Both bags and FIBCs are shipped on pallets for easy movement by forklift, and may be enclosed by a stretch wrap for stability on the pallet. The pallets are suitable for use in racking systems. In all cases care should be taken to avoid puncturing the bags or FIBCs during transport.

**Storage**
Pallets of the small 20 Kg bags can be stacked two pallets high. Pallets having a single 450 to 500 Kg FIBC should NOT be stacked two pallets high, but can be stacked one pallet stacked over a base of two pallets. Pallets loaded with a 771 to 817 Kg FIBC, and pallets loaded with 2 x 450 Kg FIBCs should NEVER be stacked.

PARALOID™ IMs and PAs are stable materials, and should be stored at or near room temperature in their original container. They should be kept dry and away from heat, light and any ignition sources. PARALOID™ powders should be stored unopened, with stretch wrap in place if present. They should be used as quickly as possible after opening.

Since PARALOID™ powders are combustible, it is important to check local requirements, fire codes and National Fire Protection Association (NFPA) standards regarding the design and construction of the storage facility, including requirements for adequate fire protection equipment such as sprinklers, and allowed storage amounts. Indoor storage facilities should have adequate fire protection equipment, such as sprinklers. [Note: This document references U.S. Standards - NFPA- to reflect government standards over and above local requirements. As PARALOID™ powders are handled globally, other, equal standards issued by the appropriate regulatory body should be consulted.]

**Handling**
Since PARALOID™ IMs and PAs can form explosive mixtures in air, precautions must be taken to avoid the formation of dust clouds and to control the potential for static charges. Use in the presence of flammable vapors requires extra care, and PARALOID™ products should not be dispensed directly into flammable atmospheres. (See NFPA 77 and 654 for specific information). More details on these key aspects are given below and are listed on the SDS for the individual product. Standard procedures can be used for handling and emptying these bags. When handling these materials proper protective equipment should be worn, as specified on the SDS for the individual material. In each case, care should be taken to use procedures that avoid the generation of dust clouds.

If airborne material is expected to be present during handling operations, several precautions should be implemented. First, the operator should wear respiratory protection. Second, because of the potential for dust explosions, careful consideration must be given to equipment grounding and electrical classification. Furthermore, in areas where airborne material is expected on a regular basis, for example around a charging chute, local exhaust ventilation connected to a nuisance dust collector is recommended to control dust clouds. Such a collector should be reviewed for any appropriate fire and explosion protection per NFPA 654.

Some considerations for avoiding dust clouds include maintaining the shortest possible distance between bag unloading and hopper, smooth flow paths for the powder, design of systems for displaced air to direct air flow away from the powder flow path, active dust collection at powder dumping stations, and closed floor grating where powder may fall to ground. All equipment that is used to handle and transfer these powders must be properly grounded. This includes hoppers, transfer lines, vacuum lines, cleaning systems, and other ventilation equipment, etc. For more information on bonding and grounding of equipment please see NFPA 70 and 77.

**Bags.** These can be handled using standard procedures, manual or mechanical. Care should be taken if there is powder on the outside of a bag, as this can make the bag slippery and hard to hold. Gloves should be worn to protect operator from dermal exposure to these powders.

**FIBCs.** These must be handled with equipment designed to lift and move the FIBC from the pallet to the discharge station. The bags should only be lifted by using all four straps. Care should be taken during discharge of the product from these FIBCs to avoid the generation of dust clouds.
**Punctured or Leaking FIBCs.** Loss of material from a punctured or leaking FIBC can give rise to a potentially hazardous situation. As powder flows from the FIBC the bag may become unstable and could collapse or tip over. If an FIBC is punctured, the first action should be to stabilize the bag against collapse by supporting it USING THE STRAPS. Once the FIBC is stabilized, the spill can be addressed following the information on the SDS for that product.

**Housekeeping**
Due to the powdery nature of PARALOID™ products, good housekeeping is important. Care should be taken to avoid the accumulation of dust on any surfaces and in any confined spaces, including areas that are not normally visible or accessible, for example behind equipment, on top of pipes or ducts, or above false ceilings. The presence of powder on the floor can cause slippery conditions, and could create an explosible dust cloud if dispersed. Care should also be taken to prevent the buildup of dust on equipment where it might get warm and start to burn.

Use of a permanent vacuum system is preferred for cleaning as opposed to a broom and dust pan, and the system must be properly bonded and grounded. Portable vacuums also can be used, however, when using portable vacuums, make sure that the vacuum filtrations system have the capacity to remove particles of the required size and check to make sure that the unit is explosion proof. The use of compressed air for cleaning should be avoided as it can easily create a hazardous dust cloud. Air handling and dust conveying systems need to be properly maintained to avoid any dust buildup.

**Disposal**
PARALOID™ IMs and PAs are not listed as hazardous under the Resource Conservation and Recovery Act (RCRA), and do not meet RCRA’s characteristic definition of ignitability, corrosivity or reactivity. However, they have not been tested under the Toxicity Characteristic Leaching Procedure (TCLP). Dispose in accordance with all local, state (provincial) and federal regulations. This material and its container must be disposed in a safe and legal manner. Do not re-use the empty container. Empty containers may contain hazardous residues. [Note: Check with Product Steward if okay to add. This statement is part of our standard Disposal disclaimer, but may not be relevant here.] It is the user’s responsibility to verify that treatment and disposal procedures comply with local, state (provincial) and federal regulations.

**Fire**
As combustible materials, these organic powders will burn, giving off heat and toxic fumes; for this reason we strongly recommend storage facilities to have sprinklers. If necessary, type Class A fire extinguishers should be used for putting out these fires. Furthermore, avoid using a stream water nozzle as it could hit the product and create a dust cloud. Instead use a wide spray of water, again taking care not to create a dust cloud. Since these products will release toxic fumes when burned, fire fighters should wear self-contained breathing apparatus and protective suits.

**Special Hazard for MBS Polymers.** MBS Polymers, which are made from a mixture of methacrylate, butadiene, and styrene monomers, should NOT be processed neat in an extruder. Under the heat and shear conditions involved in such an operation it is possible for the material to undergo decomposition and catch fire.
Dust Explosion Hazards

Combustible powders like PARALOID™ IMs and PAs have the potential to create explosive mixtures in air. This must be taken into consideration during engineering and design for all handling operations, including transfer, dispensing, conveying, storage, blending, and employees must also be trained to identify and prevent this possibility. Important elements to consider in assessing this hazard are those associated with the fire hazard triangle. Particle size and other physical properties of PARALOID™ powders and the presence of flammable vapors are also critical factors in assessing explosion risk. For more information about dust explosions see the OSHA safety and health bulletin on Combustible Dust in Industry, July 2005.

Fire Hazard Triangle

In order to have a fire or an explosion one must have three necessary ingredients: a fuel source, an oxidizer source, and an ignition source. Since they are combustible, PARALOID™ powders are fuel sources, and will burn in the presence of air when formed in a mound. For an explosion to occur, the powder must be dispersed into the air. The oxidizer source for the fire or explosion is the oxygen in the air. Oxygen will always be present, unless the powder handling system is specially designed to create an inert atmosphere using nitrogen gas.

Among the many potential ignition sources are hot surfaces (dryers, heaters, etc), open flames, smoldering materials from a pre-existing fire, welding equipment, matches, torches, a spark source such as electrical or frictional or a static discharge, cigarettes, pipes or cigars. All possible ignition sources in the plant environment need to be identified and controlled when working with PARALOID™ powders.

Explosion Hazard Identification and Prevention

Individuals and companies working with PARALOID™ powders should undertake a hazard assessment and make certain that workers can recognize and identify dust explosion hazards as a first step in preventing explosions. The importance of hazard assessment, communication and training cannot be overemphasized. The most current edition of NFPA 654, Prevention of Fire and Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate, sets forth engineering, construction, housekeeping and employee training standards which should be closely adhered to in preventing hazards. Additionally, OSHA’s Safety and Health Information Bulletin, Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions (July 2005) is designed specifically for employers.

Eliminating or minimizing the fuel source can prevent an explosion. The key control to have in place is to use equipment and procedures that prevent, minimize and remove dust.

As previously discussed, an important measure is good housekeeping to prevent and remove dust accumulation. Explosion-proof local exhaust ventilation should be carefully designed. Dust collectors, and other systems to remove dust can be used along with regular vacuuming. However, extra care must be taken to ensure that electrical equipment will not spark or otherwise create an explosion hazard. Additionally, the customer should minimize surfaces where dust can accumulate. Frequent cleaning is important to prevent dust buildup.

Eliminating possible ignition sources also is critical to preventing dust explosions.

There should be no open flames or hot surfaces in the areas where PARALOID™ powders are handled or stored. [Note” Check with Product Steward if this should be added.] In addition, electrical equipment that is designed for use in the presence of combustible powders should be used in any area that could contain organic dusts. (See NFPA 499).

It is especially important to control static discharges when handling and conveying PARALOID™ powders. Static charges will develop when the powders are emptied from a bag or transferred through conveying equipment. Non-conductive construction materials act as electrical insulators which provide a place for electrical charges to accumulate, and therefore should be avoided. All equipment must be grounded and bonded so that the resistance to ground is less than 100 megohm. In an all metal system, a resistance to ground of less than 10 ohms should be achieved. It is also important to check for electrical continuity in equipment, especially conveying lines, to insure that there are no isolated components. Although static charges can develop, transferring PARALOID™ powders from FIBCs to properly grounded equipment can be done safely using proper procedures and equipment. (See NFPA 77).
**Other Key Factors: Dust Explosivity.**

In addition to the above elements of the fire hazard triangle, particle size, explosion severity, and the Minimum Ignition Energy (MIE) of the dust clouds are important to assess in determining explosivity of PARALOID™ Powders. Some typical ranges for these properties are presented below, and Dow can be contacted for data on the specific powder you are using.

Particles less than 420 microns in diameter can form explosible dust clouds. All other things being equal, the smaller the particle size, the more severe the potential explosion will be. The severity of an explosion is usually described by the maximum pressure developed, called $P_{\text{max}}$, and a parameter called $K_{\text{sts}}$, which is a deflagration index for dusts, usually given in units of bar-m/sec. The higher the $K_{\text{sts}}$, the more severe the potential explosion will be. $K_{\text{sts}}$ for PARALOID™ powders range from about 150 – 300 bar-m/sec, depending on the material and its particle size.

$K_{\text{sts}}$ and $P_{\text{max}}$ should be used in the design of explosion protection equipment such as explosion vents and suppression systems. (See NFPA 68 and 69 for details).

The MIE measures the energy required to ignite a dust cloud of a powder material. The lower the MIE the easier the material is to ignite. Particle size and MIE are closely related, and small sized powders have lower MIEs. The MIEs for PARALOID™ powders typically fall in the range of about 5 to 500 mJ, which indicates they are suitable for packaging in a Type B FIBC (NFPA 654). For information on the explosivity properties of a specific product please contact your sales representative.

**Organic Vapors**

PARALOID™ products can release organic vapors during normal handling and processing. (See SDS). Local exhaust ventilation is the recommended practice for controlling organic vapor emissions as well as dust. In conventional equipment at normal operating temperatures used for plastics processing, any release of organic vapors from PARALOID™ products should not reach a hazardous level. Note, however, the special situation when the PARALOID™ products are compounded into plastic resins at high addition levels – 15% or more – in a pelletizing operation. In this case one can generate potentially hazardous levels of monomer vapors in areas which are in close proximity to the final product pellets, particularly around bags of pellets. In such situations appropriate ventilation is required to control the level of monomer vapors.

**Flammable Vapors Require Extreme Caution.**

The presence of flammable vapors significantly increases the potential for an explosion due to the ease of ignition and the potential for static discharges from powder flow. For these reasons, discharging PARALOID™ powders directly from the package into a vessel containing an atmosphere of flammable vapors is extremely hazardous. FIBCs should NEVER be discharged directly into an atmosphere of flammable vapors. Even for bags, special precautionary procedures and equipment are recommended, and both NFPA 77 and a safety professional with expertise in this area should be consulted.

**Powder Handling Equipment and Design.**

Due to the potential for dust explosion, equipment used to handle PARALOID™ powders must be properly designed. The design must account for the types of operations required, including unloading, transfer, storage, metering, along with the characteristics of the powder being used. Consult NFPA 654 for guidelines and information about equipment components and the design of powder handling systems. If needed, Dow can provide additional information about the powder properties of its PARALOID™ products.
Health Information

Read the Safety Data Sheet before using this material. Information on health effects, exposure guidelines, personal protective equipment, etc. is included in the SDS.

References

<table>
<thead>
<tr>
<th>No</th>
<th>Standards Number</th>
<th>Standard Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NFPA-68, BS 6713, ISO 5028, VDI3673</td>
<td>‘Guide for Venting of Deflagrations’</td>
</tr>
<tr>
<td>2</td>
<td>NFPA-69, BS 6713</td>
<td>‘Standard on Explosion Prevention Systems’</td>
</tr>
<tr>
<td>3</td>
<td>NFPA-70</td>
<td>‘National Electric Code ®’</td>
</tr>
<tr>
<td>4</td>
<td>NFPA-77, BS 5958</td>
<td>‘Static Electricity’</td>
</tr>
<tr>
<td>5</td>
<td>NFPA-499</td>
<td>Recommended Practice for the Classification of Combustible Dusts and of Hazardous(Classified) Locations for Electrical Installations in Chemical Process Areas</td>
</tr>
<tr>
<td>6</td>
<td>NFPA-650, BS 5667, ISO5028</td>
<td>‘Pneumatic Conveying Systems for Handling Combustible Materials’</td>
</tr>
<tr>
<td>7</td>
<td>NFPA-654</td>
<td>NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids</td>
</tr>
<tr>
<td>8</td>
<td>BS-EN345, BS-EN346</td>
<td>Antistatic Footwear</td>
</tr>
<tr>
<td>9</td>
<td>BS-EN60079-10</td>
<td>‘Electrical Apparatus for Explosive Atmospheres’</td>
</tr>
<tr>
<td>10</td>
<td>BS6467: Part 2 1988</td>
<td>‘Electrical Apparatus with Protection by Enclosure for Use in Presence of Combustible Dusts’</td>
</tr>
</tbody>
</table>

For further information see:
- National Fire Protection Association: www.nfpa.org
- American National Standards Institute: www.ansi.org
- Mine Safety and Health Administration: www.msha.gov
- Explosive Atmospheres: www.hse.gov.uk/fireandexplosion/atex.htm
  - ATEX 95 equipment directive 94/9/EC, Equipment and protective systems intended for use in potentially explosive atmospheres;
  - ATEX 137 workplace directive 99/92/EC, Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres
- National Institute for Occupational Safety and Health: www.cdc.gov/niosh
- Industrial Ventilation: A Manual of Recommended Practice, a publication of the American Conference of Governmental Industrial Hygienists (ACGIH)