

MALAYSIAN INTERNATIONAL TRADING CORPORATION

[CO NO : 80474-V]

INDUSTRIAL HEALTH AND SAFETY INFORMATION

The Handling in Industry of ECOPLUS Polyethylene

1. INTRODUCTION

This document outlines the precautions which should be taken in the handling and processing of ECOPLUS polyethylene pellets and powders. It is concerned with both ethylene homopolymers and copolymers of ethylene with other olefins. Commercial grades of polyethylene contain traces of process residues, and may contain minor amounts of materials such as antioxidants, lubricants, antistatic agents and UV stabilizers.

The potential hazards identified, together with the recommended precautions for storage, handling and use, give the basic information for conducting workplace assessments and providing adequate control measures as may be required by The Occupational Safety And Health Act (OSHA) 1994 or its equivalent in other countries.

This document does not include recommendations on the suitability of the material for applications.

2. POTENTIAL HAZARDS

2.1 Toxicity

Polyethylene is chemically un-reactive and is generally regarded as being biologically inert⁽¹⁾.

2.2 Inhalation

2.2.1 Fume Evolution

There is no release of any obnoxious fumes from polyethylene at ambient temperatures (See section 4.1 - Effect of heat).

2.2.2 Powders

See section 3.1.1.

2.3 Ingestion

Ingestion of polyethylene should be avoided although the material is inert and can be regarded as harmless. Some grades do, however, contain additives which could be harmful if swallowed.

2.4 Physical Contact

Polyethylene materials are not considered to be a skin irritant, but being irregular, fairly hard particles, they can have an abrasive effect on the skin; this is especially so in the case of powders (see Section 3.1 - Health and Hygiene). Powder particles may cause physical irritation if they get into the eyes.

2.5 Fire, Ignition And Burning Characteristics

When ECOPLUS polyethylene is heated in air, melting will occur at 115-135°C (depending on the density) and decomposition will commence at about 300°C. Above this temperature polyethylene will pyrolyse oxidatively to produce carbon monoxide and water plus small amounts of various hydrocarbons and aldehydes⁽⁷⁾.

The evolved gases may ignite and if they do, they will provide heat of combustion thus accelerating the pyrolysis of more polyethylene or any other combustible material in the vicinity. Carbonisation may also occur and some of the carbon is released as soot. In flaming conditions the main combustion product is carbon dioxide although if insufficient oxygen is present or when the flame is extinguished, the smoke will contain appreciable quantities of carbon monoxide, acrolein and other aldehydes⁽⁸⁾. This behaviour is in general similar to that of wood and other cellulosic products⁽⁹⁾. Burning can also be accompanied by the release of flaming, molten droplets of polymer which could ignite adjacent flammable materials (see section 3.2 entitled "Fire - Action in the event of a fire involving polyethylene").

These comments can only be of a general nature, since the conditions in a real fire can never be fully predicted. They will depend on many factors as the location, the oxygen availability and the presence of other flammable materials.

2.6 Dust

Adequate care must therefore be taken when handling polyethylene in both pellet and powder forms since a dust explosion risk may exist⁽¹²⁾. The degree of hazard is comparable with that presented by other flammable dusts and is highly dependent upon the particle size distribution, the hazard increasing as the particle size becomes less.

Special attention is required in the case of large scale operations and all operations in which the powder is mixed with air or in which a dust cloud may be formed. For example, in pneumatic conveying the material is mixed with air and in bulk containers and intermediate hoppers a dust cloud is likely to exit during the filling operation and a cloud of fines may be present for some time after. Solids - air separation operations in a bag filter can be particularly hazardous. Unearth metal sections and non-conducting parts which could lead to an electrostatic spark discharge should not be used. Equipment designed to established codes for handling flammable powders/dusts will normally be provided with adequate pressure relief venting or other suitable means where a dust explosion hazard exists. It should be noted that accumulations of split powder can cause a dust cloud and also can provide the fuel of a secondary dust explosion and so should be avoided. In small scale operations, such as loading extruders, moulding machine hoppers or rotational moulding machines, the major precaution is that no spilt powder should be allowed to accumulate.

Information on the assessment of the potential hazard and on the preventive and protective measures available is given in the literature^(1,10,11,12). Users are advised to seek expert guidance in the design and operation of powder handling equipment.

3. RECOMMENDED PRECAUTIONS FOR TRANSPORTATION, HANDLING AND STORAGE

3.1 Health And Hygiene Considerations

3.1.1 Pellets And Powders

ECOPLUS pellets do not present any unusual hazard in handling. (See section 3.1.2). If ECOPLUS Polyethylene is handled in powder form in bulk (e.g. for rotational moulding), it is recommended that the working areas should be well ventilated. An Occupational Exposure Standard (OES - 8 hours time - weighted average) of 10 mg/m³ (total dust) for nuisance dust should be observed.

Although inert, airborne particles of polyethylene may cause physical irritation of the lungs if concentrations approach the OES. Effective dust masks should be worn.

3.1.2 Working And Storage Areas

All working and storage areas should be kept clean and tidy. Any spillage of materials (especially pellets) on to the floor should be swept up immediately as walking on them presents a real hazard. Polyethylene pellets are small, of a cylindrical shape and slippery by nature and the risk of falls due to slipping can be minimised by good housekeeping.

3.1.3 Materials Handling

Materials handling systems should be set up so as to minimise dust. Protective dust masks and goggles are recommended where grinding, granulation or machining operations are carried out, or in other situations where concentrations of airborne particles approach the OES.

- 3.1.4 **Ventilation**
Adequate mechanical ventilation of workshops is essential in order to minimise the concentration of dust and fumes evolved. Local exhaust ventilation should be provided in the vicinity of processing machinery⁽³⁾.
- 3.1.5 **Skin Contact**
Direct contact with polyethylene materials does not normally lead to skin irritation. However, the usual precautionary measures must be taken and employees who have a history of skin disease or allergy should receive medical clearance prior to employment involving direct contact⁽⁴⁾. Adequate washing facilities with supplies of mild soap and hand cleansers should be available at all working locations. Solvent should never be used as skin cleansers.
- 3.1.6 **Smoking, Eating And Drinking**
Smoking, eating and drinking in working areas are not desirable practices and should be prohibited.
- 3.1.7 **Cautionary Notices And Safety Equipment**
Cautionary notices to advise operators of the precautions required should be prominently displayed in all workshops. Suitable items of personal protective equipment, such as goggles, gloves and dust masks should be available as required. Relevant staff should receive adequate training in the use of personal protective equipment.

3.2 **Fire - Action In The Event Of Fire Involving Polyethylene**

Should a fire involving polyethylene occur, any commonly available fire extinguishers may be used. Powder extinguishers are very effective in quenching flames although they do not have the cooling ability needed for a deep seated fire. Water sprays are especially effective in rapidly cooling and damping down a fire, but the use of jets of water, e.g. fire hoses, in the early stages of a fire is not recommended since they would help to spread the flames. It may, however, be inadvisable to use certain extinguishers in particular circumstances, e.g. water extinguishers in close proximity to live electrical installations. It is recommended that advice should be sought from the local fire Authority on fire fighting equipment and procedures⁽⁶⁾.

Polyethylene is unlikely to be the only factor in a total fire situation and other materials may have particular hazards. Care must be taken to avoid inhalation of combustion fumes and firefighters should wear self-contained breathing apparatus. Qualified medical aid should be sought in the event of injury to personnel.

3.3 **Explosion**

There is a risk of dust explosion when handling polyethylene, particularly in powder form, and adequate precautions should be taken (see section 2.6 - Dust).

3.4 **Storage**

Polyethylene is normally supplied in the form of powder or pellets in bags, bins or bulk tankers.

3.4.1 **25kg-bag Storage**

Indoor unheated storage areas with natural ventilation and flat floor surfaces are adequate for the storing of 25kg-bags on pallets. The main hazards are related to pallet stack slippage and forklift truck movements which can cause injuries to personnel. It is therefore recommended to establish and maintain adequate procedures covering storage and handling of pallets.

These procedures, which should be kept up to date and regularly audited should cover such aspect as:

- Quality checks upon receipt;
- Forklift operations, access to storage areas and operators qualification and training ;
- Stacking rules;
- Regular stack inspections, re-stacking rules and handling of damaged bags/pallets.

In establishing these procedures, the following may prove useful :

- Pallets loads should be checked for any transport damage and any damage found should be described on the proof of delivery document.
- Appropriate forklift trucks (min 2 tons, preferably 2.5 tones capacity) should be used to handle 50 bags pallets loads (1.25 tons). Forklift truck routes should be designed in order to minimize interference with pedestrians and/or other vehicles. Access to storage areas or ar-

areas where forklift trucks normally operate should be restricted. Driving speed limits (15km/hr maximum recommended) should be enforced. No driving should be allowed with the load in the upward position. Reverse driving to ensure sufficient visibility may be appropriate depending on forklift configuration relative to load height. Fork dimensions (thickness and length) should be appropriate to the pallet designs most commonly used in the polymer industry in order to avoid damage to pallets or bags. Forklift truck drivers should be fully qualified, knowledgeable and regularly trained to ensure adherence to safe driving and handling practices.

- Pallets in good condition can be stacked two high. There are several possible layouts for pallets storage. An effective arrangement consists of grouping stacks (2 high) in rows limited to 9 pallets on the floor (18 pallets total). Several rows can then be aligned adjacent to each other with the front end stacks facing the driving alley. It is advisable to mark the row layout and driving alleys on the floor to help forklift operations. Such a layout facilitates inspections.
- Storage areas should be regularly inspected in order to detect unstable stacks which could collapse. Stacks can become unstable because of a number of reasons including imperfect stacking in the first place, settling of pellets within the bags and/or bag material deformation with time and temperature causing bag slippage, or a punctured bag gradually losing its contents thus causing upper bag layers to sag. Pellets spillage are a serious slip hazard and should be swept up as soon as possible. Identified unstable stacks should immediately be re-stacked (switching the bottom and top pallets) and if still found unstable stacks should immediately be re-stacked. In the event of a bag within a pallet being punctured during forklift operations or otherwise, no attempt should be made at stacking the pallet on to or under another pallet. The punctured bag should be taped to prevent further damage and loss of product and the pallet should be used at the earliest opportunity. A similar procedure should apply to damaged pallets (exhibiting deformed or broken boards/corner blocks).

3.4.2 Jumbo Bag Storage

Stacking is **NOT** recommended for storing material packed in 650 kg - 1,200 kg Jumbo bags. All useful procedures in section 3.4.1 shall be observed.

3.4.3 Bulk Storage

The possibility of dust explosion should be considered when handling polyethylene, particularly in powder form (see section 2.6 - Dust).

4. RECOMMENDED ADDITIONAL PRECAUTIONS FOR COMPOUNDING, PROCESSING AND FABRICATION

4.1 Effect Of Heat

Polyethylene can be processed safely in moulding and extrusion equipment. Small quantities of fumes are evolved at about 225°C, these gradually increase until at above 300°C decomposition and oxidative pyrolysis takes place. Above 300°C, the heat of oxidation may produce a rapid rise in temperature which accelerates the pyrolysis. Under these circumstances hazardous substances such as carbon monoxide (OES 50 ppm), formaldehyde (Maximum exposure limit 2 ppm/TLV 1 ppm), and acrolein (OES 0.1 ppm), as mentioned in Section 2.5, can be evolved.

The self-ignition temperature for polyethylene is 350°C as measured by ASTM D 1929-77. This is a small scale test which is very much apparatus dependent. Its relevance to a real fire situation is uncertain. No problems should result from normal processing but machines containing polyethylene should not be allowed to stand idle at processing temperatures for more than a few minutes.

4.2 Ventilation

As mentioned in the section "Effect of Heat", small amounts of fumes containing carbon monoxide and certain aldehydes can be evolved when processing at high temperatures. With some grades, fumes from the decomposition of other additives, such as antioxidants and other stabilisers, may also be present.

A ventilation system adequate to provide safe working conditions should be installed in all areas where melt processing of polyethylene is carried out and where solid polymer is being ground, machines or being burnt off machinery parts such as extruder screws and dies^(3,5). In the case of heat sealing polyethylene film or other operations involving the use of heated wires or blades with surface temperatures in the range 400-600°C it is possible that small quantities of polyethylene may adhere to the hot surfaces giving rise to the decomposition products described in the section Effect of Heat. Atmospheric concentrations

should be within those recommended by the UK HSE⁽¹⁾, the ACGIH⁽¹⁾ or those currently recommended by other National Authorities.

4.3 **Protective Clothing**

Good industrial hygiene procedures should be observed when handling polyethylene. Protective clothing, including gloves, goggles and dust masks, should be available where necessary, particularly in powder handling areas.

4.4 **Fire**

The recommended precautions for compounding, processing and fabrication are the same as those made in section 3.2 - Fire - Action in the event of a fire involving polyethylene.

4.5 **Handling Of Molten Material**

Molten polyethylene in contact with the skin will cause severe burns and will adhere strongly to the skin. Burns are the most common injury met with in melt processing of thermoplastics materials and the utmost care must be taken. Gloves and face shields should be worn when handling hot material or when there is any risk of being splashed with molten materials, for example, when purging or starting up an extruder or injection moulding machine. It is advisable to handle with care any masses of material, e.g. purgings, which are cooling, because, due to low heat conductance of the polymer, the interior of the mass will remain hot for some time and could cause burns, or could decompose with the emission of flammable vapours if the initial melt temperatures were excessively high.

4.6 **Other Precautions**

4.6.1 Room Temperature Processing And Handling

The precautionary measures stated in section Health and Hygiene should be followed.

4.6.2 Cutting And Granulating

Gloves, goggles and dust masks should be worn when cutting or granulating operations are performed. Dust should not be allowed to accumulate and high standard of housekeeping should be maintained (see section 2.6 - Dust).

5. **RECOMMENDED FIRST AID TREATMENT**

5.1 **Eye Contact**

Immediately flood the eye with plenty of water for at least 10 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

5.2 **Skin Contact**

Powder / pellets - Wash with soap and water. Grossly contaminated clothing should be washed or dry-cleaned before re-use.

Molten material - Immediately flood affected areas and adhering molten polymer with plenty of cold water. **DO NOT** attempt to remove molten or solidified material from the skin. Obtain immediately medical attention.

5.3 **Product Ingested**

Wash out mouth with water. Obtain medical attention.

5.4 **Inhalation Of Fumes**

Remove from exposure into fresh air. Keep ward and at rest. If there is respiratory distress, give oxygen. If breathing stops, or shows signs of failing, apply artificial respiration. Obtain immediate medical attention.

NOTE

Medical staff involved should be fully advised of the nature of materials being handled, and their likely thermal decomposition products.

6. **ECOPLUS AND THE ENVIRONMENT**

ECOPLUS polyethylene, as supply, can be recycled, incinerated or disposed of in landfill without detriment to the environment.