This is *not* an all inclusive guide to polymer processing and equipment operation safety.

Please consult your polymer and equipment suppliers, as well as appropriate government and industry standards for specific recommendations and requirements.
Disclaimer

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Overview

- Safety philosophy
- Elements of safe operation
- Material Safety Data Sheets
- Fumes, processing temperatures and exhaust systems
- Burns and personal protective equipment
- Rupture discs
- Coextrusion piping and polymer packing
Safety Philosophy

- Injuries and occupational health illnesses are preventable
- The goal is zero injuries or high potential incidents.
- Individuals are responsible for their personal safety and for the safety of those who work around them.
**Hazardous Conditions**

- High Voltage
- Hot Surfaces
- Hot Polymers
- Nips
- Moving Webs
- Moving Carriage
- Overhead Lifts
- Poor Housekeeping

**Safe Actions**

- Good Communication
- Risk Assessment
- Emergency Plans
- Safe Operating Procedures
- Management of Change
- Personal Protective Equipment
Elements of Safe Operating Procedures

- Personal Protective Equipment
- Lock-out requirements
- Interlock and Safety Device usage and inspections
- Signatures of Management and ALL Operators (read and understood)

Communication

- Line of site and vocal response for nip closure and carriage movement
- Shift Change
- Changes to the Routine
- Reporting Problems
Management of Change

• Equipment changes or new equipment
• New materials
• Abnormal temperatures and pressures
• New procedures and procedure updates
• Risk Assessments and Hazard Reviews

Risk Assessments

• Equipment Design Limits
• Potential Hazards, New and Old
• Procedures in place and adequate?
• Process Understood?
• Proper Representation
  – Operator, Engineer, Safety, Management
Nip Hazards

- Never point or reach into a nip – use a tool
- String-up is high risk time!
- All rolls are a potential hazard
- Tight gaps are just as hazardous
- Nip guards
- Loose clothing
- Flag with a tool

Electrical Hazards

- High Voltage
  - Heaters – especially plate heaters
  - Corona Treaters and wiring
  - Motor Drives
  - Control Cabinets
- Multiple Power Sources
  - Lock, Tag, Clear, Try, Test
Higher Hazard Times

- Start-ups and String-ups
- Edge Trim Breaks
- Roll Wraps
- Roll Changes
- New Materials
- Maintenance
- End of Shift and Night Shift

Protection from polymer burns

- Synthetic clothing can melt at extrusion coating melt temperatures
- Leather gloves can shrink to hands holding in heat
- Do not try to wipe molten polymer off skin
- First aid: cold water, lots of it

? Do you have cold water near your extruder?
MSDS’s
How I read them

• Composition
  – monomers
  – additives
* seek information on chemicals you don’t know
• Hazards
  – read all
  – particular attention to inhalation and eye hazards

MSDS
(continued)

• First Aid Measures
  – deepens understanding of the hazards
• Flash Point
• Hazardous Combustion Products
  – indicates what could be given off as products of oxidation
• Exposure Controls / Personal Protection
  – Furthers understanding of the hazards
  – Respirable dust
  – Ventilation requirements
• Melting Point
  – Assess potential for freeze-off

• Stability and Reactivity
  – Conditions to avoid: temperatures above …
• Decomposition
  – HAZARDOUS DECOMPOSITION PRODUCTS
  – Find safety information on decomposition products or consult an occupational health chemist or specialist.
Other Supplier Information

- Product data sheets
  - maximum use temperature
  - melting / freezing temperatures
  - viscosity or melt index
    - pressure build-up
    - flow in rupture discs
- Product Safety Bulletins

Polyethylene Smoke

- Products of oxidation\(^1\)
  - Carboxylic Acids
  - Aldehydes
    - Formaldehyde
    - Acrolein - strong irritant
  - Ketones

Note: These products are present in virtually all hydrocarbon smoke including tobacco, wood etc.
Degradation of Polyethylene

- Rate of degradation increases with temperature and time
- Safe temperature limit is not obvious
- Keep temperatures as low as possible to minimize degradation and off gasses
Degradation of Polyester and EVOH

- Produces acetaldehyde
  - Acetaldehyde syndrome
  - Sweet smell
- Good Ventilation is essential
- Avoid large purge volumes - holds heat
- Avoid high rate purging
- Coextrusion with higher temperature resins can cause degradation in purge pans

Polymer Smoke Evacuation

- Slot hoods should not allow leakage between hood and die
- Hood needs to capture smoke in both running and purge positions
- Refer to Industrial Ventilation² book for design information
Evacuation of Fumes

- Effectiveness depends on Capture Velocity
- Capture Velocity decreases as inverse square of distance from hood opening
- At twice distance - velocity is 1/4

Source: Industrial Ventilation²

Flange Hoods to Increase Efficiency

- Flange increases capture velocity 42% with slot hood
- Flange decreases hood entry loss by 47%

Source: Industrial Ventilation²
Effective Purge Pan Ventilation

- Heat causes smoke to rise
- Turbulence expands the smoke as it rises
- Keep pan as high as possible and hoods far apart

Rupture Discs

Disc

Threaded tube body
Rupture Disc Installations

- Keep tubes short
  - freeze-off potential
  - increased flow capacity
  - lower cost
- Point away from operators
  - Decomposed polymers can spray
- Protect coextrusion piping
- Verify flow capacity

Polymer Packing

- Polymers are less dense when molten
- Form voids on cooling when contained
- Pipe cools more quickly - draws polymer from larger cavities - packing
- Can generate great pressure when heated - heats more quickly
- Heat and soak die and extruders before heating pipe
# References


