FACT SHEET: PVC AND FIRE

PREFACE

PVC produces smoke and toxic gases when burning, like all other materials. In contrast to other commodity plastics (PE, PP, PVC, PS) within the construction industry, rigid PVC increase fire protection in comparison to wood materials. The reason is the high content of chlorine that makes PVC the most fire resistant of all commodity plastics.

In an evaluation of a material's fire properties it is necessary to take into account a number of different factors such as: flammability, combustibility, emitted heat output, flame spread, smoke generation, toxic gases and corrosion.

IGNITABILITY

PVC is difficult to ignite. The flashpoint for rigid PVC is 150 degrees above the flashpoint for wood. The resistance to ignition for ordinary flexible PVC is lower, but with customized blends the resistance is substantially increased.

COMBUSTABILITY

When a material is ignited, the dangers that arise are linked to the material's flammability. One of the most used quantitative tests are "Limiting Oxygen Index Test ”(LOI), which measures the concentration of oxygen in an oxygen / nitrogen mixture that is necessary to maintain combustion.

A material that has a LOI value above 21 (air containing 21 percent oxygen) does not normally burn at room temperature.

Rigid PVC has a LOI value of 45-50 to compare with 21-22 for wood and 17-18 for most commodity plastics. Oxygen index values above 27 can easily be achieved for flexible PVC. That means most rigid and flexible PVC materials do not burn without adding heat from other sources.

HEAT RELEASE

Heat is released when a material is burning. How fast this heat is released is crucial for how serious a fire becomes and how fast it spreads. Rigid PVC, wood and paper produce a comparable amount of heat during combustion, however the heat generation rate is lower for PVC than for most organic materials. Rigid PVC cannot sustain a fire by itself without heat being added from other burning objects. This means that PVC limits the risk of a fire spreading to a great extent.

FLAME SPREAD

Laboratory tests show that many PVC materials have a limited flame spread. In contrast to most other commodity plastics PVC does not produce flaming particles capable of igniting a combustible product when the material is burning. Instead it produces a charred material that prevents flame spread.

SMOKE OBSCURATION

Smoke obscuration is a serious concern with fires, because when visibility decreases it hinders escape from the fire. Smoke develops due to incomplete combustion of a burning material. It is mostly the combustion intensity and oxygen supply that determines which kind of smoke that develops and how it spreads.

Provided no flames are formed, PVC products emit the same concentration of smoke as burning wood. However, PVC emits a larger amount of smoke if flames occur .

The fact that it takes a relatively long time to release heat during combustion of PVC means that the speed of the smoke evolution per unit of time is lower than for most organic materials. That means that you have a better chance to escape unharmed from fires with PVC.

TOXIC GASES

All organic materials, whether they are natural or synthetic, produces toxic gases during combustion. The most important gases from PVC when burning is carbon monoxide, carbon dioxide, hydrogen chloride and water. Chlorine gas never develops from PVC fires.

The content of hydrogen chloride in fire gases is clearly noted by people close to the fire, because the gas gives rise to irritation in the mucous membranes, even at concentrations much lower than those expected to constitute a health hazard. The gas is therefore a clear sign that PVC is burning, which is not the case when the main fire gas is carbon monoxide. However, high concentrations of hydrogen chloride can cause lung damage. But hydrogen chloride is far from as toxic as acrolein or hydrogen cyanide that can develop when burning other materials such as wood and wool.

When scientists have reviewed combustion gases from PVC, they have concluded that the gases are not substantially more toxic than combustion gases from other building materials.

Dioxin is sometimes mentioned in connection to fires with PVC materials. In case of fire in products containing chlorine, including wood, dioxins may be formed.

The amount of chlorinated material in the waste is of minor importance compared to the combustion conditions, such as combustion temperature, oxygen supply and presence of catalysts (for further information we refer to our fact sheet about PVC and dioxins).

RISK OF CORROSION

When PVC burns, a gas mixture is produced containing hydrogen chloride. Hydrogen chloride forms hydrochloric acid when in contact with water, which is corrosive. However, fire gases from other materials in combination with high temperature and humidity may also lead to corrosion.

It is therefore necessary to clean up after all fires, no matter which materials are burned. A quick clean-up is the key to limiting damage after fires, not the choice of material. That is why it is important to start decontamination and treatment of metal surfaces as quickly as possible after all fires in order to prevent corrosion.

MATERIAL	COMBUSTABILITY ISO 4589 [LOI, %]	FLASHPOINT ASTM D1929 [°C]	HEAT RELEASE [MJ/kg]
Polyurethane (PU)	15	310	25
Polyethylene (PE)	17	340	47
Poly(methyl methacrylate) (PMMA)	17	300	26
Polypropylene (PP)	17	320	46
Polystyrene (PS)	17	350	42
Acrylonitrile butadiene styrene (ABS)	18	390	36
Wood	21-22	240	17
Soft PVC	21-36	330	20-30
Polyamide (PA)	22	420	32
Hard PVC	50	390	20
Teflon (PTFE)	95	560	4,5

Source: Norsk Hydro 1987