European Committee of Electrical
Installation Equipment Manufacturers

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Sustainability of PVC Cable Management Systems

1 Introduction

The following paper is CECAPI member consensus opinion on the sustainability of PVC (Poly Vinyl Chloride) used for the manufacture of Cable Management Systems (CMS), such as conduits, trunking systems, ducting systems, and associated accessories. (Note this does not include Electrical or Data Cabling)

The Ramboll & Logika report [1] was written to assess the characteristics of PVC and the implications of its applications. In addition, the report assesses the feasibility of alternatives to PVC, as well as a number of potential phase-out scenarios for PVC applications and their socio-economic implications within the context of various EU Green New Deal policies, most notably the Circular Economy Action Plan (CEAP), the Sustainable Chemicals Strategy and the Zero Pollution Action Plan [2].

The Ramboll & Logika report [1] is focused on non-electrical products. From an electrical perspective, only PVC cables are referred to. PVC Cable Management Systems are not mentioned but are in the scope of CECAPI, which is the reason for this position paper.

2 PVC a sustainable material

2.1 A brief insight into the history of PVC

The chemistry of PVC has been understood since the end of the 19th century. The plastic was first commercially produced in Europe in the 1930s and in the past 90 years it has undergone continuous development and improvement. PVC's adaptability comes from its molecular structure. This makes possible many different blends of ingredients providing a range of properties, enabling the PVC industry to respond to the commercial and technical needs of many market sectors. This adaptability also allows the industry to respond to environmental requirements, for example replacing lead by calcium zinc.

PVC is most frequently made from salt (57%) and oil (43%). PVC is therefore far less oil-dependent than other thermoplastics. In addition, in some regions of the world, PVC is starting to be made without using oil feedstock at all (substituting oil-derived hydrocarbon with bio-derived hydrocarbon feedstock - See 2.5).

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Like many other thermoplastic materials, the manufacture of PVC involves the use of potentially hazardous chemicals. Such manufacturing methods are very closely regulated. Extremely strict guidelines govern PVC manufacture and workers' exposure.

This substantial research can and does support the fact that PVC can be safely used even in the most sensitive applications (such as medical applications). Formulations are designed to meet all applicable regulations and standards, in critical health care and food contact applications.

It is also highly durable and energy efficient across a range of applications, which allows an extremely effective use of raw materials.

2.2 PVC for Cable Management Systems

Both Plasticised PVC (PVC-P) and Unplasticized PVC (PVC-U), but mainly Unplasticized PVC, are used for the manufacture of Low Voltage Directive products such as Cable Management Systems (CMS) for over 70 years.

The properties of PVC are the perfect combination for the manufacture of electrical products such as CMS as PVC

is a thermoplastic polymer (meaning it can be reformed when heated) it can be shaped into any desirable form;

- is inherently difficult to ignite, self-extinguishing, and non-flame propagating;
- has high impact resistance properties;
- is electrically insulating;
- has good chemical resistance;
- has good resistance to Ultra -Violet radiation (UV) and
- has good recyclability.

Due to these properties of PVC and the nature and designs of CMS, the service life of PVC CMS can be in excess of 20 years.

The low cost per tonne of PVC and its valuable material properties make the use of PVC very competitive compared to alternative engineering plastics. PVC consumes less primary energy during production than any of the other commodity plastics making the cost per meter very competitive.

PVC requires only about 80% of the energy required for the production of other major polymers. This has positive environmental effects, such as fewer CO2 emissions from production processes.

2.3 Additives in PVC for Cable Management Systems

During the manufacture of PVC CMS, the following types of functional additives can be used: plasticisers, heat stabilisers and lubricants. Other additives include, but are not limited to, impact modifiers, Ultra-Violet (UV) stabilisers, and colour pigments, which are used to improve the quality of a product from a functional and aesthetic perspectives.

Migration: There is much discussion about the migration of additives, specifically plasticisers, within the structure of plastics and in particular PVC. Additives, with low molecular weight, tend to migrate. This is a well-known phenomenon that has been thoroughly researched. Through the decades of research and analysis, the adoption of the REACH Regulation in 2006, specific harmful additives have been restricted across Europe. These include some phthalates (e.g. DOP) and substances containing cadmium and lead.

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Cadmium and lead, which can migrate from PVC, were used in PVC CMS in the past. Cadmium and lead are also regulated by the RoHS European Directive for electrical and electronic equipment. Most of CMS are out of the scope of the RoHS European Directive but the majority of CMS meet the restrictions of the RoHS Directive due to voluntary decision from the manufacturer.

Flexible PVC incorporates various types of plasticisers to make the material flexible. The most common group of materials are known as Phthalates. These plasticisers have been developed and improved over the years as our understanding of toxic materials has developed. REACH compliant plasticisers are readily available as are oil resistant plasticisers.

2.4 Recycling and regrinding of PVC for Cable Management Systems and other applications

Depending on the country and the application, PVC is recycled in open and closed loops showing its high recyclability.

For a long time, the PVC industry has worked to improve recycling of PVC as shown in Ramboll & Logika report [1] and VinylPlus Report 2022 [3].

Recycled PVC has been used in the manufacture of CMS for many years.

PVC-U CMS can be manufactured from post-consumer recyclate such as window profile (open loop recycling) [4] but with additional checks for compliance with REACH, especially for lead.

PVC-U CMS can also be manufactured using material diverted from the waste generated during a manufacturing process. This is known as pre-consumer material recycling when it excludes re-utilization of materials such as rework, regrind or scrap generated in a process and being reincorporated in the same process that generated it (EN 45557).

This avoids placing PVC into landfills and reduces the need to produce PVC from non-sustainable resources.

Various processes are already implemented or under development for manufacturing PVC CMS:

a) Assembling parts, some of them being partly of fully made in recycled PVC [4]

b) Co-extruding or co-injecting integral parts. Co-extrusion is used to add a very thin aesthetic layer of primary material to an extruded profile using minimum amounts of primary material.

c) Selective dissolving (Ramboll & Logika report [1]) allowing to remove contaminants and legacy additives without destroying the polymer structure. R&D under progress.

d) Chemical recycling (Ramboll & Logika report [1]). R&D under progress.

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2.5 Alternatives to oil-based PVC and alternatives to PVC

Alternatives to oil-based PVC are starting to be made by substituting oil-derived hydrocarbon with bio-derived hydrocarbon feedstock.

PVC alternatives are an option, but these are often engineering plastics or other materials such as steel, iron, concrete. Engineering plastics such as ABS and HDPE can be used for conduits but are significantly more expensive than PVC and require greater volumes of material to ensure the same mechanical properties.

These alternatives may well also contain additives that are of concern such as flame retardants. PVC is inherently flame retardant and non-flame propagating. PVC is appropriate for CMS intended for general applications. Alternatives may be more appropriate for specific reaction to fire demanding/critical applications such as smoke production.

The available information about the risks associated to these alternatives is limited due to their small and/or recent uses.

3 Conclusions on the sustainability of PVC Cable Management Systems

– Economic aspect

  The PVC industry has enduring pre-war origins and employs huge numbers of people worldwide across the supply chain, which is spread between large multinationals and Small and Medium size Enterprises making a significant contribution to the growth of the global economy.

– Social aspect

  Generally, PVC CMS are light-weight and easy to install with a potential for fewer accidents.

– Environmental aspect

  For CMS application, PVC proves to be the most energy efficient material (in particular compared to metal for example).

  For many years, the CMS industry has worked to reduce the environmental impact of PVC CMS.

  Some improvements are already widely implemented such as

  – voluntarily complying with restrictions of RoHS Directive, so as to reduce lead use, or
  – recycling, in PVC CMS, PVC profiles from windows, but with additional checks for compliance with REACH, especially for lead, avoiding placing PVC into landfills.

  Some other improvements are under progress

  – CMS recycling schemes,
  – Investigations on bio-sourced plastics from generation 3, meaning not in competition with human nor animal food.

  Through these various actions, the CMS industry continues being fully committed to improve the environmental footprint of PVC CMS.

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4 References

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