PVC 4 CABLES

PVC4CABLES STRATEGY, RESEARCH, INNOVATION: A NEW PERSPECTIVE FOR PVC CABLES

Future of PVC 2025 Conference

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an ecvm platform

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WHO WE ARE

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WHO WE ARE

PVC4Cables is the ECVM value chain platform dedicated to PVC cables. It brings together the producers of PVC resins, stabilisers and plasticisers, PVC compounders and cable producers. Participation is also open to PVC recyclers and value chain's associations.

PVC4Cables intends to act as a driver for environmentally responsible innovations in the PVC cables sector and as a focal point for dialogue and communications with all stakeholders: regulators, specifiers, installers, electricians, media and the general public.

www.pvc4cables.org

VinylPlus® is the Commitment to the sustainable development of the European PVC industry. The program was developed through an open dialogue with stakeholders, involving industry, NGOs, legislators, representatives of civil society, and end-users of PVC. VinylPlus® operates in the 27 European Union countries plus Norway, Switzerland, and the UK.

vinylplus.eu

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WHO WE ARE

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WHO WE ARE

PVC4CABLES PARTNERS

ecvm

Ercros

INEOS Inovyn

KEM ONE

Shin-Etsu CIRES

Westlake Vinnolit

vestolit An Orbia business.

VYNOVA

ALTAIR CHEMICAL

BASF We create chemistry

BENVIC

Euro Piren

ExxonMobil

POLYMER-CHEMIE

ReVi

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WHO WE ARE

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ESPA
European Stabiliser Producers Association

Akdeniz Chemson
Beyond Additives

asua PRODUCTS

BÆRLOCHER

Galata Chemicals®

IKA®

pmc

REAGENS®

VALTRIS
SPECIALTY CHEMICALS

PVC
PVC FORUM ITALIA
COMPOUNDS FOR CABLES GROUP

BENVIC

EUROCOMPOUND

finproject

I.C.P. SPA
industrie compound e plastificanti

Industrie Generali spa

INVERPLAST

STIR
COMPOUNDS

tpv compound

VIPA

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PVC4CABLES STRATEGY AND OBJECTIVES

OBJECTIVES & ACHIEVEMENTS

STRATEGIC APPROACH

- Promote research and innovation activities to demonstrate the real characteristics of PVC cables and, if necessary, improve them also with regard to safety in the event of fire
- Promote new and fairer standards for the classification of PVC cables under the CPR (The Construction Products Regulation (CPR) sets the harmonised technical conditions for free circulation of products within the European Union, including the reaction-to-fire performance of products in the event of an outbreak of fire).
- Stimulate additives producers and cables manufacturers to continue to develop new formulations without hazardous additives
- Address the legacy additives issue that hinders the PVC cables (as well as other applications) recycling

OBJECTIVES & ACHIEVEMENTS

GENERAL OBJECTIVES

The PVC4Cables platform was set up in 2017 with the objectives of:

- Proactively engaging in the **promotion of PVC cables**, highlighting their contribution to sustainable development and to the circular economy, as well as their numerous technical and functional benefits for final users and consumers
  - Acting as a **focal point** for dialogue and communications with **all stakeholders**: compounds and cable producers, regulators, specifiers, installers, media and the general public
  - Being **the voice of the PVC cables value chain** in the relationship with authorities and standardisation bodies
  - Promoting and facilitating **cooperation** along the PVC cables value chain and with interested stakeholders

OBJECTIVES & ACHIEVEMENTS

OBJECTIVES 1

Subsequently the PVC4Cables platform defined more "scientific" objectives to:

- promote studies having the following aims:
  - Demonstrate that PVC cables can meet many of the criteria set out in existing (CPR) standards
  - Improve, where necessary, performance so that all the standards criteria can be met
  - Develop products with improved performance
  - Evaluate substances currently used in cable formulations and, for those that are or could be classified as SVHC, verify the availability of non-hazardous alternatives
  - Evaluate the performance of PVC cables in relation to new application sectors and, where necessary, define the necessary formulation improvements
  - Compare the performance of PVC cables with competing materials

OBJECTIVES & ACHIEVEMENTS

OBJECTIVES 2

Other objectives are:

- Improving the circularity of post-consumer PVC
  - Develop manual tools to detect the presence of Legacy Additives
  - Design an industrial technology using XRF and NIR to continuously separate ground PVC cables containing restricted substances from those that do not contain them
  - Develop new formulation without Legacy Additives

OBJECTIVES & ACHIEVEMENTS

OBJECTIVES 3

Other objectives are:

- Focusing on burning behaviour of cables, monitoring standardisation in IEC and CLC committees to detect any potential issue regarding PVC cables and fire safety, particularly in relation to the acidity and smoke issue
  - IEC = International Electrotechnical Committee,
    - IEC TC 20 WG18 - Electric cables / Burning characteristics of cables
  - CLC = Comité Européen de Normalisation Electrotechnique
    - CLC TC 20 WG10 - Electric cables / Fire performance tests for cables
- Be member of the Comité Electrotechnique Belge, CLC TC 20 and IEC TC 20 mirror committees
- Monitor standardisation by other committees in liaison with them
- Be in place to comment and possibly introduce ideas in the context of the revision of standards, in particular IEC 60754-1 -2 (and -3) *("acidity test")*

OBJECTIVE 1
PVC4CABLES ACHIEVEMENTS

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OBJECTIVES 1
ACHIEVEMENTS

INFORMED, SCIENCE-BASED CHOICES IN CABLE SAFETY

Recent advancements across the European PVC cable value chain demonstrate that PVC remains a responsible and balanced choice, offering superior fire performance alongside significant environmental benefits. Misconceptions regarding PVC, particularly in relation to smoke production, smoke toxicity, acidity, and corrosivity, fail to consider key data on real-world fire behaviour and material performance

We encourage stakeholders to consider the advanced capabilities of modern PVC cables, which now provide industry-leading fire safety, durability, and environmental sustainability.

Cutting-edge PVC technology ensures that these cables not only comply with but often exceed stringent fire safety regulations, reaffirming PVC as a trusted material for cable applications.

PVC4Cables remains committed to supporting the European PVC cable industry in delivering high-performance, sustainable innovations, and ensuring that both the industry and the public have access to the most effective safety and environmental solutions available.

OBJECTIVES 1 ACHIEVEMENTS

PVC SMOKE, ACIDITY, CORROSIVITY AND TOXICITY

Well-formulated PVC cable compounds incorporating flame retardants and smoke suppressants achieve the best classifications for smoke production, with modern PVC cables easily reaching the Class s2 under EN 13501-6 standards. It is important to recognize that acidity is a poor indicator of smoke corrosivity and an inadequate measure of smoke toxicity.

As noted by leading fire-safety experts, in real-world fire scenarios, hydrogen chloride (HCl) emitted during combustion rapidly breaks down and remains localised near the fire's origin. In contrast, carbon monoxide (CO) poses the primary toxic threat, reaching lethal concentrations well before any other combustion by-products.

Fire safety studies consistently show that the leading cause of fatalities in fires is the inability to control, confine, and extinguish the fire before it escalates. The heat release rate (HRR) is the "single most important variable in fire hazard" and, in this regard, PVC cables excel in performance.

Delchiaro et al., “Toxicity of PVC Cable Compounds During Combustion Compared to Halogen-Free Alternatives”, PVC4Cables Conference 2024, Prague

Cardelli, C. “PVC cables standard in Europe and beyond”, PVC4Cables Conference 2024, Prague

Hirschler, M. (2006). "Acidity is a poor representation of smoke corrosivity and is totally inadequate as a representation of smoke toxicity." Citation available at CiteSeerX.

Hirschler, M. (2006). "Fire Safety, Smoke Toxicity and Acidity." CiteSeerX.

Babrauskas, V. (1992). "Heat Release Rate as a Key Fire Hazard Indicator." ScienceDirect.

OBJECTIVES 1 ACHIEVEMENTS

FLAME RETARDANT LOW SMOKE (FRLS) AND NEW LOW SMOKE ACIDITY (LSA) PVC CABLES

Flame Retardant Low Smoke (FRLS) PVC compounds, although uncommon in the EU, are used extensively in many other countries to manufacture FRLS cables. These cables meet the Class B2ca classification and are effective in reducing not only smoke production but also toxicity, for example, the release of CO, comparable to that of Halogen Free Flame Retardant cables (HFFR).

Moreover, new Low Smoke Acidity (LSA) PVC compounds have been developed to further limit HCl release during combustion. LSA PVC cables release even lower CO emissions than their HFFR counterparts, achieving Class Bca and s1b classification for smoke production.

Cardelli, C. (2023). "FRLS PVC Compounds and their Role in Reducing Smoke and Toxicity."

Cardelli, C. “PVC cables standard in Europe and beyond”, PVC4Cables Conference 2024, Prague

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OBJECTIVES 1 ACHIEVEMENTS

REEVALUATING CORROSION AND COST-EFFECTIVE FIRE RECOVERY

Costs associated with post-fire damage repair are high, but most of these costs relate to smoke removal, rather than to corrosion caused by HCl emissions. In actual fire scenarios, high temperatures and smoke are the predominant causes of damage, while the role of HCl remains minor.

FRLS PVC cables minimise smoke density, reducing post-fire clean-up expenses. Furthermore, fire safety assessments confirm that HCl-related corrosion remains a secondary concern in fires, as critical threats like intense heat and CO levels occur well before HCl reaches problematic concentrations. The key to protecting lives, property, and business continuity is ensuring that fires remain manageable. In this context, B2ca and Cca classified cables are more suitable than Dca.

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OBJECTIVE 2
PVC4CABLES ACHIEVEMENTS

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OBJECTIVES 2 ACHIEVEMENTS

Advancing Circularity

- PVC's recyclability and durability align well with the EU's circular economy objectives. Unlike most alternatives, PVC cables can be mechanically recycled at the end of their lifecycle without losing their properties. This is a key advantage, as mechanical properties of most alternative material cables – whether cross-linked or not – are significantly decreased when recycled.

- The European PVC industry is continuing to innovate in recycling technologies, including advanced sorting and dissolution methods that separate PVC from other materials and remove legacy additives. These technologies ensure that only REACH-compliant materials enter the recycling stream, enhancing the quality and sustainability of recycled PVC.

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OBJECTIVES 2 ACHIEVEMENTS

PLANNING THE FUTURE & MANAGING THE PAST

• **Planning the future:** It is thanks to the strong voluntary commitment of the entire European PVC industry over the last 30 years that today vinyl formulations are safe and do not contain toxic additives that would preclude their mechanical recyclability; this is what PVC must now be assessed on, not on how it was (legally) additivated years ago.

• **Managing the past:** Being a durable material, used for long-life articles, at the end of its use, these articles will contain «legacy additives»: for the management of the «old» PVC an optimal solution must be found, combining safety for humans and the environment with the saving of raw materials and energy.

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MANAGING THE PAST

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OBJECTIVES 2 ACHIEVEMENTS

NEW FORMULATIONS FOR THE PRESENT AND THE FUTURE

- Study and develop innovative formulations for PVC cables able to achieve a better classification (class B) and that could be classified in the lowest additional class provided for the acidity under the EN 13501-6 standard.

- At the same time, allow the end-of-life recycling of all new cables produced, thus avoiding the need to separate ground end-of-life cables into those containing Legacy Additives and those not containing them.

OBJECTIVES 2 ACHIEVEMENTS

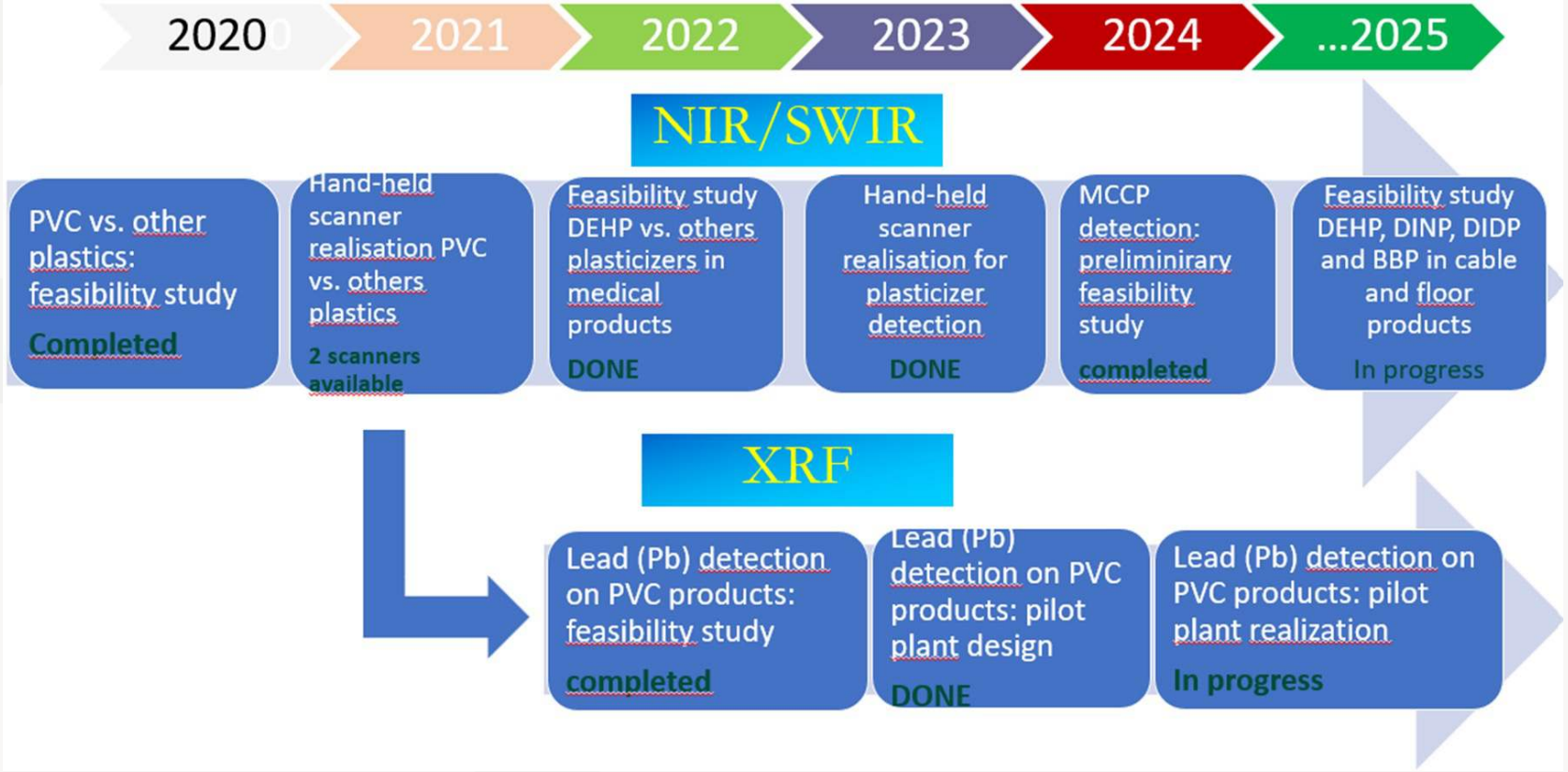
PVC CABLES AND LEGACY ADDITIVES

- The presence of legacy additives in end-of-life PVC cables (DEHP and Pb, today, and MCCP in the future) represents the main obstacle to cables (and other flexible PVC applications) recycling.
- The EU regulation recently adopted is in fact a disincentive for recyclers to accept PVC form cables, even before that this new regulations will enter into force.
- To address the issue of legacy additives is of paramount importance if we want to continue to promote the recycling of the new generation of PVC cables without SVHC.

OBJECTIVES 2 ACHIEVEMENTS

PVC CABLES AND LEGACY ADDITIVES

- Because of the presence of Legacy Additives in the end-of-life we have concentrated efforts and resources in supporting the investigation of solutions to detect, sort, and remove legacy additives from end-of-life PVC products.



OBJECTIVES 2
ACHIEVEMENTS

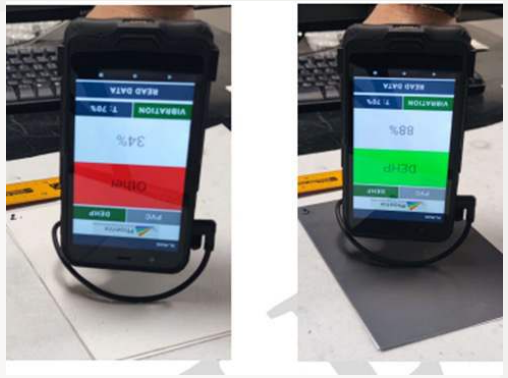
PVC CABLES AND LEGACY ADDITIVES

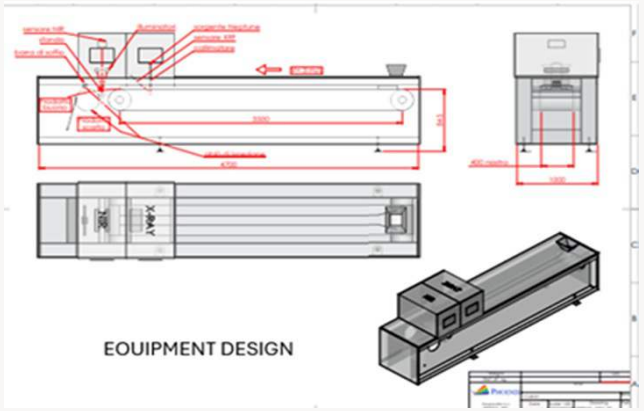
In the projects already developed or still in progress, two different technologies for detecting substances have been adopted:

- 1) X-ray technology (XRF)

- 2) Infrared technology (NIR)

Both technologies have been developed both to detect the presence on a whole product through the so-called Manual Scanner (hand-held) and on the ground product through a continuous detection system.

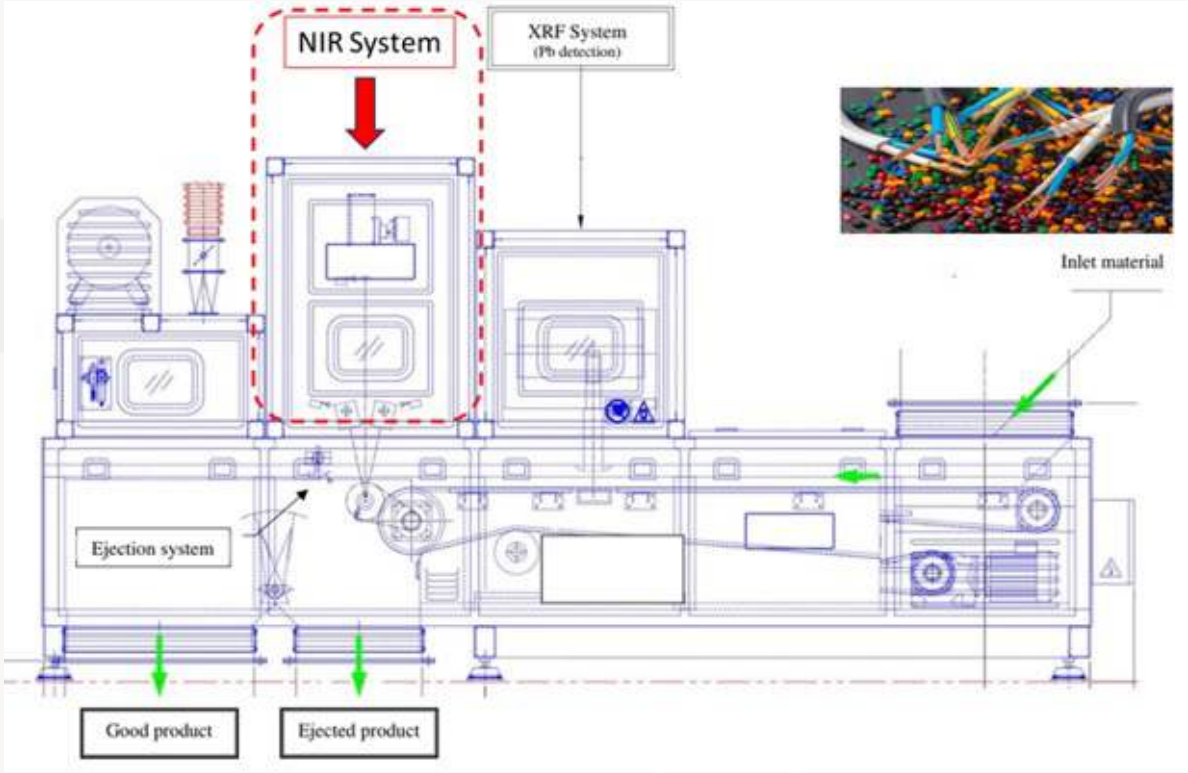




OBJECTIVES 2 ACHIEVEMENTS

PVC CABLES AND LEGACY ADDITIVES – CONTINUOUS DETECTION SYSTEM

- The company named Phoenix srl (Padua, Italy) has designed a pilot system, of which a schematic diagram is shown below.
- This pilot plant will be installed and will complete testing within this year and then an industrial plant will be designed.
- of course, this technology will be made available to all companies that deal with PVC cable waste



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PLANNING THE FUTURE

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OBJECTIVES 2 ACHIEVEMENTS

USE OF EVER MORE SUSTAINABLE ADDITIVES

Already at the beginning of the 2000s, VinylPlus had defined its own Sustainability program for its products, at the same time in line with the indications of the Reach Regulation.

Following the definition of the Reach Regulation, this program was further accelerated to the point of defining a voluntary plan for the replacement of some of the substances normally used in the past.

This Voluntary Commitment of the European PVC supply chain was naturally also applied to the cable sector with the development of new, more sustainable formulations.

Below are two examples of action by the cable sector that anticipated the Reach restrictions:

- lead

- MCCP

In recent years, a scientific method has been developed, called ASF (Additives Sustainability Footprint), that has been developed to evaluate the sustainability (positive contributions and residual risk) of the use of additives in the production of articles. PVC4Cables support this method and in the following slides there is a description of this new tool and how it could also be applied to the PVC cable sector.

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OBJECTIVES 2 ACHIEVEMENTS

ADDITIVES SUSTAINABILITY FOOTPRINT

The Additive Sustainability Footprint (ASF) = Developed for the evaluation of the sustainability of the use of PVC additives throughout the entire life cycle of PVC articles and based on scientific sustainability principles applied at each stage of the life cycle, the ASF is based on pre-existing tools with generic applicability to chemicals

The application of ASF enables PVC converters to gain information about the sustainability of additives and the supply chain, which can guide the choice of formulations. The adoption of ASF methodology in product design thus directly influences ECODESIGN.

Relevance, Concreteness and Educational contribution of the ASF method can be found: https://www.pvcforum.it/vinylplus/additive-sustainability-footprint/

ICESP (Italian Circular Economy Stakeholder Platform) has included ASF among the GOOD PRACTICES, see https://www.icesp.it/buone-pratiche

OBJECTIVES 2 ACHIEVEMENTS

ADDITIVES SUSTAINABILITY FOOTPRINT - DESCRIPTION

Four sustainability principles are derived from the science-based TNS model. These define that, in a fully sustainable society, nature must not be subject to:

1_systematically increasing concentrations of substances extracted from the earth's crust;

2_ systematically increasing concentrations of substances produced by society;

3_degradation by physical means of nature that can disturb natural cyclical processes; and there must not be

4_structural obstacles to people's health, skills, impartiality that compromise safety and opportunities in the present and/or in the future, preventing people from satisfying their needs.

The six stages of the ASF analysis are: 1) Raw materials extraction 2) Additive production 3 Transport and packaging 4) Compounding phase 5) Product durability 6) End-of-life management.

OBJECTIVES 2 ACHIEVEMENTS

ADDITIVES SUSTAINABILITY FOOTPRINT - RESULTS

The results of the analysis are highlighted through the use of ‘traffic lights’ colour coding, signifying whether the sustainability-relevant principle is fully met (green), partially met (yellow) or not met (red).

The application of ASF to an article made with PVC (an electric cable) informed significant improvement in additive formulation by highlighting whether the use of one or more substances fully met (green), partially met (yellow) or did not meet (red) the four TNS sustainability principles in each of the 6 article life cycle stages, as summarized in the following diagrams.

PVC "new"	RAW MATERIALS	ADDITIVE PRODUCTION	PACKAGING & DISTRIBUTION	COMPOUNDING & CONVERTING	ARTICLE USE	ARTICLE FATE
EXTRACTION						
NEW CHEMICALS						
EROSION						
PEOPLE						

OBJECTIVES 2 ACHIEVEMENTS

ADDITIVES SUSTAINABILITY FOOTPRINT - RESULTS

PVC Insulation	phr
PVC S K70	100,0
DEHP	36,0
$CaCO_3$	50,0
Calcined Clay	10,0
MCCP	12,0
ATO	4,0
Zinc Borate	2,0
Lead Stabiliser	4,0
Lubricants	x
Pigments	x

Stabilizzante al Pb (SVHC)
DOP (SVHC)
ATO = H351, H373
Zn Borate = H361-d, H341
MCCP = H362

PVC Insulation	phr
PVC S K70	100,0
DIDP (o bio-plastificante)	44,0
$CaCO_3$	15,0
Calcined Clay	10,0
MDH	35,0
ATO-Free Flame Retardant	10,0
RPK B-CV/3038	4,0
Lubricants	X
Pigments	X

Stabilizzante CaZn – not Classified
LMW Phthalate (DIDP) - o in futuro, bio-based
ATO-free FR = not Classified

OBJECTIVES 2 ACHIEVEMENTS

ADDITIVES SUSTAINABILITY FOOTPRINT - RESULTS

Therefore, for cables that are subjected to ASF assessment and designed according to the resulting indications it can be concluded that:

PVC cables are mechanically recyclable and have only 43% C-H

Additives that can be used in PVC cables may not be classified or may show a classification level of no concern

The recyclability of PVC cables allows for enormous savings in raw materials and energy

PVC cables evaluated with the ASF method prove to be a very sustainable application

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OBJECTIVE 3
PVC4CABLES ACHIEVEMENTS

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OBJECTIVES 3 ACHIEVEMENTS

IEC TC 20 WG18

Electric cables – Burning characteristics of cables

- IEC 60754 : Test on gases evolved during combustion of materials from cables
  - Part 1 : Determination of the halogen acid gas content
  - Part 2 : Determination of acidity (by pH measurement) and conductivity (CPR)
  - Part 3 : Measurement of low level of halogen content by ion chromatography
- IEC 60332 – Tests on electric and optical fibre cables under fire conditions (low to medium interest)
- IEC 61034 – Measurement of smoke density of cables burning under defind conditions (medium interest)

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OBJECTIVES 3 ACHIEVEMENTS

CLC TC 20 WG10

Electric cables – Fire performance tests for cables

Monitoring via CEB 20 (Belgian mirror committee)

- EN 50399 : Heat release and smoke production measurement on cables during flame spread test (CPR)
- EN 60754-1 -2 and -3 (see IEC 60754-1 -2 and -3)

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OBJECTIVES 3 ACHIEVEMENTS

CEN TC 127

Fire safety in building

Monitoring via CEB 20 (via the CEN TC 127 Belgian mirror committee)

- Need for a revision of EN 50399 and EN 13501-6 under discussion (CPR)
  - EN 50399 : Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results
  - EN 13501-6 : Fire classification of construction products and building elements - Part 6: Classification using data from reaction to fire tests on electric cables

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CONCLUSION

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CONCLUSION

RESEARCH AND INNOVATION

- **30+** studies and research carried out in 7 years
- **New formulations** developed with improved performance in terms of smoke acidity and HCl emissions. Production of the first PVC cables in **class B**
- Pilot plant for the **separation** of end-of-life PVC cables with **legacy additives**
- **Stronger cooperation** established with **academia** and **research institutes**

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CONCLUSION

PROMOTION OF THE PVC CABLES SECTOR ON THE MARKET

- Reversing the perception of a mature and non-innovative sector
- Work on the revision of the current CPR standards

• INTERNATIONAL CONFERENCES AND EVENTS

- 27 presentations at 16 conferences
- 4 PVC4Cables conferences:

Lyon 2017 Berlin 2019 Bologna 2022 Prague 2024

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THANK YOU

www.pvc4cables.org

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