Removal of Legacy Substances from polyvinylchloride (PVC) via a continuous and sustainable extrusion process

Tracking the Ever-Changing Regulations to Ensure Compliance

PVC360

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Presentation outline

- Introduction
- PVC waste management
- Hazardous substances
- ❑ REACH
- ❑ ECHA
- Lead restrictions debate
- Future perspectives & recommendations
- REMADYL as a best practice

Introduction

PVC waste has several legal aspects and implications in many different fields such as transport, handling, waste management, labelling of hazardous substances, standards, etc. Today the most relevant EU Regulations that can have an impact on PVC sector will be summed up together considering as well the actual debate on lead content in PVC.

According to Article 13 of the Waste Framework Directive 2008/98/EC, Member States must take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment and, in particular:

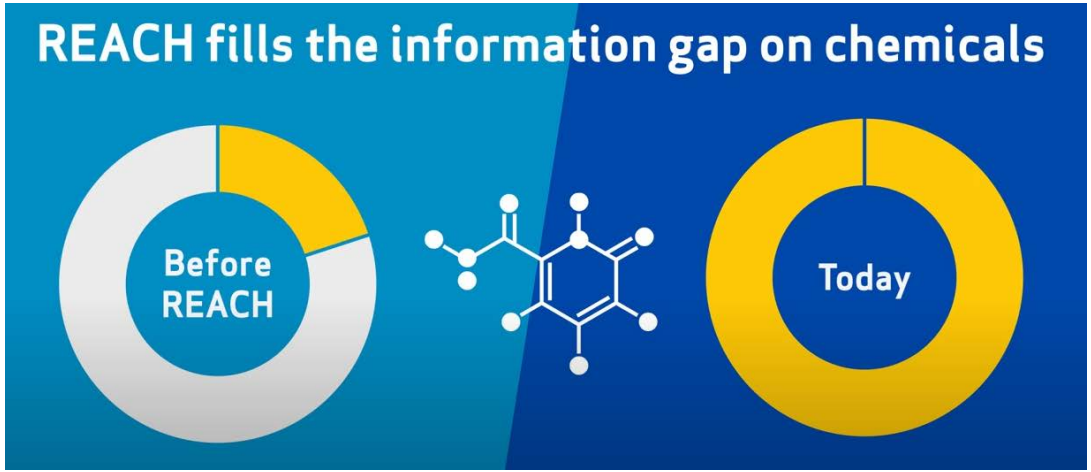
- Without risk to water, air, soil, plants or animals;
- Without causing a nuisance through noise or odours;
- Without adversely affecting the countryside or places of special interest.

The strategic objectives of the EU waste legislation are substantially two:

- the increase of separate collection with the consequent increase in the recycling index and the reduction;
- the progressive zeroing of waste disposal in landfills.

These are contained in the Directives EU members of the "Circular Economy Package" which will be implemented by the member states by going to integrate the current national legislation.

REACH is one of the most complex regulations of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. Among others, it contributes to the aim of closing the loop by transforming 'old PVC' with LS into REACH-conform rejuvenated PVC (DEHP level below 0.1% and Pb level in line with the expected restriction).



How does REACH work?

1. REACH establishes procedures for collecting and assessing information on the properties and hazards of substances.
2. Companies need to register their substances and to do this they need to work together with other companies who are registering the same substance.
3. ECHA receives and evaluates individual registrations for their compliance, and the EU Member States evaluate selected substances to clarify initial concerns for human health or for the environment. Authorities and ECHA's scientific committees assess whether the risks of substances can be managed.
4. Authorities can ban hazardous substances if their risks are unmanageable. They can also decide to restrict a use or make it subject to a prior authorisation.

ECHA works for the safe use of chemicals; it implements the EU's ground-breaking chemicals legislation, benefiting human health, the environment and innovation and competitiveness in Europe; it is currently working on the restrictions under consideration for PVC that contains lead compounds. Today and since 2015 the European PVC industry is no longer using lead stabilizers in its production. Over 70 % of PVC profile producers have already completed phase out in 2003. Lead can only be introduced into new profiles via the use of recyclate. ECHA's initial proposal considered a threshold of 0.1% lead content for articles not containing recycled PVC. For some building and construction articles produced from recycled PVC, there would be a 15-year derogation with a higher limit of lead content for articles using PVC recyclates containing it.

Lead restrictions

The plenary session of EU Parliament with the **resolution of 12th of February 2020** voted to uphold its environment (ENVI) committee's decision to block the European Commission's amended rules for lead concentration in PVC products stating that the Commission proposal "goes against the main principle of REACH, to protect human health and the environment, as lead, even in low doses can seriously affect health, including irreversible neurological damage.

The EU commission has been obliged to submit an amended draft to parliament or present a new proposal and **after 2 years something is moving**:

The EU has informed the WTO of its **intention to expand the restriction of lead under REACH**. The draft regulation is proposed to be adopted in Q4 of 2022.

On June 8, 2022, the World Trade Organization (WTO) announced a draft regulation from the European Union (EU) on its intention to expand the scope of restriction of lead and its compounds under entry 63 to Annex XVII of REACH. The draft regulation restricts lead in PVC polymers and copolymers.

Lead restrictions

The proposed regulation contains several derogations. It:

- Permits **certain PVC articles containing recovered rigid PVC to be used for 10 years after the date of entry into force of the regulation**, but subject to **less than 1.5% lead** in the recovered rigid PVC, and **less than 0.1% lead** for a layer of newly produced PVC or other material that covers the recovered rigid PVC. These PVC articles containing recovered rigid PVC are profiles and sheets for 1) specified applications in buildings and civil engineering works, 2) decks and terraces, and 3) specified interior building applications, as well as certain multi-layer pipes and fittings
- Directs suppliers of PVC articles containing recovered rigid PVC with 0.1% or more of lead to **provide the statement 'Contains lead'** on the article – this statement can be placed on the article packaging if it is not possible on the article
- Requires suppliers of PVC articles containing recovered rigid PVC to **provide documentation to national enforcement authorities**, if requested, to substantiate the claims on the recovered origin of the PVC in those articles. Substantiation of such claims may include certificates issued by schemes to demonstrate traceability and recycled content, such as EN 15343:2007 'Plastics – Recycled Plastics – Plastics Recycling Traceability and Assessment of Conformity and Recycled Content', or equivalent recognized standards. Claims made on the recovered origin of the PVC in imported articles must be accompanied by a certificate that provides equivalent proof of traceability and recycled content, issued by an independent third party.

Exempts the following:

- PVC-silica separators in lead-acid batteries, for 10 years after the date of entry into force
- 'Jewelry articles' and 'articles supplied to the general public that can be mouthed by children' (paragraph 1, in accordance with paragraphs 2 to 5 & paragraph 7, in accordance with paragraphs 8 and 10) under entry 63 to Annex XVII of REACH
- Articles within the scope of four pieces of legislation

Lead restrictions

Draft Regulation Amending Entry 63 to Annex XVII of Regulation (EC) 1907/2006 as Regards Lead and its Compounds in PVC

Substance	Scope*	Requirement	Proposed Effective Date
Lead	Articles produced from polymers or copolymers of vinyl chloride (PVC)	Prohibited to be used	2 years after date of entry into force
	PVC articles	< 0.1% in PVC materials, otherwise prohibited to be placed on the market	

*Articles within the following scope are exempt:
- Regulation (EC) 1935/2004 'Food contact materials and articles
- Directive 2011/65/EC 'Electrical and electronic equipment (RoHS recast)'
- Directive 94/62/EC 'Packaging and packaging waste'
- Directive 2009/48/EC 'Toy safety'

According to the WTO document and the draft regulation, it is proposed that the draft regulation is:

- Adopted in Q4 of 2022
- Brought into force 20 days from its publication in the Official Journal of the EU
- Brought into effect two years after the date of entry into force

Future perspectives & recommendations

Many companies/entities are expecting the creation of incentives for the implementation of technologies which could include the removal of hazardous substances from wastes, such as for example the end-of-life PVC wastes. As a starting point, it is imperative to **promote the development of legislative initiatives that could either create, modify, or strengthen the recycling processes that can remove the legacy additives**.

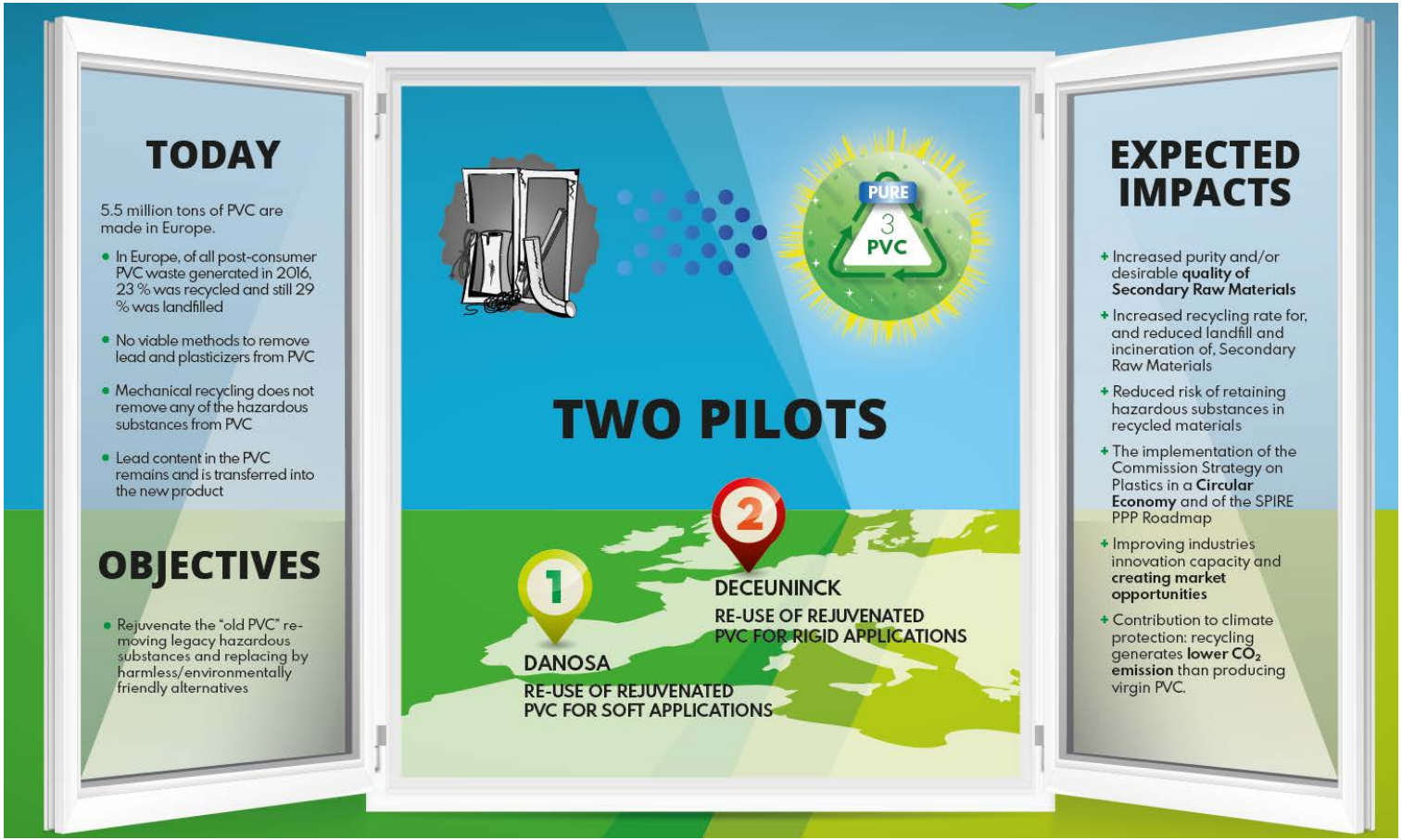
An excellent start has been set by the European Commission with the initiatives under FP7, Horizon 2020 and Horizon Europe programs, where many **EU-funded projects** target best available and most environmentally advantageous technologies for **identification of legacy substances, decontamination, recycling, and reuse** of recycled materials in new products.

There is the need of **more uniform collection schemes** throughout Europe. This will simplify the exchange of waste between European countries and its use in appropriate scaled-up recycling facilities. This must be accompanied by independent research on BATs for recycling that considers the whole picture (for example, LCA studies with all available recycling technologies or cost-benefit studies on decontamination technologies) so that the most relevant technologies are applied for the benefits of the society.

Future legislative initiatives shall **prevent the need for decontamination processes of wastes**. Therefore, the continuous stimulation of design for recycling from the chemical perspective considering end-of-life scenarios is important and shall be taken into consideration. Funding of academic research on new alternative additives to replace harmful substances in plastics shall also be within the EU Commission's scope, as well as the support for creating EU-wide standards on analysing wastes, with the aim of identifying the presence of classified substances.

It is in the interest of the European Circular Economy that we decontaminate and recycle all materials!

Example of best practice – REMADYL project



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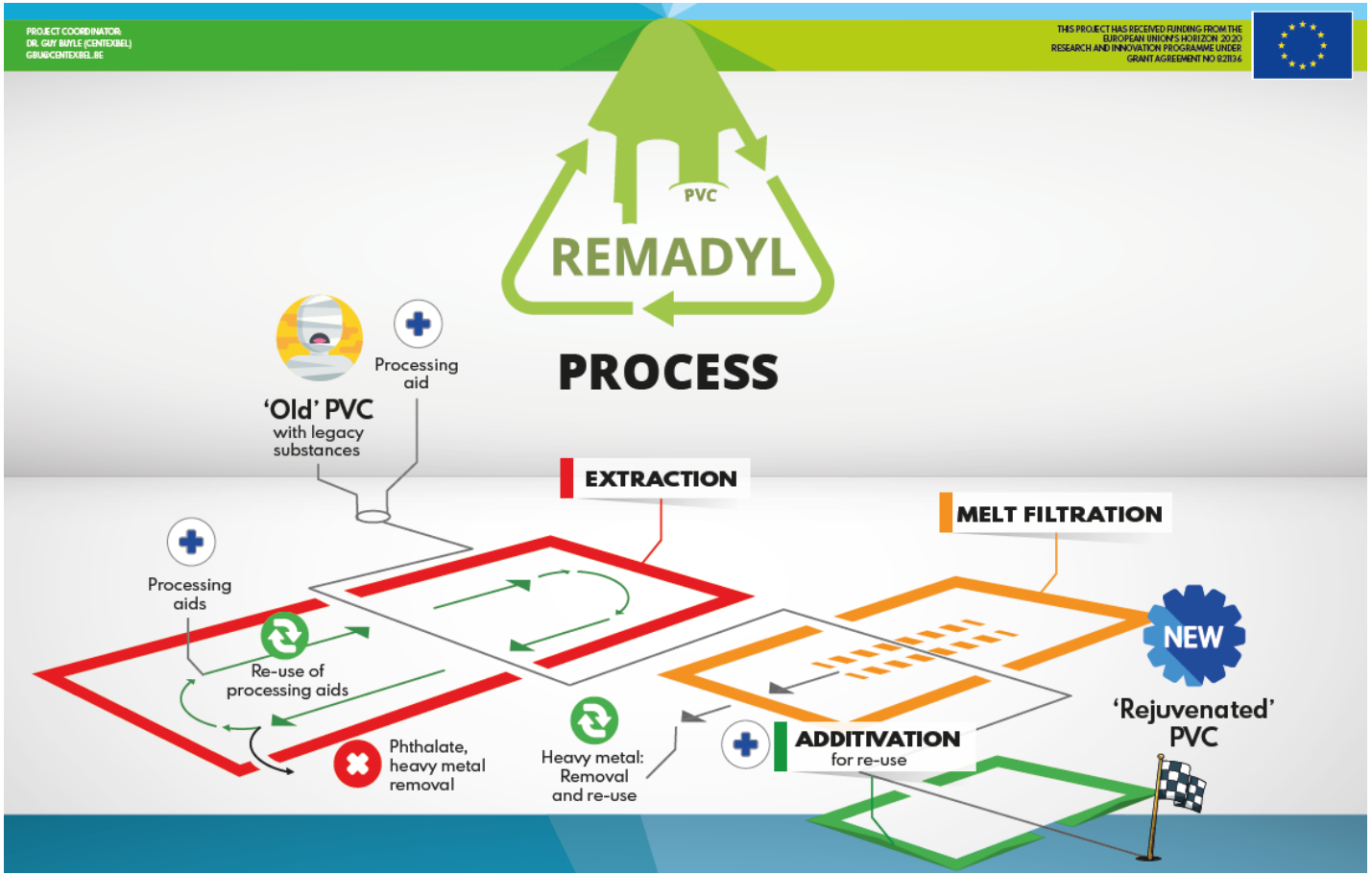
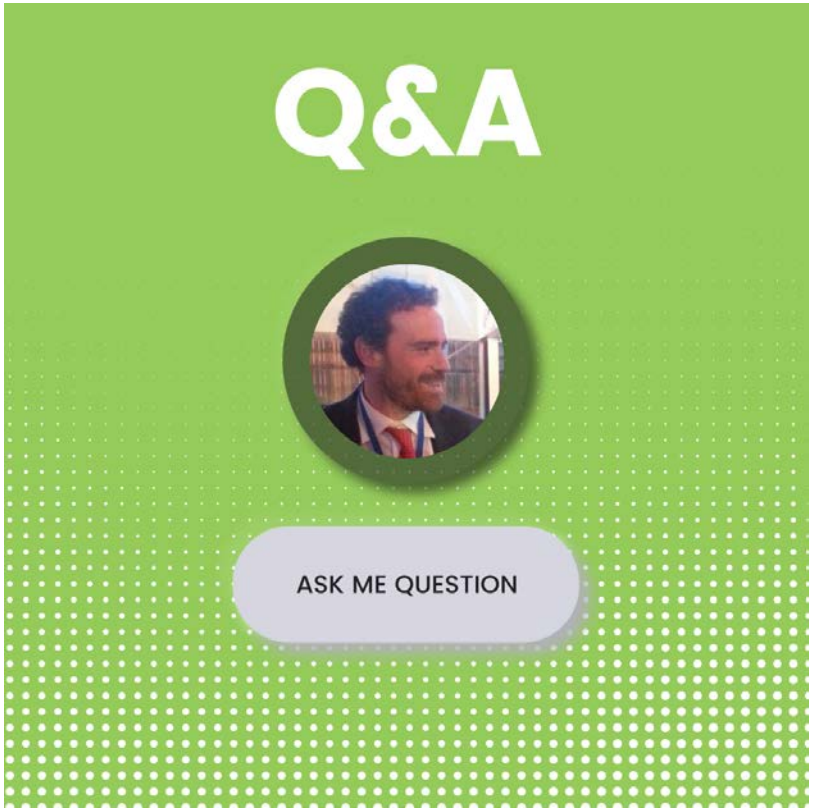


REMADYL Key Objectives

- **KO1 – Lab-scale processes for rejuvenating PVC**: develop an extraction method to remove legacy substances (LS) out of a PVC matrix. Result: lab scale process (ca 0.5-2.0 kg/hour) and processing window to remove heavy metal stabilisers (focus on Pb < 0.1w%) and non-REACH compatible phthalates (focus on DEHP < 0.1w%) while controlling the PVC stability and viscosity via additivation.
- **KO2 - Detection and sorting process for PVC containing LS**. Analysis of online separation of PVC material containing hazardous LS, based on Pb and DEHP-content. Result: selection of suitable screening technologies, ability to detect shredded PVC parts with >1.5w% Pb content, demo of online sorting.
- **KO3 – Pilot line: continuous extractive extrusion process** for rejuvenating PVC – upgrade equipment by integration of the extraction techniques into existing pilot line. Result: semi-industrial scale pilot (ca. 20-25 kg/hour) with optimised processing conditions for reaching KO1 defined levels and at energy consumption < 1kWh/kg PVC.

- **KO4 – Demo of re-use of rejuvenated PVC material** streams & design for recycling. Show the circularity of the materials flows by safe re-use of the rejuvenated PVC from technical and economic point of view, incl. REACH compliance. Result: demo of use of rejuvenated PVC resin, with varying flexibility fulfilling industrial quality requirements for hard and soft PVC extrusion and for PVC injection moulding. Safety & quality control procedure set up.
- **KO5 – Safe handling and re-use of by-products**. Research re-use of the lead salt residue for manufacturing automotive batteries (or other applications) and study on the revalorization of a mixture of phthalate plasticizers to new plasticizers. Result: protocol for purification and safe disposal of phthalate plasticizer; hydrometallurgical and green chemical routes to obtain lead ingots (desirable purity 95-99%) from the lead salt residue (desirable purity > 75%).

- **KO6 – Environmental & safety aspects**: LCA, social-LCA and LCC and safety & risk. Result: public report on environmental impact (including energy needs), social aspects and safety and risk of the rejuvenating process.
- **KO7 - Policy contribution**: review of existing legislation/guidelines concerning (re-use and recycling of) PVC waste; mapping of European PVC waste streams; best practice. Result: policy & standardisation input documents (incl. suggestions for defining End of Waste requirements for PVC and safety aspects of recovered hazardous components); white paper on rejuvenating PVC and on re-use of lead salts.
- **KO8 - Innovation management**: exploitation & business plans, IP management, dissemination & communication.
  Result: tailored business plans for (company) partners to ensure exploitation beyond the project; public roadmap and strategy to further exploit the generic results; raise awareness, engage for collaboration to leverage REMADYL project outcome.


Q&A
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