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Material Efficiency Aspects for Ecodesign'

Secretariat Enquiry (new work item JT010002 / prEN 45557)

To: National Standardisation Bodies and Collaborating Partners

Secretariat Enquiry

CEN/CLC European Standard

prEN 45557 - General method for assessing the proportion of recycled content in an energy related product.

National Standardisation Bodies and Collaborating Partners are invited to comment on the document. Comments can be considered only if form sheet (FormComments.doc) is used. The Workgroup preparing this document request to refrain from editorial comments at this stage. Furthermore figures will be drawn according to internal regulations in the next stage.

National Standardisation Bodies and Collaborating Partners shall upload their comments, as a reply to this document on the Collaboration tool, no later than 2017-11-22.

CEN-CLC TC10

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General method for assessing the proportion of recycled material content in energy related products.

Einführendes Element — Haupt-Element — Ergänzendes Element

Élément introductif — Élément central — Élément complémentaire

ICS:

CCMC will prepare and attach the official title page.

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European foreword

This document (prEN 45557/2019) has been prepared by Technical Committee CEN/CLC/TC 10 "Energy-related products - Material Efficiency Aspects for Ecodesign", the secretariat of which is held by NEN/NEC.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN-CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Introduction

Standardisation request M/543 has asked the European standardisation organisations CEN, CENELEC and ETSI to jointly draft new European standards and standardisation deliverables on Material Efficiency Aspects for energy-related products (ErP) in support of implementation of the EcoDesign Directive (2009/125/EC). It is expected that increased focus on material efficiency aspects in the application of Directive 2009/125/EC should make a sizeable contribution to the transition towards a more circular economy.

Differing from the reusability, recyclability and recoverability that are potentials of the product, the **recycled material** is a physical characteristic related to the manufacturing history of the product and all its **parts**. The **recycled content** of a finished product is fixed and does not change over time.

In general, incorporating recycled materials into products brings environmental, social and economic benefits due to the fact that less primary material is needed to make the same product. Environmental benefits resulting from the substitution of primary material include: reduced mining and consumption of natural resources, reduced landfill of valuable materials, emission and energy savings. The overall benefit will depend on the difference in environmental impact of making material from primary sources (oil, ore etc.) vs. processing waste into a recycled material which can directly substitute primary material. The benefit of increasing **recycled content** in products incentivises, in many cases, recycling of end-of-life (EoL) waste material by stimulating demand for **recycled materials**. In other cases, where there is already sufficient demand for recycled materials to use what is already supplied by the market, specification of higher **recycled content** may not incentivise recycling of additional EoL waste material, and so may not be relevant to eco-design e.g. if supply is limited. The rationale for specifying **recycled content**, therefore needs to be considered for each material individually depending on the overall market demand/supply situation for each material.

Guidelines for accounting and reporting **recycled content** will contribute to avoid potentially unsubstantiated and misleading claims on **recycled content** for which it is not clear how they are determined and that are potentially confusing or misleading.

1 Scope

This document provides a general methodology for assessing the proportion of **recycled material** in an energy related product.

It includes:

Products in the scope of Ecodesign directive

NOTE: Products falling newly under the scope of a revised eco-design directive shall also fall in the scope of this EN

This EN should be used as a general guideline, when drafting product specific standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14021, Environmental labels and declarations - Self-declared environmental claims (Type II environmental labelling)

EN 15343, Plastics - Recycled Plastics - Plastics recycling traceability and assessment of conformity and recycled content

EN 17074, Glass in building - Environmental product declaration - Product category rules for flat glass products

IEC 62542, Environmental standardization for electrical and electronic products and systems - Glossary of terms

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

Bill of materials

an extensive list of raw materials, **components** and **assemblies** required to construct a product

Note 1 to entry: A bill of materials usually appears in a hierarchical format, with the highest level displaying the finished product and the bottom level showing individual **components** and materials.

Note 2 to entry: bill of materials can also refer to **components**

3.2

Post-consumer material

material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose

Note to entry: This includes returns of material from the distribution chain.

[ISO 14021]

3.3

Pre-consumer material

material diverted from the waste stream during a manufacturing process

Note to entry: Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

[SOURCE: ISO 14021]

3.4

Recycled content

proportion, by mass, of **recycled material** in a product (synonymous to “recycled material content” in this document)

[SOURCE: ISO 14021]

3.5

Recycled material

material recovered from pre-consumer or post-consumer waste, also called “recyclate” in this document

NOTE to entry: recycled material is also called “recyclate” in this document

3.6

qualified recycling process

recycling process producing material which meets the requirements for the intended applications

[EN15343]

3.7

Part

Component or **assembly**

NOTE to entry: The term "part" will be used, unless **assembly** or **component** provides further necessary clarification

3.8

Assembly

Set of **components** assembled into a single **part**

[IEC 62542, modified]

3.9

Component

Part of a product that cannot be taken apart without destruction or impairment of its intended use

[IEC 62542, modified]

4 Assessment method for the recycled content of an energy related product

4.1 General considerations

Due to the fact that virgin and secondary material is often indistinguishable, there are no methods available for directly measuring the recycled content in a product with sufficient reliability. As a consequence, the verification of recycled content does not support physical traceability of material, but relies on an administrative allocation to maintain a reconciliation of recycled volumes (i.e. documental proof, provided by the manufacturer). **Recycled content** is treated as a characteristic of average material production output over a specified time rather than of individual products. Those materials constitute the inputs to a product manufacturer, which are transformed into **parts** of an energy related product.

The assessment of recycled content requires:

1) Correct assessment of materials composition of a single product
2) A transparent management system to trace the type of material inputs, i.e. virgin or **recycled material**
3) Performing a mass balance calculation, linking **recycled material**s input to composition of a product to total material quantity in a **part**/product

In general, the assessment may address the product at material level (based on the **bill of material**), each single **component** or **assembly** (summed up to the weight of the product). It may also target at certain material fractions (e.g. ferrous metals, plastics, etc.), for which one of the options is chosen. Which of these approaches is best applicable shall be determined by product-specific standardisation committees. Equally, decisions may be taken concerning the completeness of the assessment, e.g. by defining threshold values, below which a **part** does not need to be taken into account.

Only **pre-consumer materials** and **post-consumer materials** shall count towards **recycled content,** in accordance with their definition provided in section 3, as well as with specific guidelines provided in section 4.2.4 for different material types. Material, which is recovered within the same manufacturing process that generated it, is refered to as raw material and shall not count towards **recycled content**.

The general concept of raw material, **pre-consumer material** and **post-consumer material** is visualised in Fig. 1.

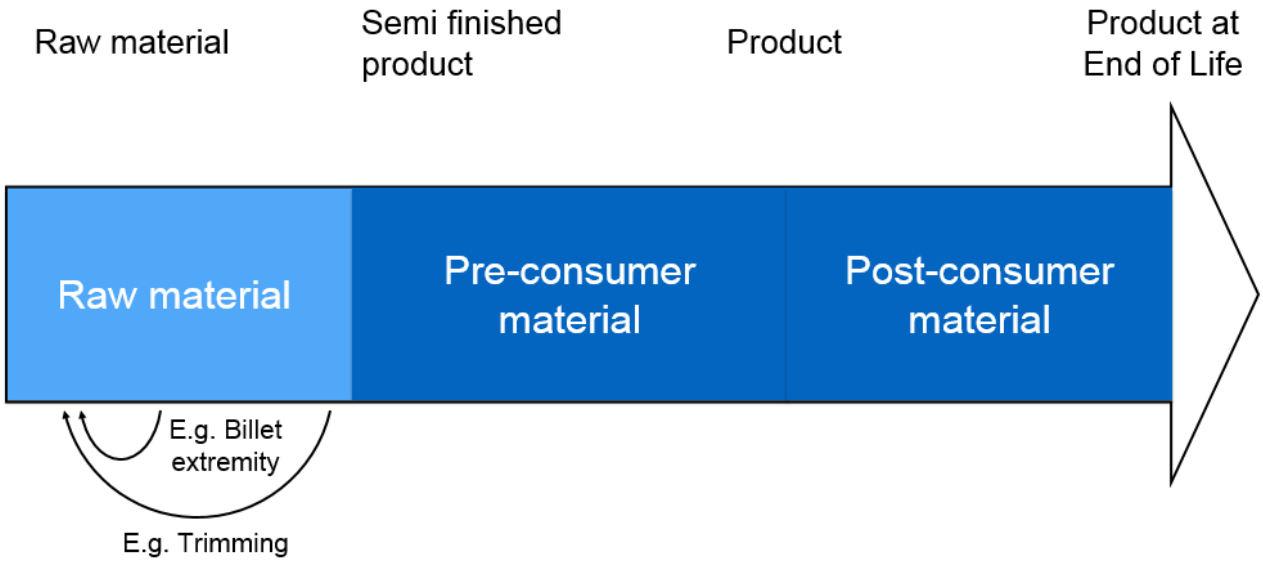


Figure 1: Visualisation of raw material, pre-consumer material and post-consumer material.

4.2 Calculation of recycled content

4.2.1 Variables and their symbols

The symbols used in calculating the **recycled content,** are depicted in Table .

Table 1 - Symbols and Definitions

$m_{rec(pre-cons),t}$	mass of **pre-consumer material** used to manufacture a material for a specific period of time
$m_{rec(post-cons),t}$	mass of **post-consumer material** used to manufacture a material for a specific period of time
m_{tot}	total mass of a material
m_k	Mass of the kth material of the product/**part**
$r_{content(pre-cons),t}$	**Pre-consumer recycled content** index of a material for a specific period of time
$r_{content(post-cons),t}$	**Post-consumer recycled content** index of a material for a specific period of time
$R_{content(pre-cons),t}$	**Pre-consumer recycled content** index of a product for a specific period of time
$R_{content(post-cons),t}$	**Post-consumer recycled content** index of a product for a specific period of time

$R_{content,t}$	**Recycled content** index of a product for a specific period of time
Note: all masses shall be expressed in the same unit	

4.2.2 General method for Recycled material content calculation

The **pre-consumer recycled content** index, $r_{content(pre\text{-}cons)}$, of a material, as a percentage by mass (mass friction in percent), shall be calculated using the formula:

$$r_{content(pre-cons),t} = \left(\frac{pre-consumer\ recycled\ material\ mass\ in\ a\ material}{total\ mass\ of\ the\ material}\right) \times 100\%$$

$$= \left(\frac{m_{rec(pre-cons),t}}{m_{tot}}\right) \times 100\%$$

The **pre-consumer recycled content** index, $R_{content(pre\text{-}cons)}$, of a complex multi-material **part** or product shall be calculated analogously:

$$R_{content(pre-cons),t} = \left(\frac{sum\ of\ pre-consumer\ recycled\ content\ of\ materials}{sum\ of\ materials'\ mass}\right) \times 100\%$$

$$= \left(\frac{\sum_k m_k \times r_{content(pre-cons),i,t}}{\sum_k m_k}\right) \times 100\%$$

The post-consumer recycled content index, $r_{content(post\text{-}cons)}$, of a material, as a percentage by mass (mass friction in percent), shall be calculated using the formula:

$$r_{content(post-cons),t} = \left(\frac{post-consumer\ recycled\ material\ mass\ in\ the\ \ material}{total\ mass\ of\ a\ material}\right) \times 100\%$$

$$= \left(\frac{m_{rec(post-cons),t}}{m_{tot}}\right) \times 100\%$$

The **post-consumer recycled content** index $R_{content(post\text{-}cons)}$ of a complex multi-material **part** or product shall be calculated analogously:

$$R_{content(post-cons),t} = \left(\frac{sum\ of\ post-consumer\ recycled\ content\ of\ materials}{sum\ of\ materials'mass}\right) \times 100\%$$

$$= \left(\frac{\sum_k m_k \times r_{content(post-cons),k,t}}{\sum_k m_k}\right) \times 100\%$$

Note: Instead of the whole product, the proportion of **recycled content** could be calculated with different granularities, by amending the formulas for $R_{content(post\text{-}cons),t}$ and $R_{content(pre\text{-}cons),t}$ respectively. In addition, adaptation of the formulas above to cover the proportion of **recycled content** for a specific type of material is possible, e.g. 4.2.4.

When information on a material is missing, it shall be assumed as virgin material. There is no obligation to collect all information, however only documented verifiable **pre-consumer material** and **post-consumer material** input shall be accounted as **recycled content**.

Calculation and verification of the **recycled content** in an ErP consists of balancing the mass of production output over a certain accounting period not exceeding one year, with the material inputs, corrected for changes in material stock and conversions during processes:

Output = Input + accumulation + internal conversions - waste

A Mass Balance (4.3.) shall be done for every separate material.

Where a process has more than one input, the input is attributed to the outputs based on the average composition of the inputs.

EXAMPLE: When mixing equal amounts of recycled and virgin material, the output has 50% **recycled content**; when using equal amounts of **recycled material** on day one and virgin material on day two, the average output has 50% **recycled content**.

Where more than one process produces the same output, the average output shall be used to assess the **recycled content**.

The input may start as early as reagents or constituent materials used, e.g. monomers, or it may be any **part** or intermediate product. This depends on the position in the value chain of the manufacturer assessing the **recycled content** of his product(s).

The output may be a **part**, intermediate product or product. This depends on the position in the value chain of the manufacturer assessing the **recycled content** of his product(s).

The output shall be calculated by:

1) Unambiguously identifying materials involved
2) Tabulating weight
3) Counting production over a certain accounting period not exceeding one year
4) Summing up total weights of materials per type for production output over a certain accounting period not exceeding one year

The input shall be calculated by:

1) Unambiguously identifying shipments of materials, fillers, additives, product intermediates and product **parts**
2) Tabulating weight, material composition for materials, fillers, additives, product intermediates and product **parts**.
3) Summing up total weights of materials per type for production input over a certain time

Accumulation shall be accounted by calculating changes in material stock between the start and the end of the period for making the assessment (e.g. a fiscal year).

Internal conversion accounts for any losses, including from chemical reactions (e.g. polymerization) and use of materials for application outside the production system under investigation.

4.2.3 Bill of Material (BoM), Clustering and Cut-off rules

The **BoM** is a way to express the composition of the materials contained in a product or any **part** of it. To establish a **BoM**, each **part** of the product shall be assessed for the weight of its constituent materials. The masses of the respective material fractions of all **parts** shall be summed up to obtain the material composition of the whole product.

In many cases a given material type represents a family of materials that are not identical but very similar and thus share the majority of physical and chemical properties.

EXAMPLE: Steel or polypropylene (PP) are produced in different grades for specific applications. The Society of Automotive Engineers (SAE International) lists among others different grades of Nickel-chromium steels with varying proportion of Nickel and chromium, e.g. 31xx, 32xx, 33xx, 34xx. For Polypropylene, the three main grades are homopolymer PP, random copolymer PP, block copolymer PP.

Various grades of a material type shall be treated as one material to determine the proportion of **recycled content** of a product. Alloys may require the allocation to a certain material. Product-specific standardization committees shall define the applicable material clusters for their respective product group.

Due to their small size or complexity of material composition, e.g. printed circuit boards, cut-off rules for **parts** which shall not be taken into account for the **BoM**, may be required for such **parts**. Product-specific standardization committees shall determine those cut-off rules if applicable.

4.2.4 Specific guidelines per material type

4.2.4.1 Plastics

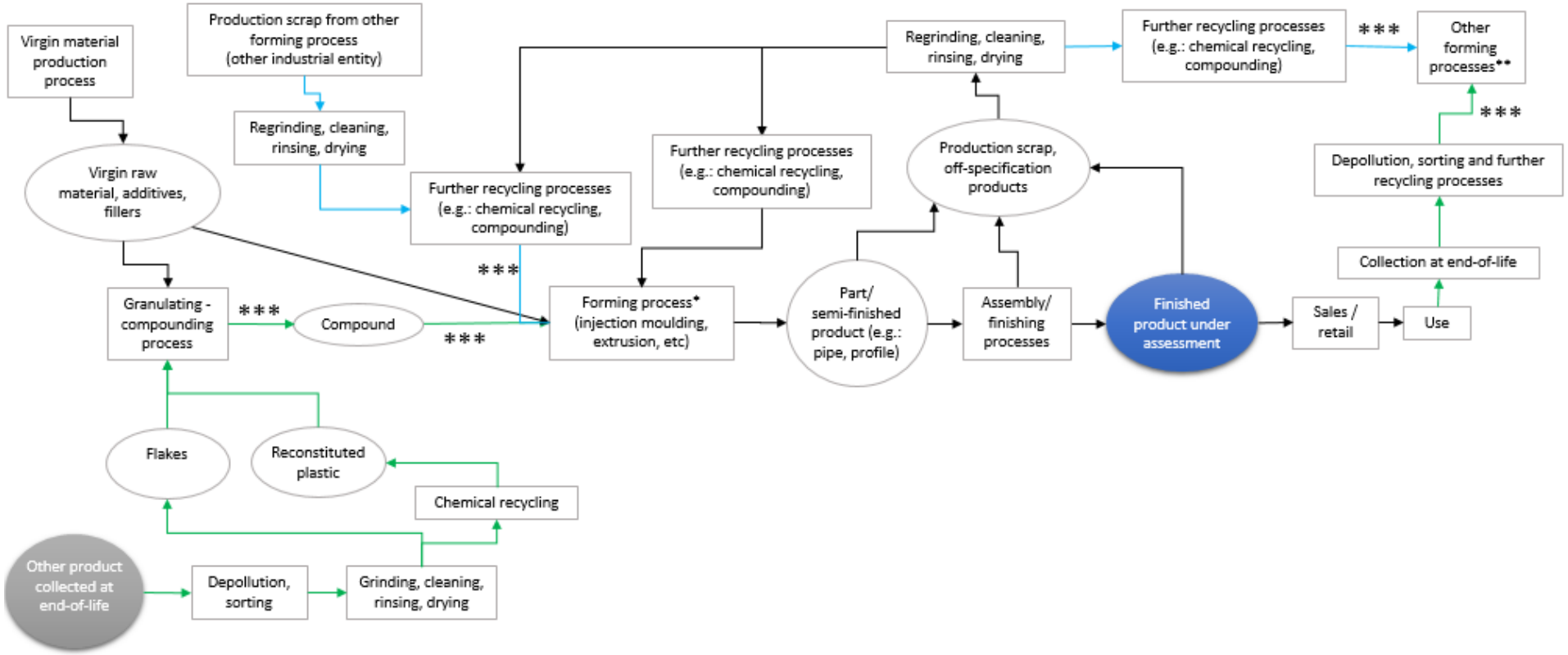
The **recycled** plastic **content** in the product may be calculated as a percentage of total plastic weight of any plastic **parts** in the product.

The following may be excluded from calculations:

- Packaging, tape, plastic protective and stretch wraps, labels;
- Printed Circuit Board (PCB), wiring and cables, connectors, electronic **parts**, optical **parts**, electrostatic discharge (ESD) **parts**, electromagnetic interference (EMI) **parts**

In the calculation of **recycled** plastic **content**, distinction shall be made between the **pre-consumer** and the **post-consumer recycled material** for the calculation of the **recycled** plastic **content**.

Material flows for counting **pre-consumer recycled content** and **post-consumer recycled content** in plastics are depicted in Figure 2:



* The post-consumer recycled material can feed processes aiming at producing either the same type of product that generated it (closed-loop) or another type of product (open-loop recycling)
** Not to be accounted in the finished product under assessment
*** Material can be 100% or < 100% pre/post-consumer depending if it is blended with virgin polymers, additives, fillers

Figure 2 : Typical material flows for plastic materials. Processes leading to pre-consumer and post-consumer material are indicated.

Various types of processes and plastic flows presented in the Figure 2 can be distinguished and help classifying the material as **pre-consumer** or **post-consumer recycled material**. However, with regard to typical approval processes of materials in a company, all types of recycled plastics shall behave similar to the respective new materials. Thus, the consistency of the **recycled material** and its properties should be checked accordingly.

Regrinding, granulating

Regrinding internal scrap from a forming process, e.g. injection molding, extrusion, etc., producing plastic **parts** or intermediate products and reusing it in the same process ("in-house use") in the form of flakes or granules, shall be excluded from the calculation of **recycled content**, in accordance with ISO 14021 principles.

Regrinding may also be applied to plastics proceeding from damaged or defective products, overstock or obsolete inventories from manufacturers, distributors, and wholesalers[1] which have not been put on the market. In this case, the ground plastic, in the form of flakes or granules shall be considered as **pre-consumer recycled material**. If the flakes or granules are mixed with virgin material as input for the forming process or during the granulating process, the share of virgin material shall be identified and excluded from the **recycled content**.

Compounding

Compounding results in an intimate blend of one or more polymers with other substances such as fillers, plasticizers or colourings, which may be used in a new manufacturing process[2]. If virgin polymers are mixed with **pre-consumer** or **post- consumer** recycled plastics, their share within the compound shall be identified and excluded from the **recycled content** of the **part** or product embedding it. If recycled plastics are used which are derived from waste plastics containing fillers, the entire amount of that material shall be counted towards the **recycled content**.

Reconstituted plastics

The chemical recycling of plastic waste comprises various thermal, physical and chemical procedures by which polymeric materials are decomposed into basic materials and chemically reassembled. This results in new synthesized polymeric materials which can be purchased under various trade names, and are considered as **pre-consumer** or **post-consumer materials** following the same criteria than for the outputs of any other recycling process

4.2.4.2 Metals

The **recycled** metal **content** in the product is calculated as a percentage of total metal weight of any metal **parts** in the product. In this calculation, distinction shall be made between the **pre-consumer** and the **post-consumer recycled material** for the calculation of the **recycled content**.

The material flows to account for both types of **recycled material** are shown in Figure 3:

[1] Standard for Sustainability for Products Made From Recycled Plastic, UL 2778 - First Edition, Dated September 29, 2011.

[2] Adapted from Glossary of common terms in recovery and recycling for the use of industrials businesses and their regulatory contacts, Association Alliance Chimie Recyclage, 2nd Edition, November 2014

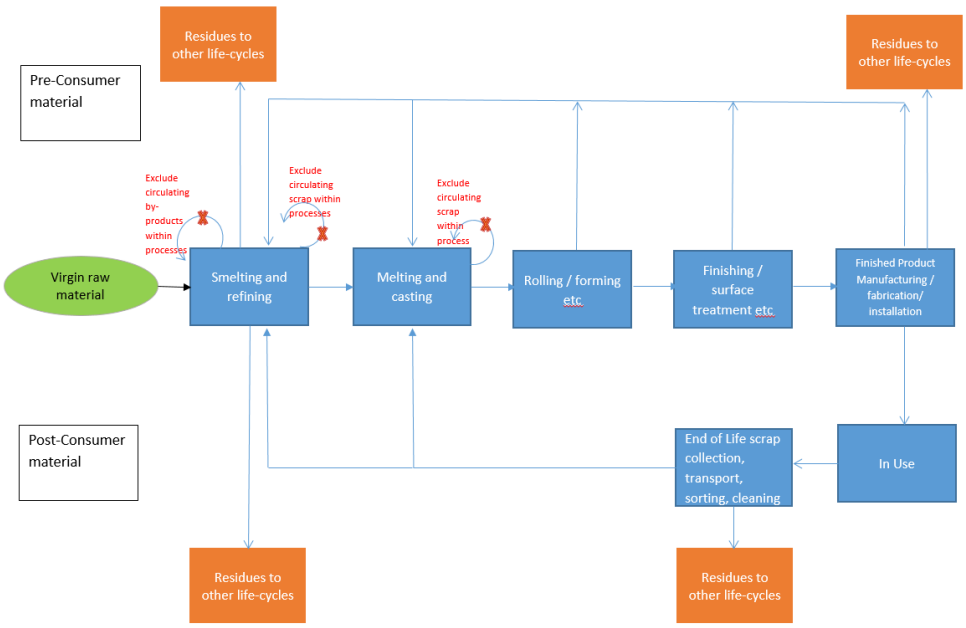


Figure 3 Schematic diagram to distinguish pre-consumer and post-consumer recycled material in metals

In many cases, mainly in the non-ferrous metal industry, virgin raw material is composed of more than one metal. The first step, the smelting and refining process, will separate the metal under consideration from the accompanying metals. In such case, the other metals will be leaving the process and will be taken into account in other life-cycles.

The smelting and refining processes as well as the melting and casting processes may consume the internal scrap generated during the processing. Such circulating scrap (or by-products in the case of the smelting and refining process) shall not be counted as **pre-consumer recycled material**.

The downstream processes are combined in the diagram in the processes “Rolling/forming”, “Finishing /surface treatment etc.” up to the “Finished Product Manufacturing /fabrication /installation”. The scrap generated during those processing steps may not be recycled within those forming and finishing process steps and will be sent as raw material to the “melting and casting” or the “smelting and refining” process steps, depending upon quality and commercial/technical needs for the processes. Therefore, scrap generated from these processes shall count as **pre-consumer recycled material**.

The final “Finished Product Manufacturing/fabrication/installation” step will combine in many cases different metals at the same time, resulting in residues to be recycled in other life cycles. These residues shall count as **pre-consumer recycled material**.

All materials collected and treated after the use phase are by definition **post-consumer recycled material**. Due to the combined use of many metals, the pre-treatment steps can already result in complex residues of a combination of metals, to be counted in other life-cycles.

Depending upon the quality of the **post-consumer recycled material**, the metallic material can be treated immediately in the melting and casting. For some metals and for some complex materials only the smelting and refining processes are capable to return the metal again into the next life-cycle.

4.2.4.3 Glass

The **recycled** glass **content** in the product is calculated as a percentage of total glass weight of any glass **parts** in the product. In this calculation, distinction shall be made between the **pre-consumer** and the **post-consumer recycled material** for the calculation of the **recycled content**.

The material flows to account for both types of **recycled material** are shown in Figure 4:

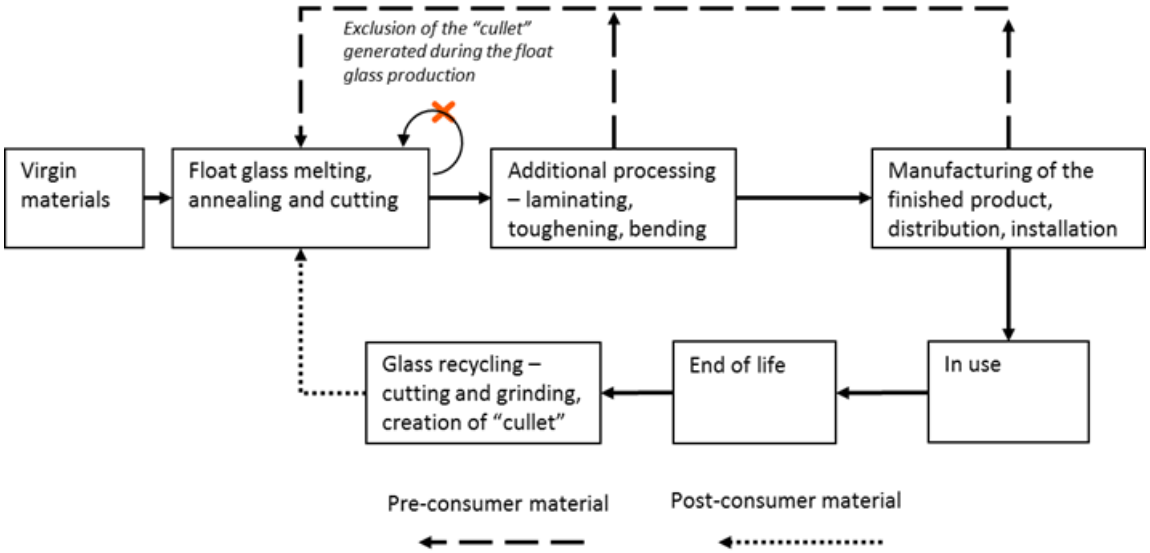


Figure 4 : Schematic diagram to distinguish pre-consumer and post-consumer recycled material in glass

Float glass is manufactured using virgin materials mixed with cullet, which corresponds to recycled glass. The cullet comes from different origins and, depending on its origin, may be considered as **pre-consumer** or **post-consumer materials** in certain cases:

- Cullet originating from float glass manufacturing, i.e. furnace process, shall not be considered as **pre-consumer recycled material**.
- Cullet originating from off-cuts and losses occurring during additional processing shall be considered as **pre-consumer recycled material**. The processing could be at the same facility as the production furnace but, in this case, it is separated to the float glass manufacturing process.
- Cullet originating from off-cuts and losses happening during the manufacturing of finished products (e.g. insulating glass units (IGU)) shall be considered as **pre-consumer recycled material**.
- Cullet originating from off-cuts and losses during distribution and installation of finished products shall be considered as **pre-consumer recycled material**. This approach has been validated in EN 17074 and represents an exception to the **pre-consumer recycled material** definition in 3.2.
- Cullet originating from glass recycling operations of flat glass wastes after the product reached its EoL shall be considered as **post-consumer recycled material**.

4.3 Traceability

When reliable technologies for an analytical determination of the **recycled content** in a material or product are not available, traceability information from both the recycled and the virgin materials are needed to calculate the **recycled content**.

In this case the supplier of the **recycled material** shall provide information allowing traceability. The level and type of information recorded is expected to be varying. Apart of the quantity of **recycled material** it may include information as:

- type of material the **recycled material** originates from
- processing techniques of the **recycled material**
- tests carried out before/after processing
- suitable applications for the **recycled material**

The level of detail for this information shall be defined by product-specific standardisation committees. All procedures for the identification and the recording of the data shall be appropriately documented and recorded. The required level of detail will depend upon the type of material (e.g. glass, plastics, metal, etc.

Note: In general, a technical method to measure the **recycled content** in a product, which are reliable, accurate and reproducible, is not available. Therefore, the verification of **recycled content** is based on paper documentation only. Thus a mandatory proportion of **recycled content** as market entrance criteria for ErP is discouraged.

The traceability of information can be achieved through the implementation of different Chain of Custody (CoC) models as:

1) Identity Preservation
2) Physical Segregation
3) Mass Balance

The three models correspond to different levels of traceability objectives:

In case of Identity Preservation each batch of **recycled material** shall be uniquely traced through the production process from the point of origin to the last point of transformation.

In a Physical Segregation model **recycled material** shall be kept separate from non-**recycled materials** through each stage of the supply chain allowing assurance that the **parts** within a particular product originate from **recycled materials**, though it may not be possible to identify which molecule came from which batch of recycled source.

In the Mass Balance model the volume of **recycled materials** entering the operation in a period of time is controlled and an equivalent volume of material leaving the operations may be claimed as recycled. The physical mixing of **recyclable** and non-**recyclable materials** is allowed. Balance of material volume may be applied at batch level, production site level or company level. The **recycled content** claim may be allocated to any physical product leaving the system, independently from its physical composition, as long as the volumes are appropriately balanced.

Considering the complexity of implementation of a traceability system, Mass Balance is the most feasible of the above mentioned methods. Product-specific standardisation committees shall establish a Mass Balance verification scheme, taking into account:

- traceability of each individual item of waste is not realistic, and not necessary for **qualified recycling processes**. The traceability should start from the sorting centres for household waste and EoL products. In case of industrial waste traceability should start from the material/product producer or converter, where the waste originates from.

- each economic operator in the chain of custody is responsible for the data supplied in the product declarations submitted to the next economic operator. The validity of these declarations shall be assessed through a conformity assessment carried out by an accredited conformity assessment body.

5 Reporting

5.1 General

The assessment of **recycled content** shall be documented in a report.

The assessment report shall be considered as confidentiality level 3 in accordance to prEN 45559:2019.

The assessment report shall contain any data and information of importance for any results published in confidentiality level 2 or 1.

Special care shall be taken to demonstrate transparency and the correlation between information of the results of the assessment and the data and assumptions used in the assessment.

5.2 Elements of the assessment report

The results, conclusions, data, methods, assumptions and limitations shall be completely and accurately reported.

The project report shall give the following:

a) General aspects
   1. Company name and address
   2. Date of the report
   3. Statement that the assessment has been conducted according to the requirements of this standard

b) Scope of the assessment
   1. Product description (type or family)
   2. A description of the material management system
   3. A description of the manufacturing process included in the assessment
   4. A description of cut-off rules applied

c) Detailed material and product description
   1. Bill of materials
   2. List of parts

d) Recycled material content calculation
   1. Accounting period for the calculation
   2. Results of the calculation

5.3 Documentation

The assessment reports shall include any documentation or references to the documentation used for the assessment.

If generic data are used for the assessment, these must be referenced and the use must be justified.

Bibliography

[1] EN 50625, *Collection, logistics & Treatment requirements for WEEE*

[2] EN 50574, *Collection, logistics & treatment requirements for end-of-life household appliances containing volatile fluorocarbons or volatile hydrocarbons*

[3] ISO 14021, *Environmental labels and declarations - Self-declared environmental claims*

[4] CEN 15343, *Plastics - Recycled Plastics - Plastics recycling traceability and assessment of conformity and recycled content*

[5] CEN 15347, *Plastics - Recycled Plastics - Characterisation of Polypropylene (PP) recyclates*

[6] UL ECVP 2809, *Environmental Claim Validation Procedure (ECVP) for Recycled Content*

[7] SCS 2014, *Recycled Content Standard, V7.0, Environmental Certification Services, SCS*