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Packaging for detergent and stain removers

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Nordic Swan Ecolabel criteria influence on recyclability of packaging for detergent and stain removers

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1. Executive Summary

Packaging requirements for detergents and stain removers

Overall summary

Purpose of study

The study intends to evaluate the impact of the Nordic Swan Ecolabel criteria on packaging for 'Detergents and stain removers' regarding the recyclability of the packaging.

Effect of packaging design

Packaging design alone cannot ensure high circularity for packaging. Collection systems and sorting are also key aspects that influence the availability of recycled plastic. Design for recycling can help to ensure that packaging will be sorted correctly and that the quality is high enough for the material to be used in new products without too much downgrading. Setting design criteria for recycling should keep a balance between ensuring the functional properties as packaging material and making the packaging recyclable.

1.5 to 2.7 kg CO2e can be saved every time 1 kg plastic is being recycled instead of incinerated[1]

Method

The evaluation is based on results of a review of relevant literature and design guidelines and 4 semi-structured interviews with relevant stakeholders. The stakeholders have in some areas diverging perspectives based on their specific positions and experiences.

As agreed, the impact is discussed qualitively since quantifying the impacts would be subject to large uncertainties.

Result

The study found that the criteria are largely aligned with design guidelines for improved recycling. Interviewees also agreed that compliance with the requirements would increase recyclability of packaging in this product category - detergents and stain removers - and thereby achieve a positive impact on the greenhouse gas emissions.

The criteria set requirements that aim to:

1) Create a demand for recycled plastic in the packaging
2) Increase the recyclability both through ensuring correct sorting (yield) and limiting contaminations (quality)

The yield from recycling is mainly determined by the use of monomaterial in the most common polymer types and avoiding non-detectable colors, which the requirements address. The quality is affected by contaminants such as non-compatible labels, additives, silicone or metal on which the Nordic Swan Ecolabel sets multiple requirements, all of which are deemed relevant.

The study also found some areas where the interviews and the literature review showed potentials for further development of the criteria. These should however be subject to more detailed investigation, to ensure the market is able to adapt.

1 https://plastikviden.dk/plastik-i-tal/#:~:text=Genanvender%20vi%201%20kg%20plastik,2%20mindre%20ud%20i%20atmosf%C3%A6ren

Packaging requirements for detergents and stain removers

Main conclusions from evaluation of the individual criteria

Keeping to PE, PP and PET

Keeping to the three main polymer types PE, PP and PET, as required by the Nordic Swan Ecolabel, is important to ensure the best possible recycling.

The interviews disclosed diverging positions about use of PET for packaging of detergents and stain removers. From a recycling perspective, it is beneficial to decrease the amount of non-food PET entering the waste stream, as this increases the possibility of PET from household waste being recycled into new food packaging. However, PET has some aesthetic and functional qualities and is highly recyclable, so it might not be a long-term solution to completely exclude PET from the product group. In the future, sorting technology might allow to separate non-food PET from food-PET.

Labels

For PP and PE, it is generally preferable to create the label in the same polymer as the main polymer, or at least to ensure that the label does not cover too much of the product, as this increases the risk of the product being sorted into the wrong fraction. The criteria are well aligned with guidelines, allowing maximum coverage of 60%, but it could be investigated if it is possible to use labels in the same polymer as the packaging.

Paper labels with fiber loss are detrimental to the recycling process. If the paper does not have fiber loss, as required as a part of the Nordic Swan Ecolabel requirements, it is less problematic, but is still less compatible than plastic labels.

Additives and barriers

The use of EVOH barriers is problematic for the recycling, especially in larger amounts. The criteria set limits on the use of EVOH barriers that are generally in line with guidelines. It could however be investigated whether other barriers can be used, which are less problematic for the recycling.

Fillers such as CaCO3 are problematic for the recycling process, especially if it changes the density of the material. The criteria define a limit on the amount of CaCO3 that can be added to ensure the density is not altered to a degree where it is problematic for the recycling process.

Metals and silicone

The criteria set restrictions on use of metals and silicone, which lowers the risk of contaminating the recycled plastic.

Recycled plastic

Dansk Erhverv highlights that you should “Aim for as high a proportion of recycled material as possible, without compromising the product function, or the consumer and product safety“[1]. A key aspect found in the interviews is, that the demand is higher than the supply of post consumer recycled (PCR) plastic. This means that the requirements of using a minimum amount of PCR in the product can be challenging to fulfill.

Colors

Currently the requirements do not allow the use of any color in PET but sets restrictions on the use of carbon black in PE and PP. Keeping the plastic transparent, colorless or in light colors is important for the value of the recyclate. Based on the study, it is suggested to look into the possibility to further limit the use of color in PP and PE.

1. detailsektorens-designguide-for-plastemballage.pdf (danskerhverv.dk)

2. Introduction and methodology

Introduction

What are we looking at

The Nordic Swan Ecolabel sets criteria for a broad selection of products, in order to minimize the impacts on the environment, the climate and our health. Some of the product categories that The Nordic Swan Ecolabel has worked with are different products for cleaning and personal care products. The criteria covers both the core product (content) and the packaging, but this study singles out the packaging, in order to evaluate the effect of the criteria on the recyclability of the packaging. To do this, the product group 'Detergents and stain removers' has been chosen as a case. Although the criteria varies between the different products within the product categories, the criteria are comparable, and all sets the same goal; to increase recyclability of packaging.

The criteria for packaging of detergents and stain removers is evaluated through literature, as well as interviews with selected stakeholders. The effect on recyclability is qualitatively assessed, and the broader implications of an improvement in recyclability within this product category is discussed.

Introduction

Why are we looking at this

We live in a time which has been dubbed by some ”The plastic age”[1]. Plastic is a versatile material which can be shaped and modified to be used for almost anything. It is used to keep our food protected and fresh, reduces the weight of goods to be transported and is indispensable in our hospital system. However, the production of plastic entails substantial emissions of greenhouse gases both during production and in the situations where it is burned.

Recycling is one way of mitigating these environmental challenges and increasing recycling of collected plastic packaging starts with the design of the plastic product[2,3].

> *“at the manufacturing stage; 80% of environmental pollution and 90% of manufacturing costs are the result of decisions taken at the product design stage.”*[3]

Manufacturers must consider 3 things: 1) the product has to be designed in such a way that, when it has served its purpose, it can be separated into clean, uncontaminated fractions, which can be used again in the production of high-quality plastic. 2) Manufacturers must focus on optimizing their products so that no more plastic is used than is necessary (which is both good for the planet and the bottom line). 3) Manufacturers must think about their products in a reuse economy, where the product can be reused several times before it is thrown in the bin.

Thus, the purpose of this analysis is to determine the effect of the Nordic Swan Ecolabel’s packaging requirements on the design of packaging from a recyclability perspective.

1: After bronze and iron, welcome to the plastic age, say scientists | Plastics | The Guardian
2: Breaking the Plastic Wave: A Comprehensive Assessment of Pathways Towards Stopping Ocean Plastic Pollution | One Planet network
3: https://www.europarl.europa.eu/doceo/document/A-8-2018-0165_EN.html

Methodology

How the study was conducted

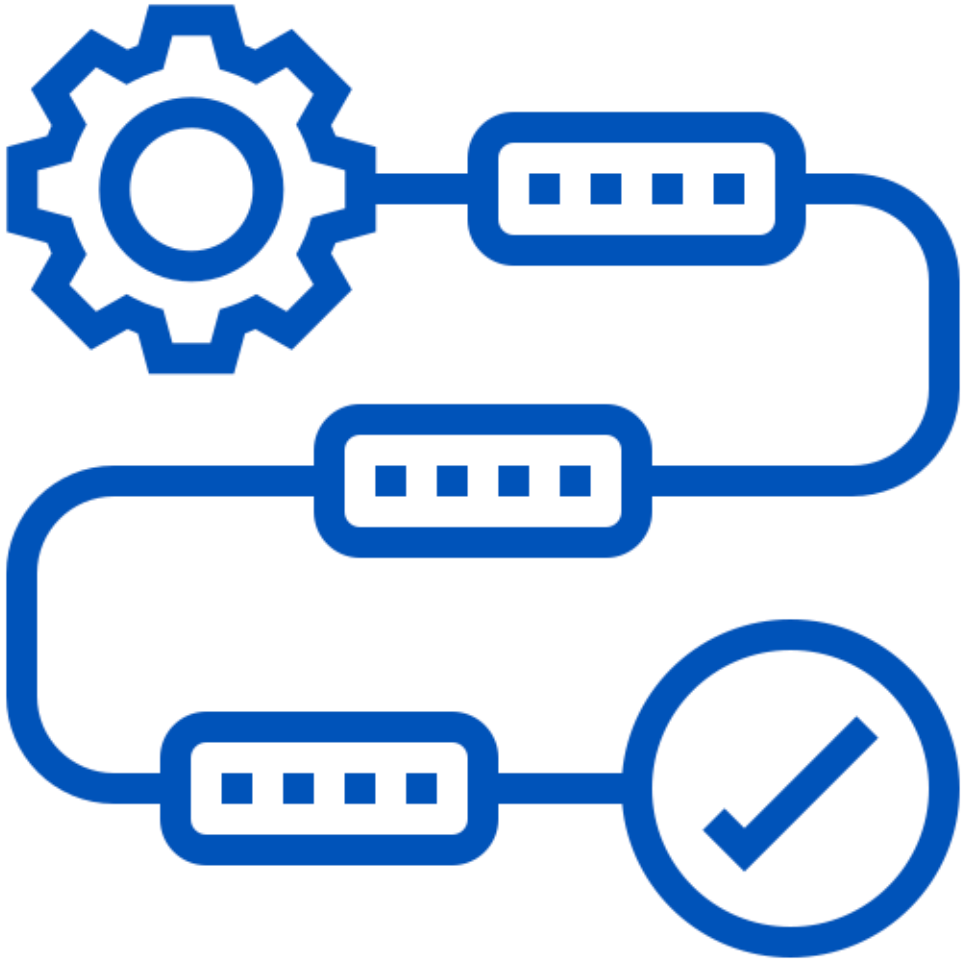
The assessment in this study is based on a literature study reviewing reports and guidelines developed by researchers and organizations and on interviews with relevant stakeholders. First, the requirements were studied through the lens of available literature and design guidelines. The knowledge gained from this exercise was then used to create an interview guide. The interview guide was adjusted based on the interviewee in order to focus the questions on the areas of their expertise. It was decided to limit the interviews to four stakeholders, each with a different relation to packaging of the assessed product group.

The literature study in combination with the interviews were used to make a qualitative assessment of the Nordic Swan Ecolabel criteria's effect on recyclability.

In addition to this, a list of potential changes and additions to the requirements were made, to be used as a basis for further research.

The study only looks at recyclability in terms of mechanical recycling and does not address the challenges and opportunities of chemical recycling. Chemical recycling is not included in the study as it currently accounts only for a minor part of the plastic recycling market (≈1%)

In order to assess the quantitative effects of the criteria, the estimate of the effects of the criteria on the recyclability of the studied product group (in percentage) was combined with data on the household plastic waste composition.



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3. Plastic recycling

Recycling statistics

Description of the plastic waste landscape

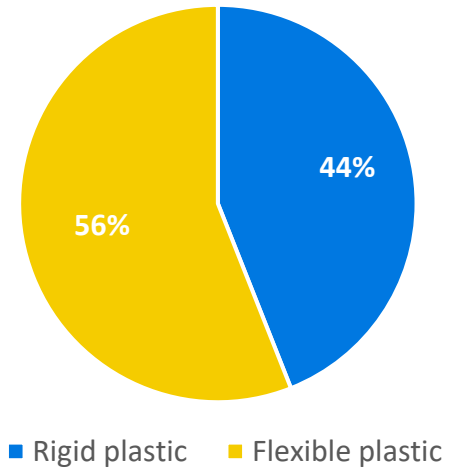
The amount of plastic collected for recycling varies significantly between the Nordic countries, as seen in Table 1. The amount of plastic waste that ends up being recycled is, however, much more similar, indicating that a high collection also entails the collection of more plastic with low recyclability. The average of collected plastic waste that is recyclable is 44% based on the three Nordic countries where data was found.

Table 1: Percentage of plastic waste collected and recycled, and the resulting percentage of the collected plastic, that is recyclable.

	Collected	Recycled	Recyclable
Denmark[1]	31%	14%	45%
Finland[2]	42%	-	-
Iceland[3]	25%	-	-
Norway[4]	35%	18%	51%
Sweden[5]	53%	18%	34%

Products for cleaning and personal care falls within the category of rigid plastics (except pouches and labels if not attached to the main product). The plastic packaging waste from households consist of 44% rigid plastic and 56% flexible plastic, as seen in Figure 1. It is assumed that the distribution is similar for the other Nordic countries.

Figure 1: Plastic waste from Danish households. Share of flexible and rigid plastic[6].



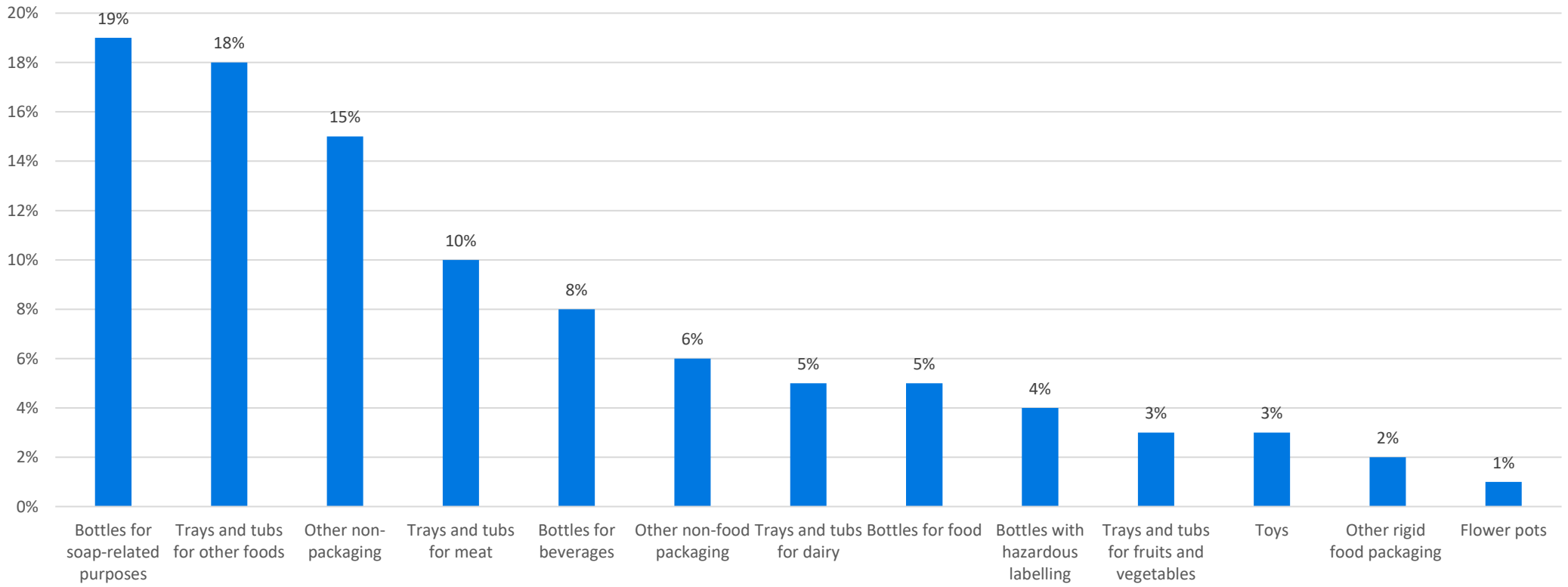
1: Affaldsstatistik 2019 (mst.dk)
2: Packaging statistics | Finnish Packaging Recycling RINKI Ltd (rinkiin.fi)
3:Statistics | Eurostat (europa.eu)
4: Plastemballasje fra husholdninger - Grønt Punkt Norge (grontpunkt.no)
5: Statistik för insamling och återvinning - FTI
6: Characterisation of source-separated, rigid plastic waste and evaluation of recycling initiatives: Effects of product design and source-separation system | Request PDF (researchgate.net)

The product group

Significance of the addressed product category

Around 19% of the rigid plastic waste from households, is made up of products for ‘Soap related purposes’. This category is comprised of both cleaning products and products for personal care, and it is the largest fraction in rigid household plastic waste. The data stems from a study of Danish household waste, but it is assumed that the composition of rigid plastic waste from household in the other Nordic countries is similar.

Figure 3: Composition of rigid household plastic waste[1].



1: Characterisation of source-separated, rigid plastic waste and evaluation of recycling initiatives: Effects of product design and source-separation system | Request PDF (researchgate.net)

Plastic recycling

GHG emissions from production of virgin plastic compared to recycled

Production of virgin plastic emits green house gasses from extraction and refining of crude oil. When plastic is recycled, virgin production is avoided and direct emissions from incineration are avoided as well.

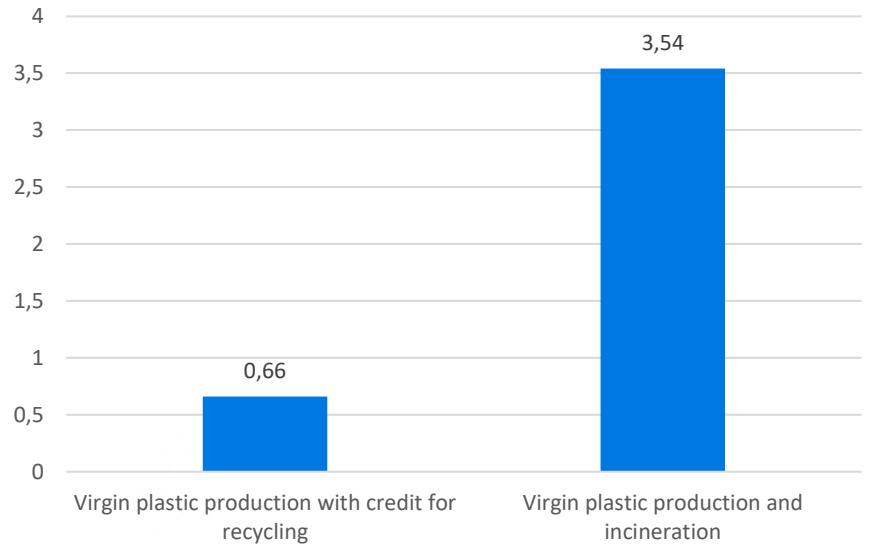
Incineration of plastic leads to direct emission of green house gasses, but the incineration of waste also creates heat and electricity, which substitutes other energy sources. The direct emissions are higher than the avoided[1], and the avoided emissions depends largely on what alternative energy sources the heat or energy replaces.

The calculation only shows the emissions from the plastic that is actually recycled, which means it does not show the efficiency of the Nordic recycling system in general. Plastic that is sorted for recycling but is not recyclable emits more green house gasses than plastic that is sent to be incinerated, as it will have to be transported and attempted recycled at multiple places before it is eventually sent to be incinerated.

Different studies have been conducted to assess the savings in GHG emissions from recycling plastic packaging instead of incineration. Studies show savings of between 1.5 and 2.7 kg CO2e/kg[2].

Figure 2 shows the life cycle emissions from virgin plastic production being recycled or incinerated based on calculations from ecoinvent data.

Figure 2: Production virgin and recycled plastic (PE) (kg CO2/kg)[1]



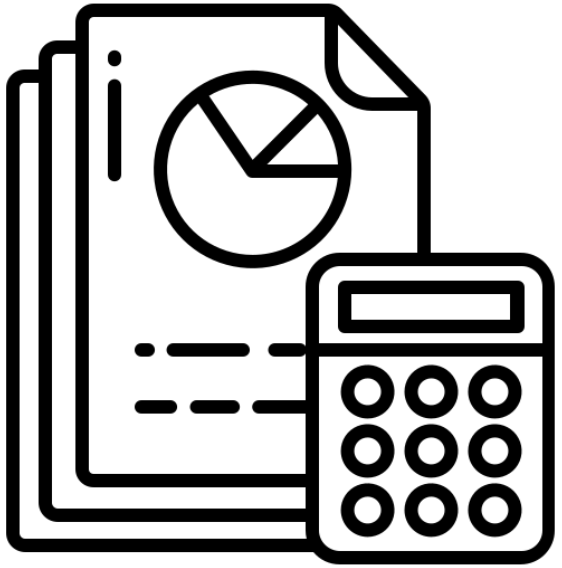
1 Calculated based on data from ecoinvent
2 https://plastikviden.dk/plastik-i-tal/#:~:text=Genanvender%20vi%201%20kg%20plastik,2%20mindre%20ud%20i%20atmosf%C3%A6ren

Impacts from improved packaging design

The Nordic Swan Ecolabel criteria focuses both on increasing the demand for recycled plastic and ensuring design for recycling, which are two aspects mentioned in the European Strategy for Plastics in a Circular Economy[1], as needed to increase circularity of plastic packaging.

Increasing the amount of recycled plastic packaging will depend on both collection and sorting of plastic, recycling technology and the packaging design. Therefore, packaging design alone cannot solve the issue of low recycling rates. It can however positively influence the recycling rate and quality of collected plastic. In the European Strategy for Plastics in a Circular Economy[1] it is mentioned that "(…) design improvements could halve the cost of recycling plastic packaging".

The potential increases in amount of recycled plastics from improved packaging design are difficult calculate, since data is subject to high uncertainty. A study by Kampmann and Astrup[2] suggest that improving the product design of packaging could increase the amount of recycled plastic by 18-23%, based on a case study of rigid plastic packaging.



1: https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf#:~:text=The%20EU%20is%20best%20placed%20to%20lead%20the,2030%20Sustainable%20Development%20Goals%20and%20the%20Paris%20Agreement.

2: Kampmann, M., Astrup, T. (2019): Characterisation of source-separated, rigid plastic waste and evaluation of recycling initiatives: Effects of product design and source-separation system

Recycling technologies

Today the majority of plastic is recycled machnically (≈99%) and only a smaller fraction chemically (≈1%)[1].

Mechanical recycling

The different types of plastic found in household waste cannot be recycled together, as their chemical composition differs[2]. Plastic waste is therefore sorted using machines that can identify which type of polymer the main component of the various waste products are made of. The individual plastic types are then sent to the appropriate recycler. At the recycling plant, the plastic is chopped into pieces, sorted once more, washed and remelted. The product is a granulate that can be used for new plastic products.

Chemical recycling

Much of the plastic that cannot be recycled mechanically might be recycled chemically[1]. One of the most widespread methods is called pyrolysis. This is done by heating the plastic to high temperatures under oxygen-free conditions. This breaks the structure of the plastic and creates products consisting of, among other things, gas, tar and oil.
These can then be used as raw material for e.g. chemical processes, production of fuel or production of new plastics.

1:ECHA (2021), Chemical Recycling of Polymeric Materials from Waste in the Circular Economy
2: Schyns & Shaver (2021), Mechanical Recycling of Packaging Plastics: A Review

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4. Overview of requirements

List of packaging requirements groups

General description

The Nordic Swan Ecolabel takes a holistic view of the environmental impacts for different product groups. For detergents and stain removers criteria generation 8, requirements are also defined for the packaging material. Some requirements include many sub-requirements. These are presented below in the table and evaluated individually in the next section.

Table 2: Overview of the requirements and sub-requirements

	Requirements	Description of sub-requirements	
O19	Recycling and recycled material in packaging	R1	All hard/rigid plastic packaging must contain a minimum 50 % (by weight, calculated on the total mass of the bottle/box/container, closure and label) post-consumer/commercial recycled material (PCR).
O20	Design for recycling of packaging (except pouches)	R2	The individual components of the primary plastic packaging (excluding labels) must be made from monomaterial of polyethylene (PE), polypropylene (PP) or polyethylene terephthalate (PET).
		R3	It is not allowed to add pigments to PET used for box/bottle/container. Colored, recycled PET-granulate where the pigment originates from the recycled material is allowed for use.
		R4	Carbon black pigments can not be added to the box/bottle/container of PE or PP or closures. Exemption is made for small amounts of carbon black used in other colors than black. It must then be documented that the NIR sensor reads and sorts the box/bottle/container or the closure to the correct plastic fraction.
		R5	Silicone is not allowed in closures

List of packaging requirements groups

General description

Table 2: Overview of the requirements and sub-requirements[1]

Primary requirement		Description of sub-requirement	
O20	Design for recycling of packaging (except pouches)	R6	Barriers are not allowed in plastic packaging
		R7	Fillers (such as CaCO3) cannot be included in PE or PP box/bottle/container and closures at a level that the density of the plastic exceeds 0.995g / cm3.
		R8	Metal must not be part of the packaging (box/bottle/container, closure or label).
O21	Design for recycling of flexible plastic pouches/bags and cardboard packaging for liquid products	R10	The plastic packaging (incl. closure, excl. label) must be made from Polyethylene (PE), Polypropylene (PP) or Polyethylene terephthalate (PET).
		R11	The pouch/bag must be made of monomaterial, i.e. not laminates with layers of different materials. Barrier coating of EVOH (Ethylene vinyl alcohol) is allowed in maximum amounts of 2% related to the total weight.

1: Nordic Ecolabel Criteria for Laundry Detergents and Stain Removers https://www.ecolabel.dk/da/virksomheder/kriterier/vis-produktgruppe?produktgruppeid=006&projektgruppe=Svanen#,tab:kriterier

List of packaging requirements groups

General description

Table 2: Overview of the requirements and sub-requirements

Requirement		Description of sub-requirements	
O21	Design for recycling of flexible plastic pouches/bags and cardboard packaging for liquid products	R12	Carbon black pigments can not be added to the pouch or closures. Exemption is made for text and pictograms. Exemption is also made for small amounts of carbon black used in other colors than black. It must then be documented that the NIR sensor reads and sorts the pouch or the closure to the correct plastic fraction.
		R13	Fillers (such as CaCO3) cannot be included in PE or PP packaging (incl. closures) at a level that the density of the plastic exceeds 0.995g / cm3.
		R14	Polystyrene (PS) and polyvinyl chloride (PVC) or plastics based on other types of halogenated plastics must not be present in the label.
		R15	Silicone is not allowed in closures
New	Labels for rigid plastic packaging: Design for recycling of packaging	R16	For containers in polyethene (PE) and polypropene (PP): The following label materials are permitted: Polyolefin plastic labels (PE and PP) as well as PET or PET-G labels with density > 1.0 g/cm3. For labels of different material than the packaging, the suitability must be substantiated in accordance with Recyclass' Washing quick test procedure: For film labels applied on HDPE & PP containers, version 1.0 .
		R17	For containers in polyethene (PE) and polypropene (PP): The following label materials are permitted: Paper labels without fibre loss: The suitability must be substantiated in accordance with Recyclass' Washing quick test procedure: For paper labels applied on HDPE & PP containers, standard laboratory practice, version 1.0.

List of packaging requirements groups

General description

Table 2: Overview of the requirements and sub-requirements

Requirement		Description of sub-requirements	
New	Labels for rigid plastic packaging: Design for recycling of packaging	R18	Containers in polyethylene terephthalate (PET) must have a label of a different plastic material, with a density < 1.0 g/ cm3, or a paper label without fibre loss.
		R19	Polystyrene (PS), Polyvinyl chloride (PVC) and other halogenated plastics must not be used in labels.
		R20	Metallized labels/shrink film labels are not permitted.
		R21	For labels of different material than the packaging: Labels must not cover more than 60% of the container. The calculation of the percentage shall be based on the two-dimensional profile of the container i.e., the area of the top and bottom of the packaging and the sides of a box/ container/bottle/can shall not be included in the calculation. If the label on the front of pack and back of pack are of different size, the maximum percentage of 60% shall be fulfilled for each side separately. For a cylindrical bottle, the calculation can also be based on the three-dimensional profile exclusive bottom and top of the bottle.
		R22	Direct print on the container is not permitted except for date codes, batch codes and UFI (Unique Formula Identifier).

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5. Evaluation of requirements

The Interviews

In order to gain additional insights to evaluate the requirements, four interviews were carried out with selected stakeholders. The main goal of the interviews were to establish the influence on recyclability, but one Private Label Producer was also included to gain some insight into the potential challenges the requirements can create. It is thus important to clarify that the insights from the interview can only give indications on the challenges and no conclusion can be drawn from this interview.

The interviewees are briefly introduced in the table below. The interviewees are not referred to using their actual names, but instead given names reflecting their relevance to the product group and requirements evaluated. These are also the names that will be used when referring to the interviewees throughout the evaluation.

Interviewee	Description
Private Label Producer	Producer of private labels for both laundry detergents, cleaning and personal care products.
Expert	Municipal expert with extensive knowledge on waste & resource management.
PET Recycler	Recycler of PET from households (PCR PET). Uses float-sink separation and mechanical recycling with BAT. Recycles into food grade PET products.
PE/PP Recycler	Recycler of PE and PP, among other plastic types. Uses float-sink separation and mechanical recycling with BAT.

R1

On the content of post-consumer/commercial plastic in the packaging

General recommendation based on literature

Requiring a high amount of PCR[1] in plastic products is viewed as a good solution to create larger demand for PCR plastics, thus creating a better business case for plastic recycling[1]. The Danish retail sector describes that you should "Aim for as high a proportion of recycled material as possible, without compromising the product function, or the consumer and product safety" – Dansk Erhverv[2]

There is an established market for recycled PP and PE[3]. For PET on the other hand, the demand is high for recycled PET from food packaging, which is considered high quality, while a some of the non-food PET is of relatively low quality and therefore one of the most difficult fractions to sell[3].

Insights from interviews

The Expert and the PET Recycler both agreed that it was generally a good requirement, but as the requirements allow for the use of PET, it would risk removing food-grade PET from the waste stream. The Private Label Producer mentioned that there was a current supply limitation on PCR, which made it more difficult to meet the requirement, and that they had difficulties acquiring enough non-food grade PCR PET for their production. The Expert wished to emphasize that packaging producers need to conduct toxicity analyses of the PCR plastic, if it is non-food grade.

The Private Label Producer voiced the concern that for some of their products, where up to 50% (by weight) of the product had to be made in virgin plastic due to a need for high material strength, it was difficult to meet the 50% PCR requirement.

Sub-conclusion

The requirement of 50% seem to strike a good balance, as the aim should be to require as high a proportion of PCR as possible, but still allow packaging producers to meet the target, both considering the supply of PCR compared to demand, and the technical property requirements.
It could be relevant to investigate the possibility of relaxing the requirement on products where a large percentage of the products mass has high material property requirements.

1. Post-consumer/commercial recycled material is defined in the requirement according to ISO 14021:2016: *"Post-consumer/commercial" is defined as material generated by households or by commercial, industrial and institutional facilities in their role as endusers of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.*
2. detailsektorens-designguide-for-plastemballage.pdf (danskerhverv.dk)
3. Plastindustrien : Designguide – Genbrug og genanvendelse af plastemballager til de private forbrugere (2019) https://plast.dk/2019/12/ny-designguide-skal-sikre-mere-genbrug-og-genanvendelse-af-plastemballage/

R2, R10 & R11

On the use of mono-materials in PE, PP and PET (fossil or biobased) for all components but the label

General recommendation based on literature

It is important to limit the number of plastic types on the market in order to create homogenous plastic waste streams, that are large enough to entail that recycling of the plastic type is economically feasible. The three main plastic types on the market are PE, PP and PET. As pointed out in regard to PS:

"PS is too uncommon in the packaging materials stream to make recycling economically viable. As a result, it is rarely sorted from household waste and recycled, with the majority of it incinerated or landfilled."[1]

It is also essential that the plastics are kept in mono-material, as plastics consisting of multiple polymers can not be recycled or only recycled into low quality applications. This is also the recommendation from Kampmann, M., Astrup, T, who suggest to "Regulate the design of PET, PE and PP packaging, so that no black or multi-polymer packaging products are allowed"[2]

Insights from interviews

The Private Label Producer agrees that it is important to keep the plastic in these three types but says that all their rigid packaging products are already mono-material and in these plastic types.

On the other hand, The Private Label Producer have had historic difficulties creating an alternative pouch in monomaterial. They have made a new pouch type in monomaterial that does not use EVOH or any added barrier, but there is a larger waste in production and the barrier properties are not as good. However, they see the change as a necessity to facilitate recycling.

The PET Recycler and the PE/PP Recycler agrees that it is essential for the quality of the recyclate that the individual plastic parts of the products are mono-material.

Continued on next slide

1: 2021-Plastics-All-Golden-Design-Rules-One-Pager.pdf (theconsumergoodsforum.com)
2. Characterisation of source-separated, rigid plastic waste and evaluation of recycling initiatives: Effects of product design and source-separation system | Request PDF (researchgate.net)

R2, R10 & R11 - Continued

On the use of mono-materials in PE, PP and PET for all components but the label

General recommendation based on literature

PET is mainly used for packaging of food items, and there are regulations stating that recycled PET can only contain 5% PCR PET that is not food-grade, if it is to be used for food packaging[1]. Allowing the use of PET in non-food items, thus risk polluting the food-grade PCR PET waste stream.

According to Plastindustriens Design guide, it might however be problematic to exclude the use of PET for all non-food purposes, since some packaging producers need the barrier properties given by PET[2].

Insights from interviews

Both the PET Recycler and the Expert saw it as problematic, that PET was allowed in these types of product, as it contaminates the PET waste stream, with low quality PET, that can not be used in food-grade applications. It was mentioned that there is an ongoing project that is trying to create a digital watermark technology, for identifying and separating non-food from food-grade plastics, called the HolyGrail 2.0 project[3]. If/when this is implemented it will mitigate the issue of using PET in non-food applications.

Sub-conclusion

Using only the most common polymer types in mono-material is important in order to increase recyclability and improve the economic feasibility. For rigid plastic products it might be something that the producers already live up to, whereas for flexible plastic products such as pouches, it might be challenging for the producers to do. The inclusion of PET for this application is problematic from a recycling perspective, as it can contaminate the PCR PET waste stream with PET that is not food-grade. According to Plastindustriens Design Guide, some Packaging Producers need the barrier properties given by PET, which makes it difficult to exclude its use in this product category. It could however be assessed whether this is the case for all detergents and stain removers. In the future, it might be possible to separate non-food from food-grade PET in the future.

1: Safety assessment of the process 'Krones' used to recycle post-consumer PET into food contact materials | EFSA (europa.eu)
2: Plastindustrien: Designguide – Genbrug og genanvendelse af plastemballager til de private forbrugere (2019) https://plast.dk/2019/12/ny-designguide-skal-sikre-mere-genbrug-og-genanvendelse-af-plastemballage/
3: HolyGrail 2.0 Banebrydende sorteringsteknologi til emballageaffald (danskretursystem.dk)

R3, R4 and R12

On the restrictions on pigments in PET and general ban of Carbon Black

General recommendation based on literature

Recycled plastic without color or with light colours has a higher market value, than colored plastic[1]. However, it is difficult for the recyclers to keep their recyclate colorless, as there will most likely be impurities in the plastic waste from consumers.

Plastic colored with carbon black is not detectable with the commonly used near-infrared (NIR) sorting technology, and thus end up being sent to incineration[2]. Thus, carbon black should be avoided in plastic products.

Insights from interviews

The Private Label Producer does not see a need for color at all in this product category. The desired differentiation between products can be acquired with the label. Carbon black is also not necessary and can in any case be substituted with another less black coloring.

The recyclers do not receive much plastic with carbon black, as it does not get sorted. It is also difficult for their buyers to paint the PCR white, if it contains carbon black, which lowers the market price.

The recyclers both say that plastic without color has a higher value. However, the PET Recycler states that it is difficult to keep the recycled plastic colorless.

The PE/PP Recycler thought that the requirements lacked a bit on color in terms of how much color is allowed and migration limits.

Sub-conclusion

Keeping plastics colorless increases the market value and thus also the incentive to recycle it. The use of Carbon Black might result in the plastic not being detected by the NIR sorting technology. It is difficult for the plastic recyclers to keep the recyclate colorless, as there will often be impurities in their input material. Thus allowing color stemming from the recycled material is a good idea. It was indicated in the interviews that limits on the amount of color and migration levels could be added in the criteria.

1 Plastindustrien: Designguide – Genbrug og genanvendelse af plastemballager til de private forbrugere (2019) https://plast.dk/2019/12/ny-designguide-skal-sikre-mere-genbrug-og-genanvendelse-af-plastemballage/

R5 & R15

On the restrictions on silicone in closures

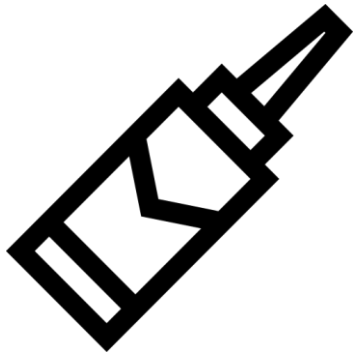
General recommendation based on literature

The use of silicone is especially problematic in closures on plastic products, if it can not be separated from the plastic during the recycling process[1,2]. If a silicone closure is used on a PP or PE product, it is important that the silicone has a density above 1 g/cm^3, so that it separates from the main polymer during float-sink separation. If used on a PET product it should be below 1 g/cm^3.

If silicone is used, the best case is that it is lost to the waste stream and send to incineration. Therefore, to minimize waste, it would be preferable to not use silicone at all.

Insights from interviews

The PET Recycler did not see an issue in silicone being used in the closures, as it can be washed off and separated from the plastic. The PE/PP Recycler on the other hand, viewed this requirement as very important, as silicone have critical quality implications if not removed in their process. The Private Label Producer had spent a lot of effort on R&D to develop an alternative to using silicone in their closures. They have managed to create a functioning alternative in TPE, however, although it works it does not perform as well as the silicone. They did agree that it was a good idea to move away from the use of silicone in closures.



Sub-conclusion

Silicone can be detrimental to the recyclate quality if not removed. If removed, the silicone is not recycled. Thus, in order to create a circular product, silicone in the closures should be avoided. Therefore, excluding the use of silicone in closures has a positive effect on recycling. However, it was indicated in the interviews that it was difficult to find alternatives.

1: The Association of Plastics Recyclers | APR Design® Guide (plasticsrecycling.org)
2: Grønt Punkt: Basic Facts Report on Design for Plastic Packaging Recyclability (2017)

R6 & R11

On the restrictions on barriers

General recommendation based on literature

The use of EVOH in PP and PE plastics contaminates the recyclate, as it cannot be separated mechanically[1]. It is, however, acceptable for the recyclers in quantities if it only constitutes a certain level the plastic mass. What this level is differs between design guides, between platics and depending on the tie layer used[2,3]

The APR design guide allows EVOH at 5% for PE if it includes 32 mol% ethylene, 3% EVOH for PP and no barriers for PET.[2]

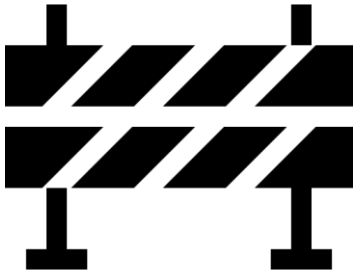
The Recyclass designguide allows only 1% EVOH for PE and non for PP, if a compatible tie layer is not used. EVOH up to 6% is, however, allowed for both plastics if a PP/PE-g-MAH tie layer with MAH > 0.1%wt and EVOH:Tie layer ratio less than or equal to 2 is used. For PET a SiOX plasmas coating is viewed as fully compatible.

Instead of EVOH it is recommended to look into the use of other barriers such as SiOx and AlOx[1].

Insights from interviews

The PE/PP Recycler views the use of EVOH as problematic but can handle it as long as it constitutes less than 2% of the plastic mass. AlOx powder on the other hand, is not an issue.

The PET Recycler views any use of barriers as an issue, as it lowers the quality of the recyclate.



Sub-conclusion

The use of EVOH barriers is problematic for the recycling, but it can be managed in the PE/PP waste stream if it constitutes under 2% of the plastic mass. All barriers are detrimental in the PET recycling, but AlOx powder was not an issue in the recycling of PE/PP.

1: Ny designguide skal sikre mere genbrug og genanvendelse af plastemballage | plast.dk
2: The Association of Plastics Recyclers | APR Design® Guide (plasticsrecycling.org)
3: Design for Recycling Guidelines - RecyClass

R7 & R13

On the use of fillers (such as CaCO3)

General recommendation based on literature

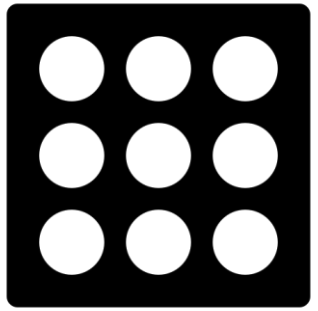
There are PS, PP and HDPE products on the market which contain up to 50% CaCO3. CaCO3 has a density of 2.71 g/cm3, which means that it significantly influences the density of the packaging material[1].

The use of CaCO3 fillers is detrimental to the recycling of PP and PE, if it increases the density of the plastic so that it is higher than that of water (>1g/cm3), as this will cause the plastic to sink in the float-sink separation process[2]. However, even when the density of the plastic is kept below 1 g/cm3, the presence of CaCO3 can negatively impact the quality of the recyclate – although it is not detrimental to the recycling process[3].

Insights from interviews

The Private Label Producer does not use it in their products. The PET Recycler also does not see it present in the plastic that they receive. For the PE/PP Recycler it is not seen as an issue as long as the density of the plastic is kept below 1 g/cm3.

The Expert think that the use of CaCO3 in the plastic might limit the market for the recycled material, as there are fewer buyers looking for plastic with those properties.



Sub-conclusion

Using fillers such as CaCO3 is problematic for the recycling process as it changes the density of the material. This is especially the case for larger amounts. The PE/PP recycler did not see it as an issue in recycling PE and PP, as long as the density of the plastic remains below 1 g/cm3. The use of fillers might, however, result in a lower value recyclate.

1:Grønt Punkt: Basic Facts Report on Design for Plastic Packaging Recyclability (2017)
2:Design for Recycling Guidelines – RecyClass
3: Methodology - RecyClass

R8 & R20

On the restriction of metal, metallized layers and metallized labels

General recommendation based on literature

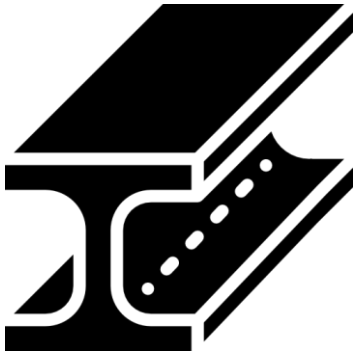
If larger items of metal are present in the plastic packaging, it can both result in the plastic item being sorted as metal by the NIR machine, which means that the plastic is not recycled, or if the metal is not detected, it can damage the cutting machinery, that cuts the plastic into smaller pieces before the float-sink separation[1]. The use of metal in labels is generally listed as problematic according to an assessment by Grønt Punkt[2].

"Large items [of metal], or items adhesively bonded to the PE [or PP], can damage the machinery and render the entire package non-recyclable"[1]

Insights from interviews

Both the Expert and the PE/PP Recycler did not see an issue in metallized layers being used for this product group. If larger pieces of metals are used in the packaging material. However, the Expert said that the plastic and metal composite would be send to the metal recycling. The PE/PP Recycler said that larger pieces of metal composites can be an issue for the recycling process.

The PET recycler found metallized labels to be unwanted, as they washed of the labels and sold them to PE/PP recyclers, who then would have more difficulties recycling it. The PE/PP Recycler said that metallized labels could in theory be recycled similarly to other plastic labels, but were currently washed off, in order not to compromise the quality of the output. At the PE/PP Recycler the labels were not send to recycling after they were washed of.



Sub-conclusion

Larger metal items should be avoided as they can both result in the plastic being sent to metal recycling, and if not detected, can damage the machinery during the recycling process. Metallized labels were seen an unwanted as they lowered the quality of the recyclate and made the labels washed off in the PET recycling process harder to sell. Metallized layers was not seen as an issue in the recycling of PE and PP by the PE/PP recycler.

1: The Association of Plastics Recyclers | APR Design® Guide (plasticsrecycling.org)
2: Grønt Punkt: Basic Facts Report on Design for Plastic Packaging Recyclability (2017)

R14 & R19

On the use of PS, PVC or halogenated polymers in cardboard packaging and labels

General recommendation based on literature

As mentioned in relation to R2, R10 & R11 it is best to keep the amount of used polymer types to a minimum, and ideally limit it to PE, PP and PET. Furthermore, PVC can be problematic if it ends up in the waste streams of other plastics.

"It [PVC] can be problematic if in the recycling stream by disrupting the recycling of some other plastics" [1]

Insights from interviews

Both the PE/PP Recycler and the PET Recycler agreed that PVC and PS should not be allowed. The PET Recycler stated that PVC can create benzenes when recycled, which is very problematic - especially if the recycled plastic is used for food-packaging. The PET Recycler also said that PS is on its way out, and as fewer plastic types on the market means better and more profitable recycling it should also be removed from plastic packaging applications. The PE/PP Recycler stated that both PVC and PS were problematic for the recycling process if not removed.

Sub-conclusion

Limiting the number of plastics on the market is, as discussed earlier, favorable for the plastic recycling. PVC can furthermore pose a health risk when recycled, especially if it ends up in food packaging. Both of the plastic materials would be problematic if it was not removed from the PE, PP and PET before recycling.

1 2021-Plastics-All-Golden-Design-Rules-One-Pager.pdf (theconsumergoodsforum.com)

R16 & R18

On the permitted plastic materials in labels and their compatibility with the main polymer

General recommendation based on literature

For PET containers the label should be in a different polymer and have a density below 1 g/cm3[1]. For PE and PP containers it is best if the label is in the same polymer as the container, however, combining PE and PP is acceptable.

Insights from interviews

The PE/PP Recycler and the PET Recycler agreed that it would be problematic if labels in a material not compatible with the main polymer did not come off. For the PET Recycler, labels would always have to come off, as the label is not food-grade, thus the label on food grade PET containers should never be in PET. The PET Recycler did not see any reason for using PET-G in labels, but believed it to be manageable in labels [on PE and PP containers], however, PET-G is generally undesired in the waste stream.

Labels in PET are washed off from PE and PP and not recycled, according to the PE/PP recycler. On the other hand, the PET Recycler said that labels in PE or PP on PET containers were washed off and sold to recyclers.

Sub-conclusion

It is important that the labels are compatible with the main polymer. Labels in PE and PP can always be used, as they are recycled with the plastics when used on PE and PP and washed off and sold when used on PET. PET-G and PET will be washed off and not recycled, if used on PE and PP containers.

1: Design for Recycling Guidelines - RecyClass

R17

On the use of paper labels without fiber loss

General recommendation based on literature

Paper labels without fiber loss is not detrimental to the recycling process of PE and PP, as long as they are washed off, and the paper has a density above 1 g/cm3, so that it sinks[1]. On PET, the paper label should have a density below 1 g/cm3, which might not generally be the case. Paper is not seen as fully compatible with any of the three polymers[2].

"Paper labels pulp and become a water filtration and contamination problem if they are processed through a wet recycling process"[1]

"Non-pulping labels, heavy enough to sink and durable enough to withstand the washing process that are used with releasing adhesives may alleviate this issue" [1]

"Non-pulping paper labels that resist the caustic wash process sink in the float-sink tank, thereby causing RPET contamination" [1]

Insights from interviews

The PET Recycler voiced that in case the paper labels dissolves in the float-sink separation tank, it makes the recycling process more difficult, more expensive and ruins the products. The PE/PP Recycler also saw paper labels that dissolved as detrimental to the recycling process, as it created black spots in the granulate.

According to the Private Label Producer, paper labels are used because they are cheaper than plastic labels.

Sub-conclusion

Paper labels with fiber loss are detrimental to the recycling process. If the paper does not have fiber loss, it is less problematic, but it is important that the paper can be washed off effectively, which is required as a part of the Nordic Swan Ecolabel requirements. There is also a need to specify the paper density, as it need to be different for PE and PP than for PET. It would generally be better to use plastic labels.

1: The Association of Plastics Recyclers | PE Film Design Guidance (plasticsrecycling.org)
2: Design for Recycling Guidelines - RecyClass

R21

On the label coverage of the container - Labels must not cover more than 60% of the container if material is different from the main polymer

General recommendation based on literature

Labels on PET containers should be in a size that ensures that the NIR machine recognizes the polymer of the underlying container[1]. For containers in PE and PP it is only important if the label is not in PE or PP. For containers that are larger than 500 ml it should cover less than 70%, for smaller container it should cover less than 50%.

"all products made of multiple polymers have an increased risk of being sorted into the wrong polymer stream during mechanical sorting, as the NIR scanner may detect the polymer of the label or lid and sort it accordingly instead of sorting it according to the polymer of the main product component." – M. K. Eriksen[2]

Insights from interviews

If the label can only cover 60%, it can be difficult for the Private Label Producer to fit all the required information in, without using double labels in PP.

The initial sorting where this can be an issue, is done before it arrives at the recyclers, so they do not know if the 60% requirement is important.

Sub-conclusion

On products where the labels is in a different polymer than the main polymer, it is important that the label does not cover too much of the product, as this increases the risk of the product being sorted into the wrong fraction. There is always a chance of this happening independent of the label size, and thus it is better to keep the label in the same polymer as the main polymer (for PP and PE). However, the Nordic Swan Ecolabel's requirement is in alignment with the guidelines on larger containers, but is a bit higher than the guides on smaller containers.

1 Design for Recycling Guidelines – RecyClass
2: Characterisation of source-separated, rigid plastic waste and evaluation of recycling initiatives: Effects of product design and source-separation system - ScienceDirect

R22

On the use of direct print on the container

General recommendation based on literature

Residues of color from printing directly on the container is accepted in the PP recycling, but not in the reycling of PE and PET[1]. It should, however, be avoided if possible, as specified below for the three main polymers:

"Direct print affects the color and value of the recycled PP, but not the recyclability." - Translated from Forum for Cirkulær Plastemballages Designguide[1]

"If colors from printing is not dissolved during the washing process it compromises the quality of the recycled PE." - Translated from Forum for Cirkulær Plastemballages Designguide[1]

"Print color is unwanted in the recycling stream of the packaging [PET] under all circumstances" - Translated from Forum for Cirkulær Plastemballages Designguide[1]

Insights from interviews

The PET Recycler and PE/PP Recyler did not see print on the container as a problem for plastic that is not intended to be recycled into food-grade applications.

Sub-conclusion

Print directly on the product is always unwanted, as it affects the recyclability of the product and the value of the recyclate. The Nordic Swan Ecolabel only allow direct printing of date codes, batch codes and UFI (Unique Formula Identifier).

1: Ny designguide skal sikre mere genbrug og genanvendelse af plastemballage | plast.dk

Viegand Maagøe

6. Conclusion

Summary of sub-conclusions

The table below presents the sub-conclusions of the previous slides.

Table 3: Summary of sub-conclusions

	Summary of sub-conclusions		Agreement with guidelines
	*On the content of PCR in the packaging*	The requirement of 50% seems to strike a good balance, as the aim should be to require as high a proportion of PCR as possible, but still allow the packaging producers to meet the target, both considering the supply of PCR compared to demand, and the technical property requirements. It could be relevant to investigate the possibility of relaxing the requirement on products where a large percentage of the products mass has high material property requirements or to set the requirement on component level rather than for the whole packaging. However, it was voiced by some of the interviewees that the requirement risks channeling food grade PCR PET into a non-food application.	-
	*On the use of monomaterials in PE, PP and PET for all components but the label*	Using only the most common polymer types in mono-material is important in order to increase recyclability and improve the economic feasibility. For rigid plastic products it might be something that the producers already live up to, whereas for flexible plastic products such as pouches, it might be challenging for the producers to do. The inclusion of PET for this application is problematic from a recycling perspective, as it can contaminate the PCR PET waste stream with PET that is not food-grade. According to Plastindustriens Design Guide, some packaging producers need the barrier properties given by PET. It could however be assessed whether this is the case for all detergents and stain removers. Also, it might be possible to separate non-food from food-grade PET in the future.	High
	*On the use of pigments in PET and general use of Carbon Black*	Keeping plastics colorless increases the market value and thus also the incentive to recycle it. The use of Carbon Black might result in the plastic not being detected by the NIR sorting technology. It is difficult for the plastic recyclers to keep the recyclate colorless, as there will often be impurities in their input material. Thus allowing color stemming from the recycled material is a good idea. It was indicated in the interviews that limits on the amount of color and migration levels could be added in the criteria.	Medium
	*On the use of silicone in closures*	Silicone can be detrimental to the recyclate quality if not removed. If removed, the silicone is not recycled. Thus, in order to create a circular product, silicone in the closures should be avoided. Therefore, excluding the use of silicone in closures has a positive effect on recycling. However, it was indicated in the interviews that it was difficult to find alternatives.	High

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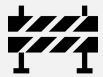	*On the use of barriers*	The use of EVOH barriers is problematic for the recycling, but it can be managed in the PE/PP waste stream under certain circumstances. All barriers have a negative impact on the recyclability, but finding barriers that are compatible with the specific plastic and using appropriate tie layers can mitigate the issue.	High/Medium
	*On the use of fillers (such as CaCO3)*	Using fillers such as CaCO3 is problematic for the recycling process as it changes the density of the material. This is especially the case for larger amounts. The PE/PP recycler did not see it as an issue in recycling PE and PP, as long as the density of the plastic remains below 1 g/cm3. The use of fillers might, however, result in a lower value recyclate.	High
	*On the use of metal, metallized layers and metallized labels*	Larger metal items should be avoided as they can both result in the plastic being sent to metal recycling, and if not detected, can damage the machinery during the recycling process. Metallized labels were seen an unwanted as they lowered the quality of the recycle and made the labels washed off in the PET recycling process harder to sell. Metallized layers was not seen as an issue in the recycling of PE and PP by the PE/PP recycler.	High
	*On the use of PS, PVC or halogenated polymers in cardboard packaging and labels*	Limiting the number of plastics on the market is favorable for the plastic recycling. PVC can furthermore pose a health risk when recycled, especially if it ends up in food packaging. Both of the plastic materials would be problematic if it was not removed from the PE, PP and PET before recycling.	High

Summary of sub-conclusions

The table below presents the sub-conclusions of the previous slides.

Table 3: Summary of sub-conclusions

	Summary of sub-conclusions		Agreement with guidelines
	*On the permitted plastic materials in labels and their compatibility with the main polymer*	It is important that the labels are compatible with the main polymer. Labels in PE and PP can always be used, as they are recycled with the plastics when used on PE and PP and washed off and sold when used on PET. PET-G and PET will be washed off and not recycled, if used on PE and PP containers.	Medium
	*On the permitted non-plastic materials in labels*	Paper labels with fiber loss are detrimental to the recycling process. If the paper does not have fiber loss, it is less problematic, but it is important that the paper can be washed off effectively, which is required as a part of the Nordic Swan Ecolabel requirements. There is also a need to specify the paper density, as it needs to be different for PE and PP than for PET. It would generally be better to use plastic labels.	Medium
	*On the label coverage of the container*	On products where the labels is in a different polymer than the main polymer, it is important that the label does not cover too much of the product, as this increases the risk of the product being sorted into the wrong fraction. There is always a chance of this happening independent of the label size, and thus it is better to keep the label in the same polymer as the main polymer (for PP and PE). However, the Nordic Swan Ecolabel's requirement is in alignment with the guidelines on larger containers, but is a bit higher than the guides on smaller containers.	Medium
	*On the use of direct print on the container*	Print directly on the product is always unwanted, as it affects the recyclability of the product and the value of the recyclate. The Nordic Swan Ecolabel only allow direct printing of date codes, batch codes and UFI (Unique Formula Identifier).	High

Disagreement with guidelines

Table 4: List of elements where the proposed Nordic Swan Ecolabel's criteria are not fully in agreement with the RecyClass Guidelines.

ID	Incompatibility	Effect
D1	Dark colors	**Light downgrading**
D2	Mineral fillers not changing the plastic density	
D3	Paper labels / sleeves without fiber loss	
D4	PP components in HDPE package	
D5	Any material and blend with density higher than 1 g /cm3 (for PET)	**Strong downgrading**
D6	PP components in HDPE packaging > 10%, PE components in PP packaging > 10%	

The above-mentioned incompatibilities with the RecyClass guidelines show areas where the design could be optimized to increase the recyclability. The incompatibilities can however be technically challenging to comply with. It is for instance challenging to avoid using PP components on PE packaging, since PP has some material properties that makes it more optimal for lids and trigger functions.

1: Methodology - RecyClass

List of proposed additions and changes

Potential areas for improving the criteria alignment with guidelines is presented in table 5. The proposed additions are based on the assessment performed. It should however be noted that these should be investigated further specially to see if it is feasible for the market to live up to them.

Table 5: List of proposed changes and additions to the requirements, that would ensure greater alignment with the design guidelines.

Proposed changes	Justification	Improves
Investigate the possibilities for limiting the allowed amount of added color to the components - except label.	As colors reduce the value of the recycled plastic and the interviewed producer sees no reasons to add them, it might be relevant to include a ban or limit on added color to the requirements. It is, however, still important that colors stemming from recycled plastic is still allowed, as it is difficult for recyclers to keep the recyclate completely free from color.	D1
Investigate the possibilities to further restrict the use of mineral fillers	Based on the interviews and assessed guidelines, mineral fillers is found to have a negative effect on the recyclability even when the density is kept above 1 g/cm3.	D2
Investigate if it is possible exclude the use of PET and paper labels	Labels in PET are not food-grade and is currently not recycled when washed off in the recycling process of PE and PP at the interviewed recycler. Paper labels without fiber loss are also not ideal as they are not recycled and are detrimental to the recyclate if they end up not being washed off.	D3
Investigate if all components can be in one polymer for PE and PP products. Or set requirements on maximum amount other plastic present.	It could be an idea to look into the possibility of tightening the requirement, so that all plastic parts in the product were to be made of the same polymer or set requirements on how much of the product can be in a different polymer than the main polymer. This might however be difficult, since the different polymer types have different material properties making the suitable for different purposes.	D4 & D6
Specify the density of paper labels	If paper labels are permitted, it is important that the density of the label is specified so that it is compatible with the polymer. Currently the requirements does not specify that the density of the paper label needs to be less than 1g/cm3 if used on PET containers. This is important as it will otherwise not be removed during the float-sink separation.	D5
Investigate the use of other barriers than EVOH, tie layers and overall compatibility	It came up in the interviews and from the investigated literature, that other barriers than EVOH might exist, that is less detrimental to the recyclability of the plastic. This could be investigated further.	-
Investigate the possibilities of limiting the use of PET for this product type	As it is now, it is not possible to separate PET that is food-grade from PET that is not, when it comes from household waste. Thus using PET in non-food application risk contaminating the PCR PET stream. The opportunities and challenges of limiting the use of PET for this application, until a solutions is on the market that can separate food and non-food plastic packaging, should be accessed further.	-

Summarizing conclusion

Based on the interviews and literature, the requirements set in the Nordic Swan Ecolabel's criteria appears to overall strike a good balance between what needs to be done in order increase recycling yield and quality as well as demand for recycled plastic, and what can be done technically, while maintaining the essential packaging functions and without pushing the packaging producers, to a point where they do not want to partake.

To ensure a good recycling potential, both yield and quality is critical. The most important design factors to increase the yield of recycled plastic is to ensure that the plastic is in monomaterial, sorted correctly and kept in the right polymers. The quality of the recyclate is determined to a large extend by the amount of contaminants in the plastic, that can not be removed in the recycling process. This can stem from things such as non-compatible labels, metal or silicone. Labels made in paper with fiber loss or labels in a non-compatible polymer that can not be washed off, is a large issue for the recyclers. Silicone is also detrimental to the recyclate if it is not washed off, and if it is successfully removed in the recycling process, it is not recycled, and its value lost. Some of the main conclusions from the evaluation of the individual criteria are listed below:

- Keeping to the three main polymer types PE, PP and PET, as required by the Nordic Swan Ecolabel, is important to ensure the best possible recycling
- The use of PET for this product group is highly discussed, and there was not agreement among the interviewees. Looking at this from a current recycling perspective, excluding the use of PET in this product group would be beneficial, as it would result in less non-food grade PET entering the waste stream, increasing the possibility of PET from household waste being recycled into food applications. However, there might be applications where the material properties provided by PET are difficult to meet by other polymers. This can make the complete exclusion of PET from this product group difficult and there are different opinions as to what the best solution is to this issue.

Summarizing conclusion

- The ban on silicone was seen as important for recyclers of PE and PP, and large pieces of metal is also important to exclude from the packaging, as defined in the Nordic Swan Ecolabel's criteria
- The investigation of requirements on label compatibility showed in general good alignment with guidelines, but potentials for tightening the current requirements were identified.
- In terms of using colors, there are potentials for tightening the requirements, as color affects the value of the recyclate. Currently the requirements do not allow the use of any color in PET but sets restrictions on the use of carbon black in PE and PP.

Based on the assessment, some potential areas of improvement were listed. These are aiming to further increase the yield or quality of the recycled plastic. Suggested improvements should, however, be further investigated to ensure that it is possible for packaging producers in general to comply.

Reference list

Guidelines:

APR Design Guide: https://plasticsrecycling.org/apr-design-guide

Dansk Erhverv: Detailsektorens Designguide for Plastemballage (2022) https://www.danskerhverv.dk/siteassets/mediafolder/dokumenter/04-politik/2022/detailsektorens-designguide-for-plastemballage.pdf

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