Colour guide

How to determine the colour of packaging

Netherlands Institute
for Sustainable Packaging
part of **verpact**

FieldLab
Circular
Packaging

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Introduction

The colour of packaging determines its sortability and the possibilities for use after recycling. This document discusses the last aspect, as light colours offer more possibilities for using recycling. This guide provides insight and assistance in determining the colour of the packaging, focusing on transparent, white and natural. The aspects of colour have been mapped out by KIDV and FieldLab Circular Packaging, commissioned by the Packaging Waste Fund (Afvalfonds Verpakkingen).

Why is it important to determine the colour of packaging?

There are two reasons:

1. The colour of packaging or disposable unit is important for the extent to which the recyclate from the packaging can be used.
   a. Transparent and white for PE and PP have a wider range of applications than coloured PE and PP. Transparent and white recyclate can be reused for white or transparent material. But they can also be used in coloured recyclate.
   b. The same applies to natural/transparent PET. Coloured PET can only be used in coloured recyclate. This makes it less widely usable than natural/transparent recyclate.
2. Packaging that is transparent, natural or white is eligible for fee modulation with the Packaging Waste Fund. A lower fee applies for this under certain conditions. More information about fee modulation can be found on the website of the Waste Fund.

The base material of the main component of packaging or a disposable unit can be coloured by mixing a dye into the material. This does not involve decorating the exterior with coatings or inks.

There are several ways to determine the colour of packaging. This is further elaborated in this document.

What is colour?

Colour is a property of light, determined by the different wavelengths of which that light is composed. The colour of an object's surface is determined by the spectrum of light reflected by that surface. The remaining colours are absorbed.[1] For instance, a red material reflects the red spectrum, the rest of the spectrum is absorbed by the material. White reflects almost all light.

The colours that are beneficial for recycling are described below, as well as how to recognise them.

White

Material with a white colour is coloured white (with dye, sometimes called *masterbatch* or pigment) and is not transparent. Pure white is not very common. Often, there is a small deviation towards green or red and/or blue or yellow. There is also often a deviation towards greyish, because not all light is reflected. Regular white packaging often still allows light to pass through, depending on its thickness. So if you hold a cup up to a light source (sunlight or a lamp), you will see the light shining through it. If you hold the light of your smartphone against a bottle, you will see the light through the bottle.

Figure 1 Two examples of white packaging.

Opaque packaging

There is (white) coloured PET packaging that does not allow light to pass through: opaque packaging. These are coloured white using, for instance, titanium dioxide, to such an extent that the packaging has become lightproof. The light from a smartphone lamp does not penetrate the material of white opaque packaging. Examples of such packaging are PET bottles for long-life milk. These are almost non-existent in the Netherlands but they are often used for long-life milk in France. In the Netherlands, such packaging currently has limited value as recyclate.

[1] https://nl.wikipedia.org/wiki/Kleur

Transparent

A material is transparent if light passing through it is completely clear. When a transparent material is placed on text, the text is readable.

Figure 2 Four examples of transparent packaging.

Natural

A material is natural if it is not white and allows light to pass through. Sometimes text is illegible because of the material.

Figure 3 Four examples of natural packaging.

Determining colour

The colour of an object (such as packaging) can be defined, among other things, by the CIELab method. Colours are recorded by placing them on a coordinate of three axes:

- L*: between black and white.
- a*: between green and red.
- b*: between blue and yellow.

In the example in Figure 4, the grey area in the centre is defined by the location on the three axes L*, a*, and b*.
For instance, the L*a*b* value is L*=50, -a*=0, b*=0. Or in short: CIELab = 50, 0, 0. This value can be measured with a spectrophotometer.

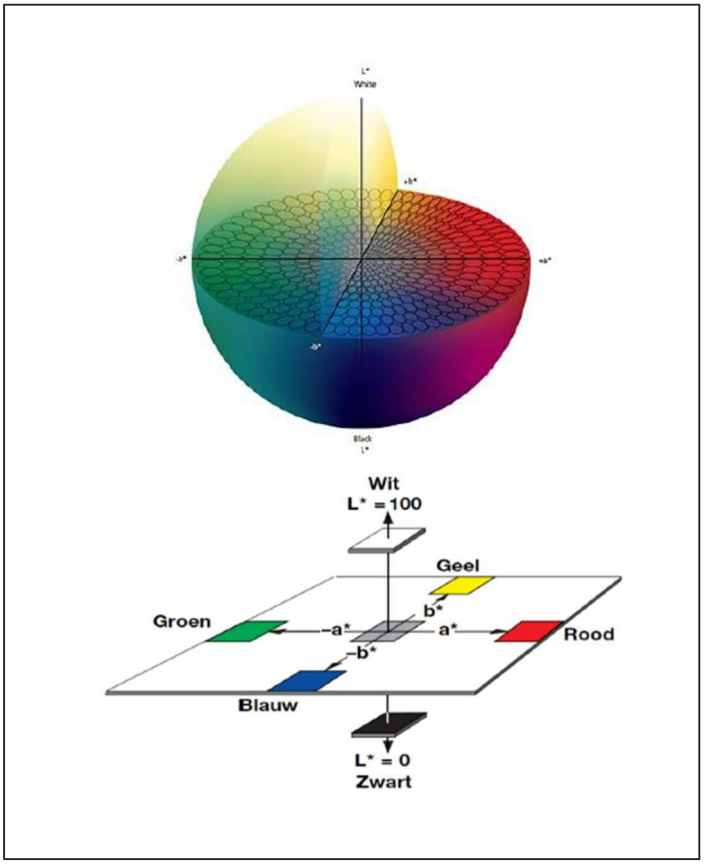

Figure 4 The CIELab method, with the axes: L, a* and b*.*

Colour space

Figure 5 shows an example of the colour space in which a green colour is plotted (indicated in the figure as Colour point). The colour defined on the three axes is L*=93.4, a*=-40.2, b*=81.2

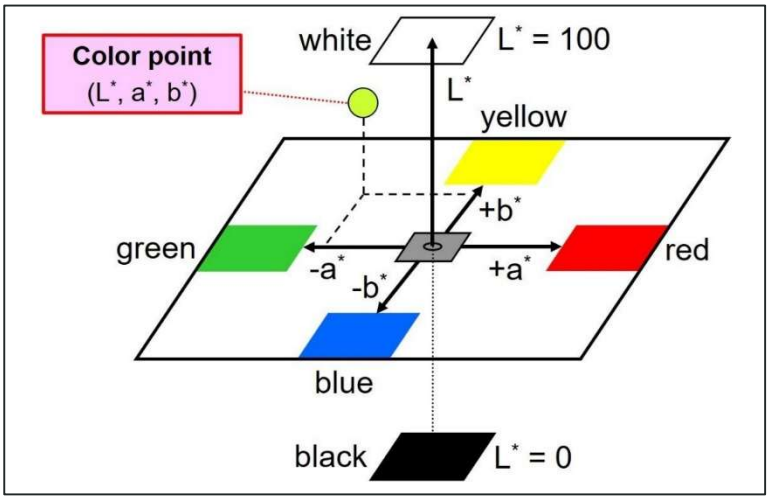

*Figure 5 Example of the placement of a colour (green) on the L*a*b* axes. For the green point (colour point) L*=93.4, a*=-40.2, b*=81.2*

Figure 6 shows an example of the colour space that a white colour must conform to. Too far to the left is too green, too far to the right is too red, too far up is too blue, too far down is too yellow. Darker is too grey. In this example, the colour space for a* is between -2 and 2 and for b* it is between -2 and 2.
The L* value is 90.

Figure 6 An example of acceptable colour space.

The allowed L*, a*, b* values

The FLCP has defined the colour space for packaging as follows, where the L* value is the lower limit and the a* and b* values are the outer limits:

Material		L*	a*		b	
			min	max	min	max
PET	transparent	>90	-2	2	-2	2
PP	transparent natural	>90	-2	2	-3	3
	white	>90	-2	5	-2	5
	white recycled	>85	-2	5	-2	5
HDPE	natural	>90	-2	2	-3	6
	natural recycled	?	?	?	?	?
	white	>90	-2	5	-2	5
	white recycled	>85	>-2	5	-2	5

Figure 7 Acceptable colour space on axes L, a* and b*. No values can yet be established for natural recycled material.*

Assessing the colour of a package

Example for transparent PP:

- Here are four examples of transparent/natural PP packaging.
- It is important that the packaging material is clearly visible. To achieve this, the packaging must be thoroughly emptied and cleaned and the label removed.

Figure 8 Four examples of transparent/natural PP.

Assessment:

- The colour of packaging, white or transparent/natural, can be determined by eye.
- If in doubt, the packaging can be compared with reference packaging that is known to comply.
- If there is still any doubt, the colour of the packaging can be measured with a spectrophotometer and compared with the standard established for the material in question.

Accountability

The KIDV asked the FLCP to develop a practical method that helps to determine the colour of packaging. To this end, the FLCP conducted a desk study and spoke to various relevant parties, such as recyclers and converters and organisations such as Returpack (Sweden), Infinitum (Norway), Recyclass, the National Circular Plastics Test Centre (Nationaal Testcentrum Circulaire Plastics) and Polymer Science Park. In addition, discussions were held with various suppliers of measuring equipment to map out the possibilities and limitations of this equipment.

In Sweden and Norway, the institutions responsible for the PET bottle deposit system have specified the colour space for transparent (and light blue) PET. These specifications have been adhered to in this guide.

For more information on the subject of 'colour', please contact the KIDV. Ask your question via: Vraag.kidv.nl.