CHIRA
CHI Recyclability Assessment

CHIRA

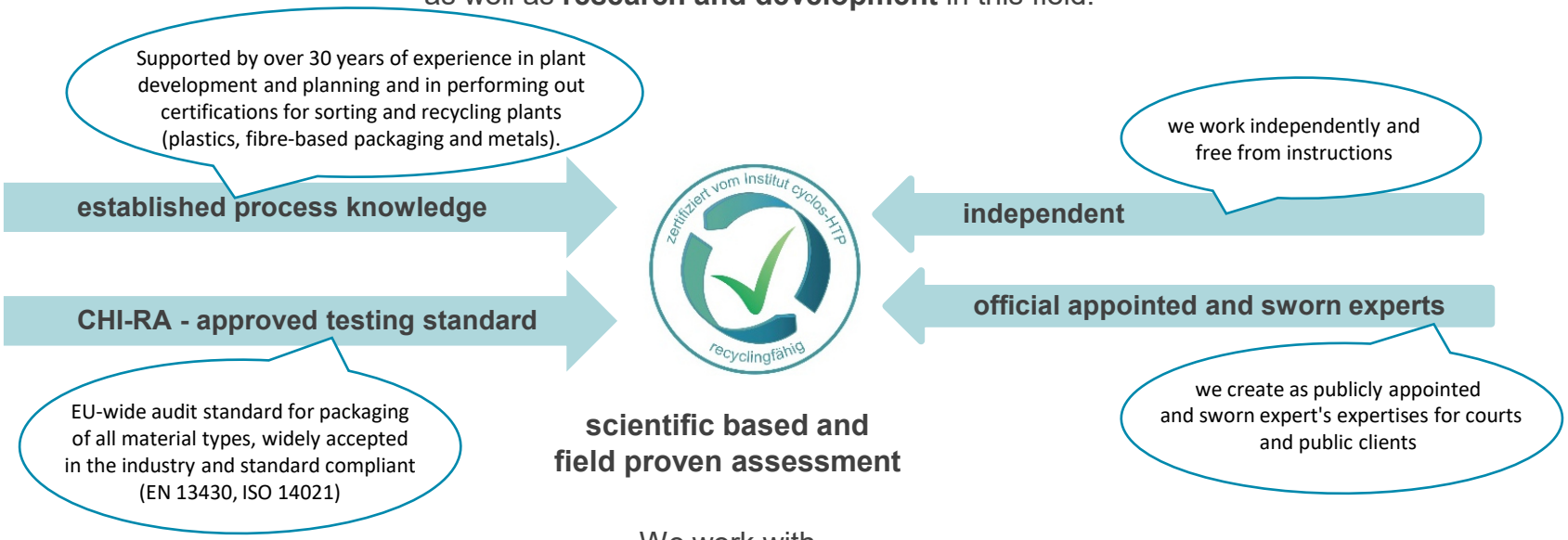
IT tool to determine the recyclability of packaging

June 2022

Overview

1. The Institute cyclos-HTP (CHI)

The Institute cyclos-HTP (CHI) with its headquarters in Aachen was founded in May 2014 as a company for the **classification, evaluation and audit of recyclability for packaging and goods**, as well as **research and development** in this field.



scientific based and field proven assessment

We work with
brand owners
packaging manufacturers
discounters and dual systems.

CHI, was the first **expert organisation** to elaborate and implement a **fully transparent assessment procedure** for packaging – based on scientific principles as well as hands-on experiences in recycling operations.

2. Program Overview

CHIRA is THE SOFTWARE SOLUTION from the HTP engineers and the experts of the Institute cyclos-HTP (CHI) for the differentiated assessment of recyclability and was developed as a multifunctional tool for ecological packaging optimisation.

What characterises CHIRA?

CHIRA is based on the current version of the CHI Recyclability Assessment, a proven examination and certification basis. The CHI assessment and the CHIRA IT tool have the following characteristics:

- First evaluation standard for the assessment of recyclability (publication 2011)
- Development and continuation based on scientific and practical primary knowledge of leading recycling experts
- Neutral and independent expert assessment (by publicly appointed and sworn experts)
- Assessment method: transparent quantitative assessment of recyclability / no ordinal assessment system
- Conformity with EN 13430 and EN ISO 14021
- Conformity to the German minimum standard
- Recognised, established industry standard
  (industrial companies, international brand manufacturers, packaging manufacturers, packaging material manufacturers, retailers and discounters use the CHI standard for differentiated status determination as well as packaging development and optimisation)
- Scope: EU, NO, CH, UK in country-specific differentiation
- Area of application: Packaging of all material types
- Continuous adjustment to the latest knowledge and technical innovations

What does CHIRA include?

In addition to the calculation of recyclability, CHIRA provides a differentiated assessment result for the 9 standard criteria of the CHI assessment catalogue as well as a report with comments that can be freely edited by the user; determination of the recyclable material content, NIR simulation, automatic density calculation and much more are implemented in CHIRA. All CHIRA predictions for the individual criteria can be overwritten by measured values.

2. Program Overview

Recyclability of the assortment packaging completely in view

CHIRA is equipped with intelligent query menus for individual packaging types that enable the user to create assortment packaging in a short time. In the CHIRA packaging archive, even extensive assortments can thus be fully documented, sorted and managed by article number. The option of exporting data from the archives enables further processing and data use in tabular calculations or databases, e.g. for periodic tracking of your sustainability targets.

Differentiated individual packaging optimisation using CHIRA

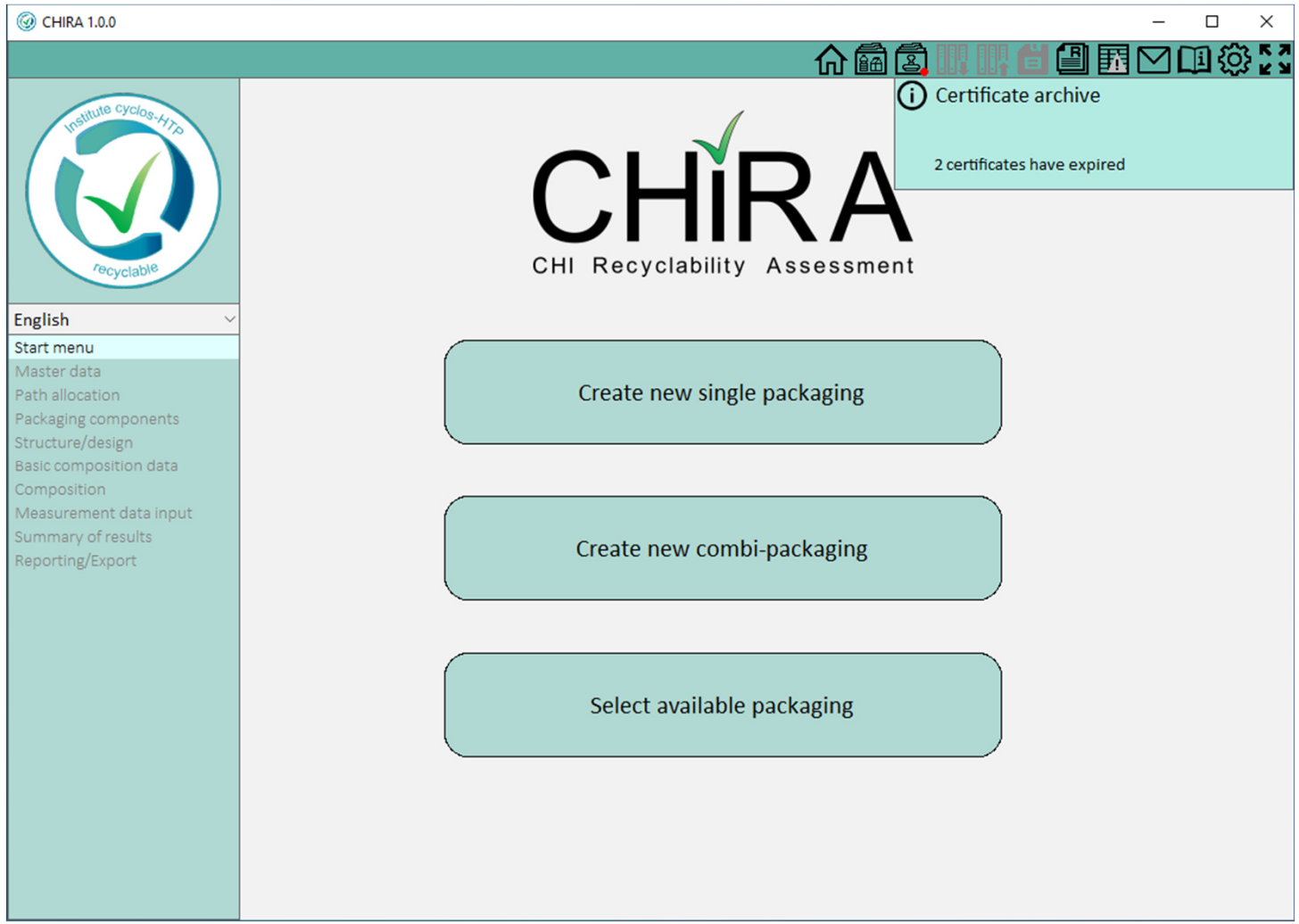
Last but not least, CHIRA is also designed as an instrument for ecological packaging optimisation. After specifying the current packaging design, design details such as colouring, labelling, closures, adhesives, fillers, etc. can be varied in CHIRA in order to determine the changed recyclability with just a few clicks thanks to the implemented copy function. An interesting usage variant not only for packaging developers!

Continuous updating of the assessment and planned functional extensions

CHIRA is constantly updated by the development team to keep up with the latest research and technical innovation and regulatory requirements. The introduction of new recycling processes, the expansion of collection and recycling infrastructures in individual nation states, research results on new materials and findings on the recycling compatibility or incompatibility of material combinations are implemented as part of regular updates. In addition, it is planned to further develop CHIRA functionally: A component library, guidelines check and a module for CO_2 footprint calculation have already been initiated as development projects.

3. Introduction to CHIRA

3.1 Start Menu



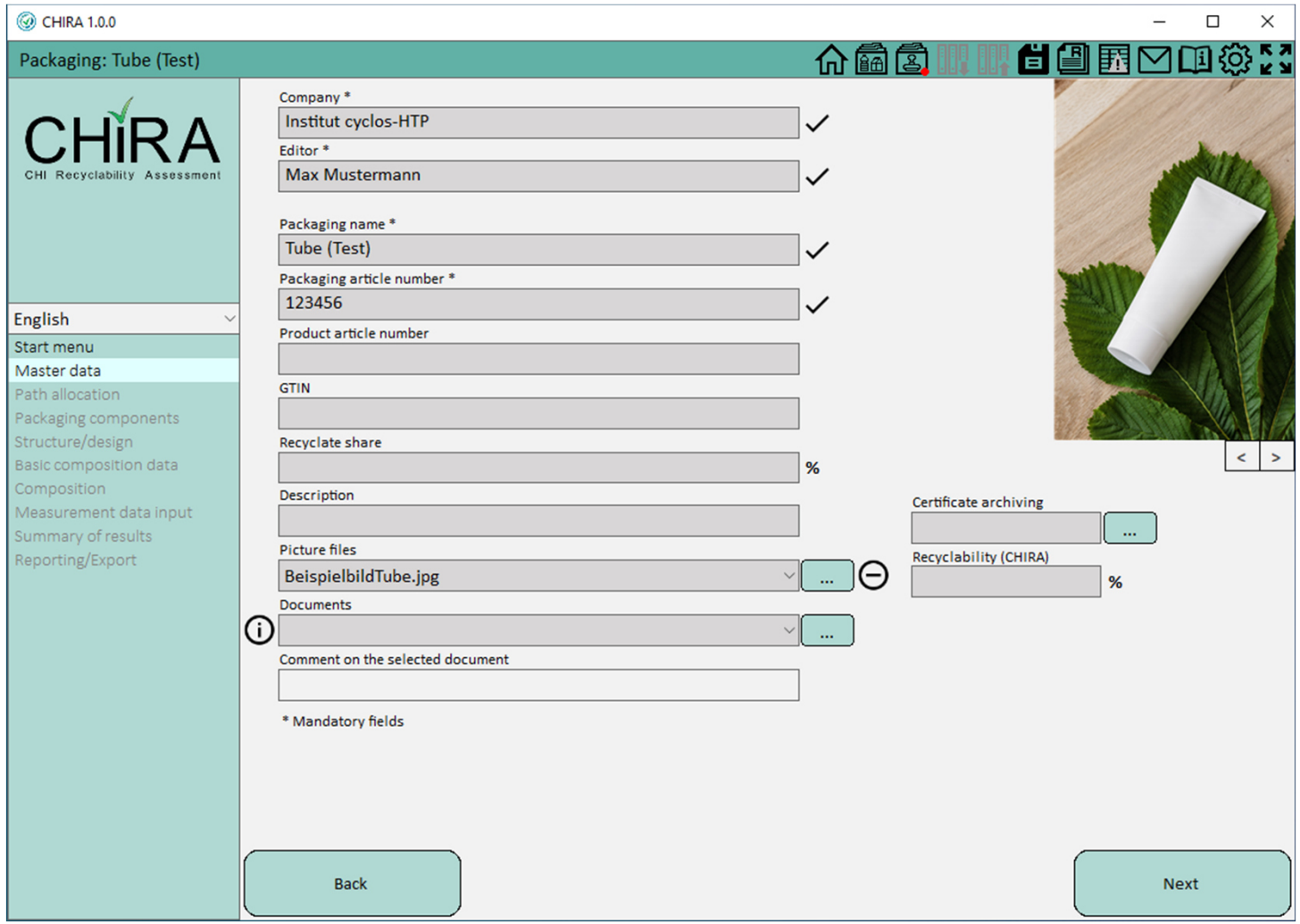
Language selection:
- German
- English
- French

Navigation area within the Recyclability Assessment

- Start screen
- Packaging archive
- Certificate archive
- Component library, future function
- Save current status
- Open the directory of reports
- Show messages
- Write an e-mail to CHIRA Support
- Open instruction
- Settings
- Adjust program to start size

3. Introduction to CHIRA

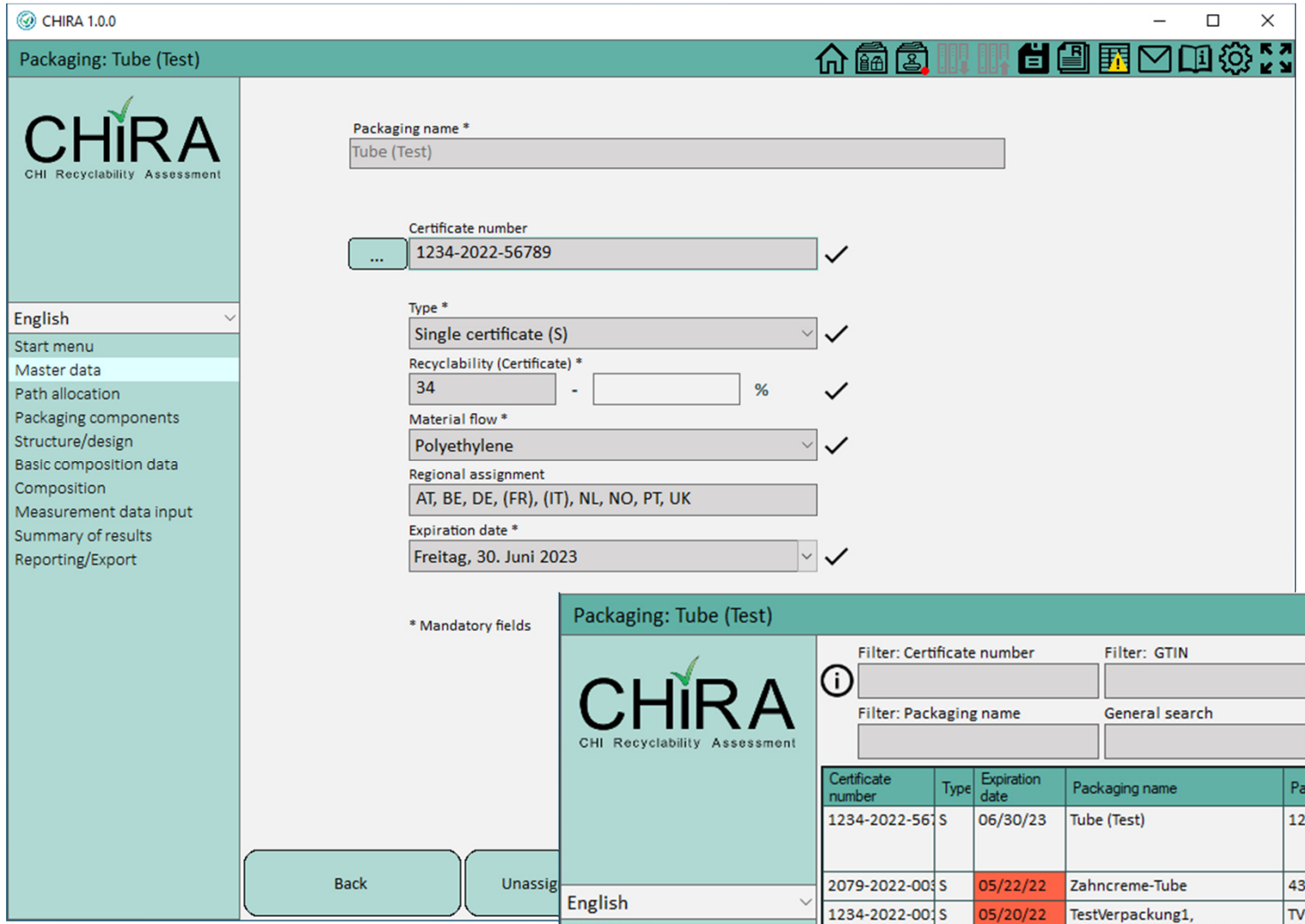
3.2 Create Packaging | Master Data



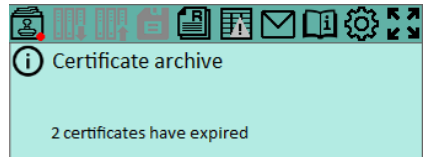
Every Recyclability Assessment begins with the entry of basic packaging-specific information, the so-called **Master data**. The information entered here forms the basis for fully documenting even extensive assortments by article number and for organising and managing them in the packaging archive. In addition, the user has the option of importing packaging-related files, such as photos and laboratory reports, and thus linking them to the data set.

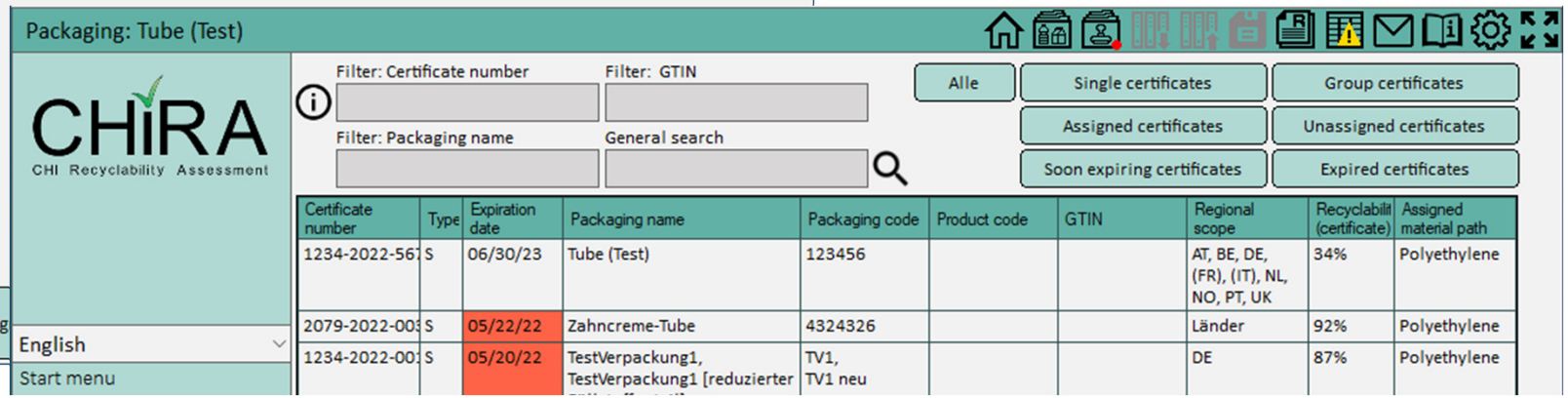
3. Introduction to CHIRA

3.3 Create Packaging | Master Data - Create Certificate & Certificate Archive



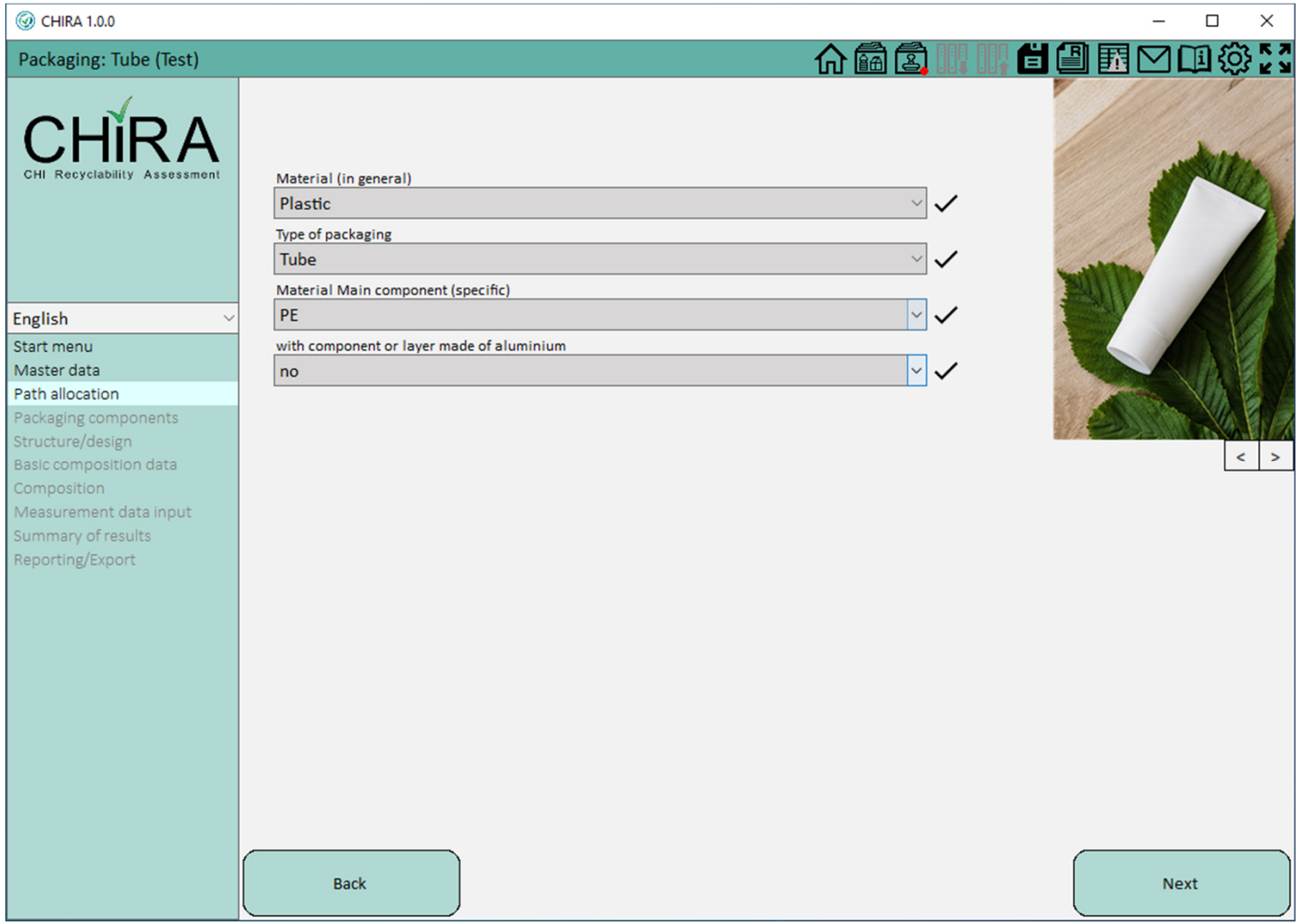
In addition to data such as files, e.g. photos and laboratory reports, existing certificates can also be connected to the packaging data set. All relevant information - recyclability, material flow classification, validity scope and expiry date - can be saved here.
The **certificate archive** with reminder function is used for user-friendly management of all existing certificates stored in CHIRA. In addition, the certificate archive can be exported as a CSV file. Expiring and expired certificates are highlighted in colour in the certificate archive and displayed as a note on the CHIRA start page.





3. Introduction to CHIRA

3.4 Create Packaging | Path Allocation



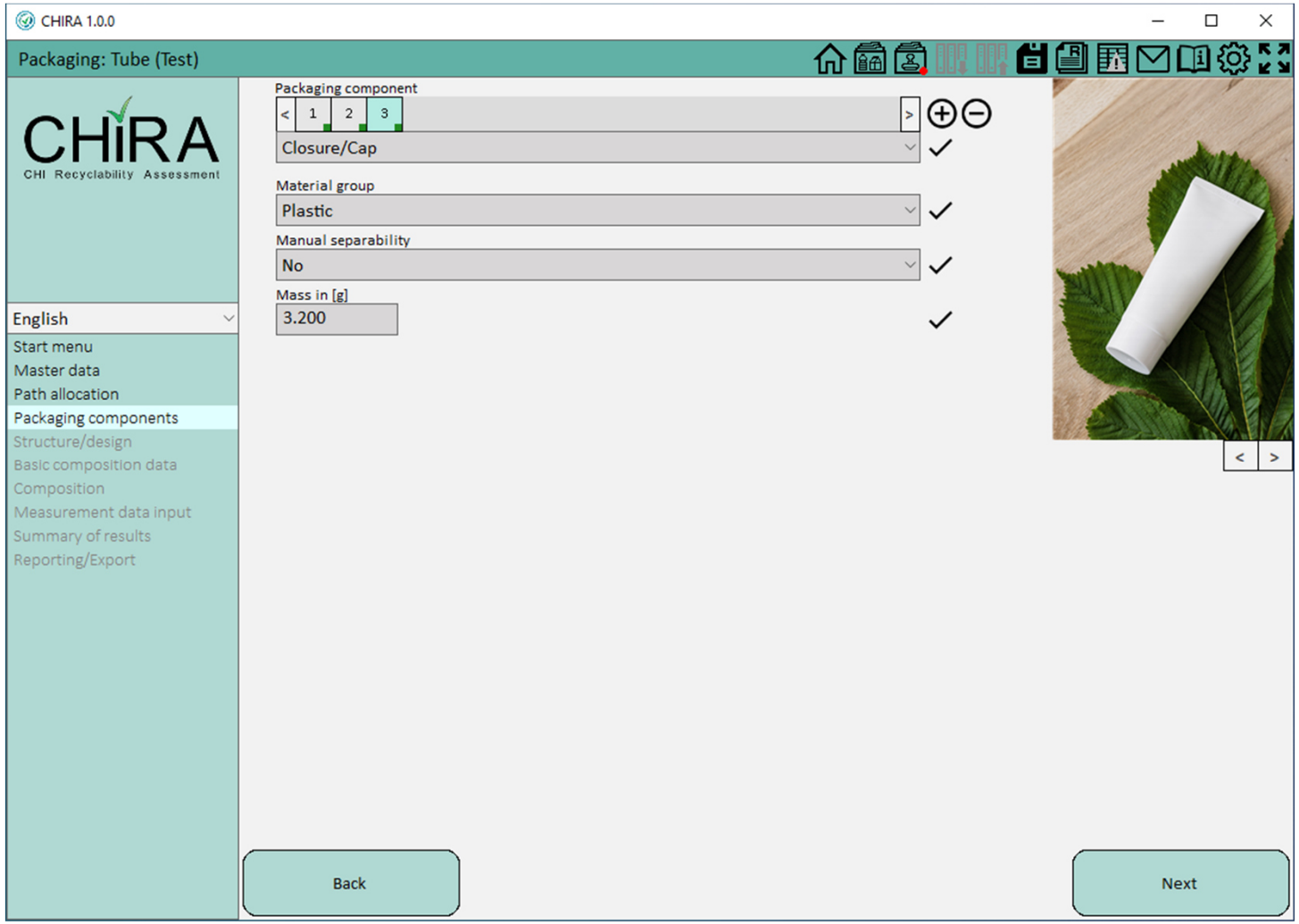
CHIRA's application range covers all material types as the only IT tool available:

- Plastic
- Paper, cardboard
- Liquid packaging board
- Aluminium
- Timplate
- Glass
- Other (Wood, Ceramics, etc.)

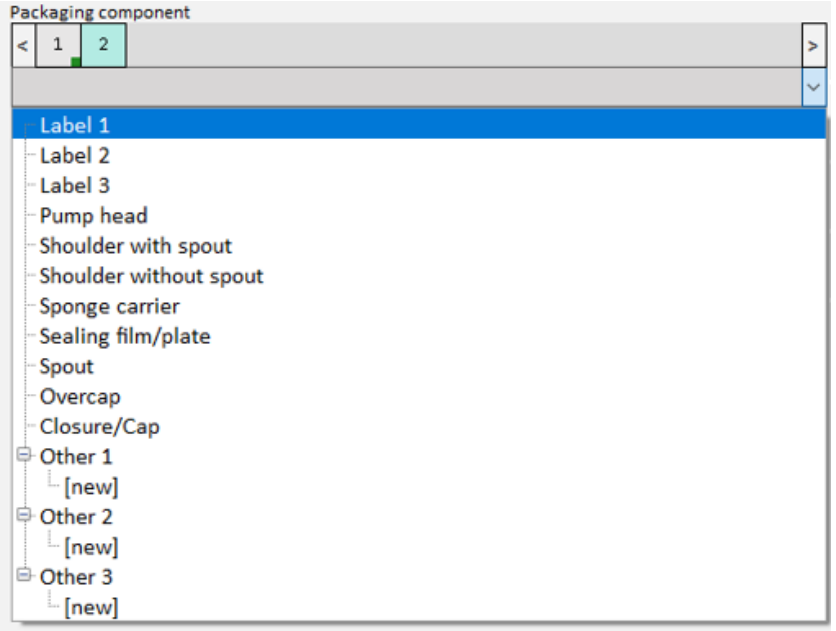
The menu point **Path allocation** is used to determine which recycling path is to be taken into account for the packaging. Currently, a distinction is made between 14 recycling paths. The superordinate criterion for the classification of products, according to their recyclability, is the availability of an applicable collection and processing structure. The individual criteria for assessing recyclability are based on the path-specific reference processes.

3. Introduction to CHIRA

3.5 Create Packaging | Packaging Components

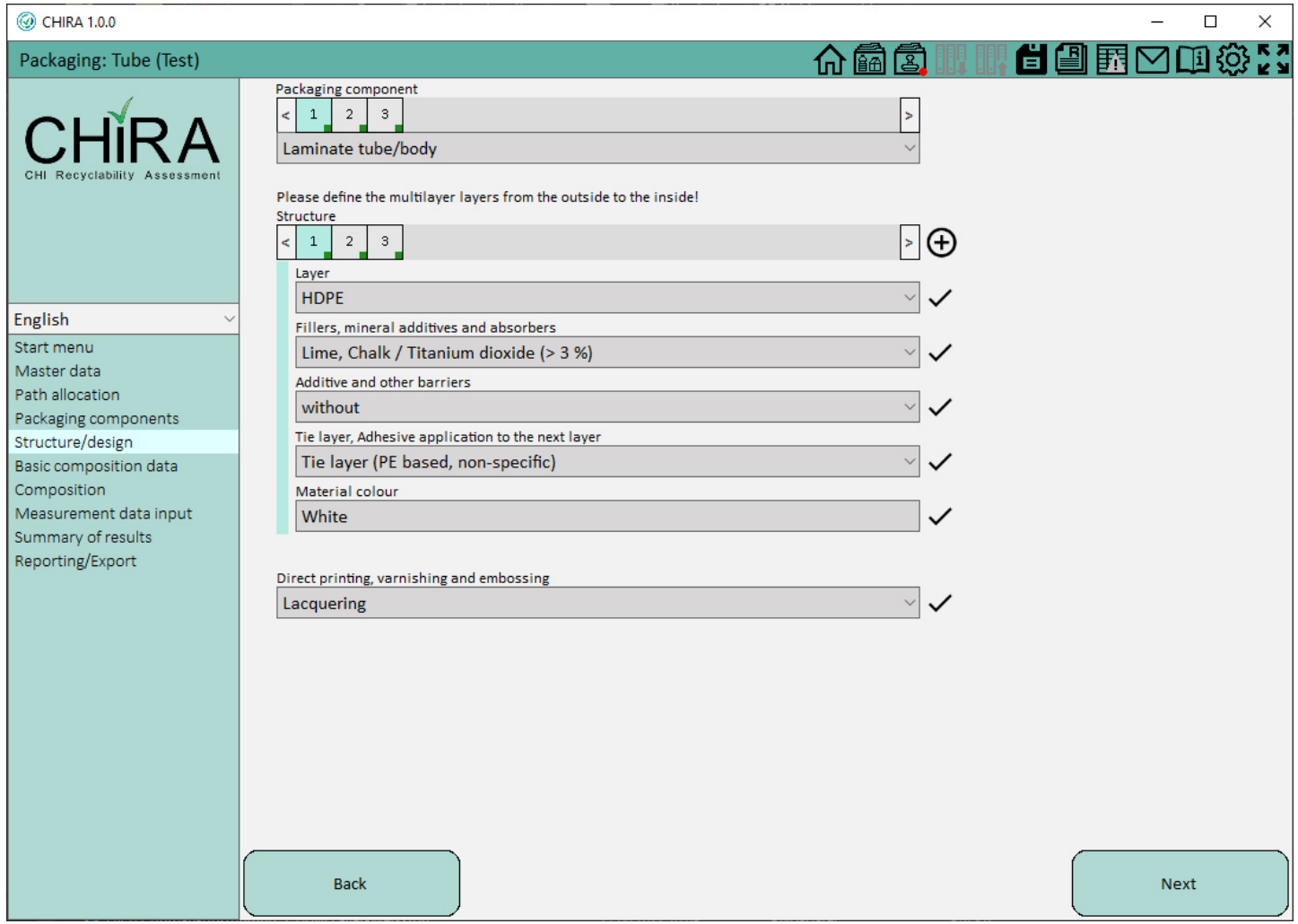


In the menu point **Packaging components**, the individual components of a packaging can be added. The selection of the packaging components is already specifically adapted to the packaging type.
In the example of the tube, the components listed here can be selected. In addition, further components can be added as desired via others.

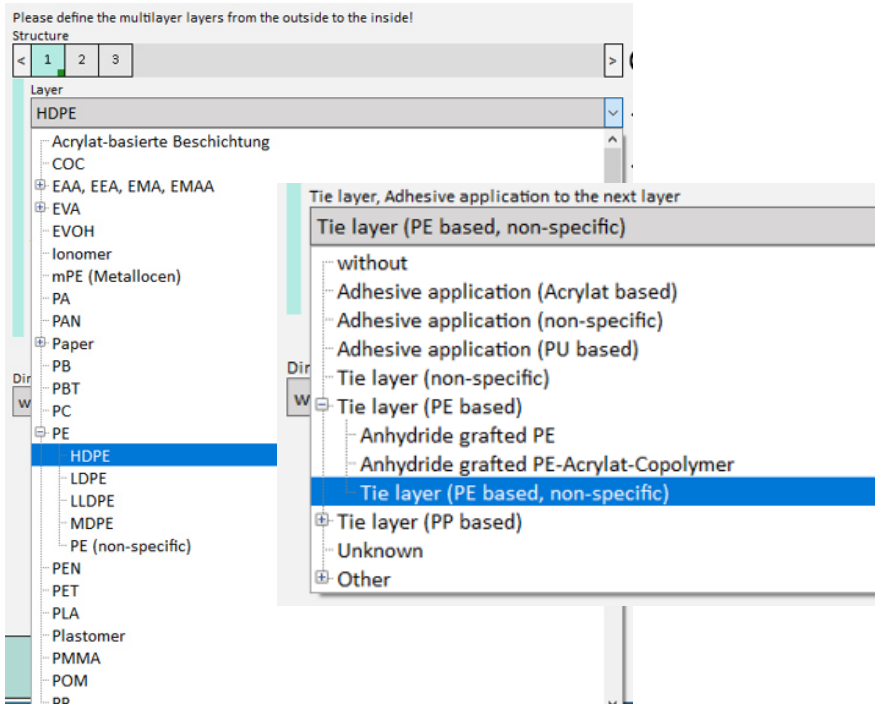


3. Introduction to CHIRA

3.6 Create Packaging | Structure/Design

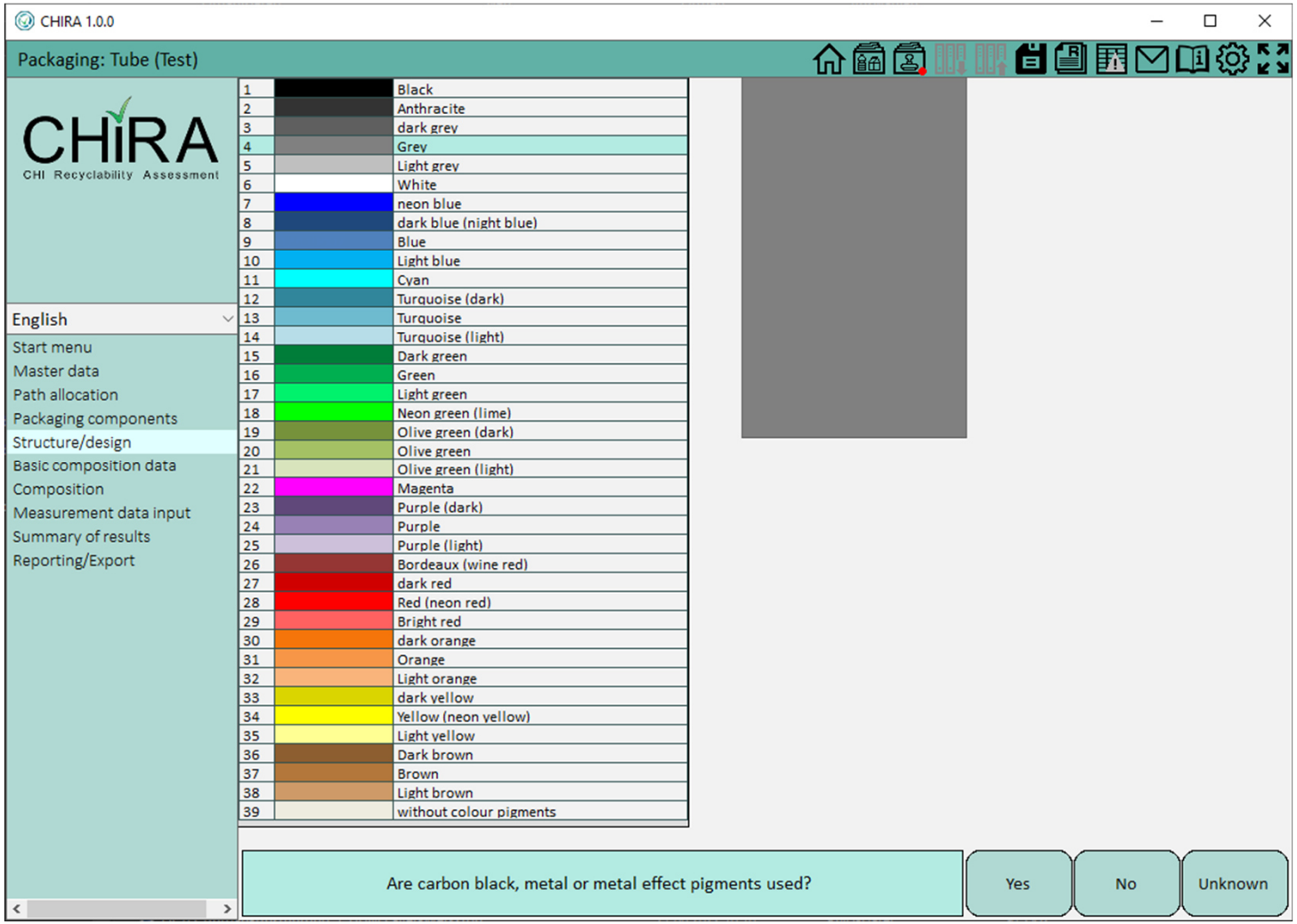


The components created are specified in the menu point **Structure/Design**. The intelligent query menus for individual packaging types with which the CHIRA tool is equipped enable the user to set up packaging in a short time.



3. Introduction to CHIRA

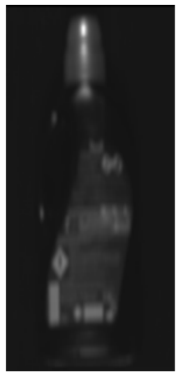
3.7 Create Packaging | Structure/Design - Colour Selection



In addition, the material colour of the packaging is queried and it is checked whether carbon black, metal or metal effect pigments are contained in order to take into account the influence on sortability and to fully specify the packaging.

Example: Black plastic bottle with carbon black based masterbatch
Sensor-based sorting based on the principle of NIR spectrometric reflectance measurement is an elementary process step in the reprocessing of mainly lightweight packaging (LWP, "yellow bag/bin"). The measured spectra per pixel are compared with stored reference spectra.
The classification image (below) shows that the bottle body is not identified due to the carbon black-based masterbatch.

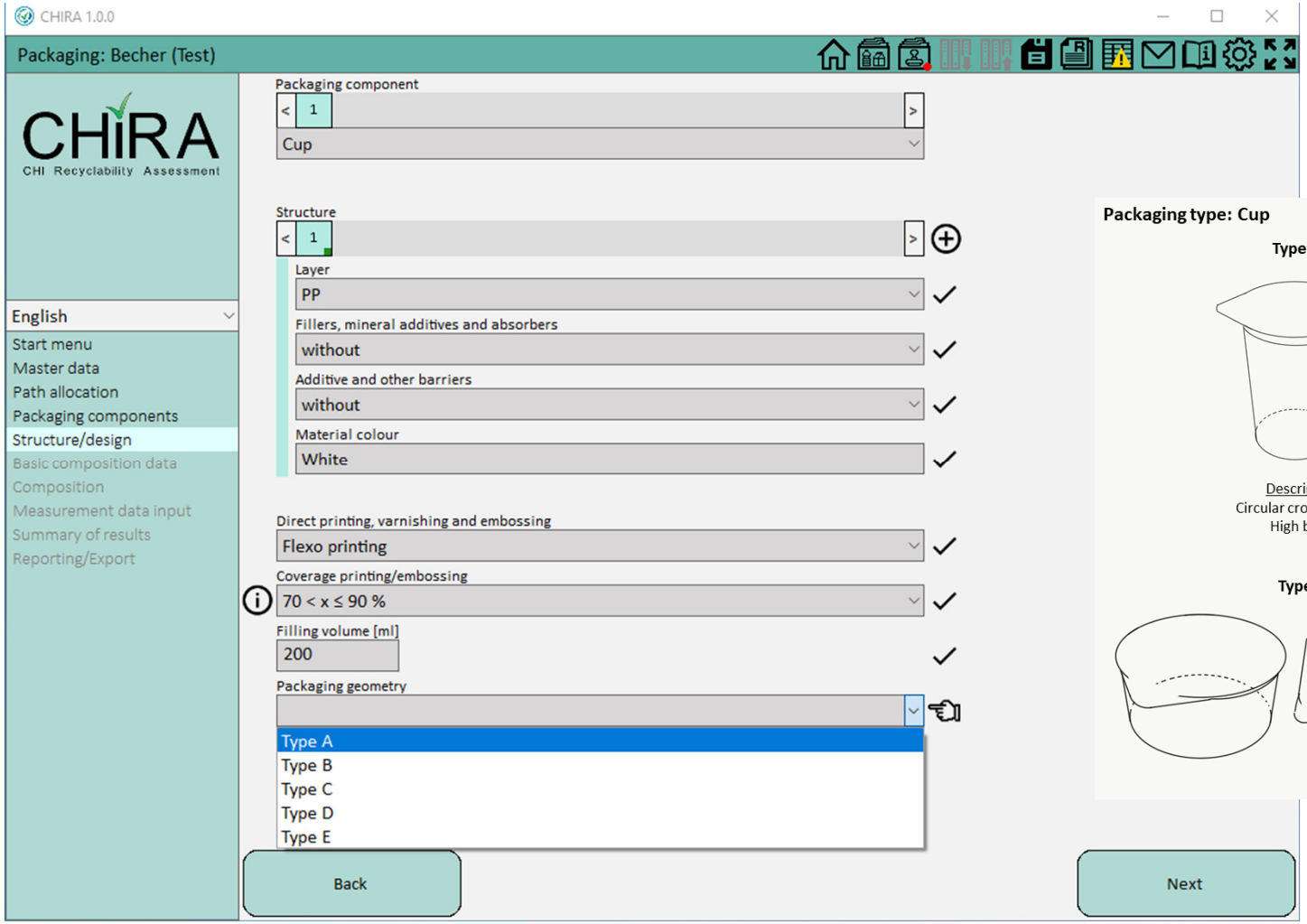
Intensity image



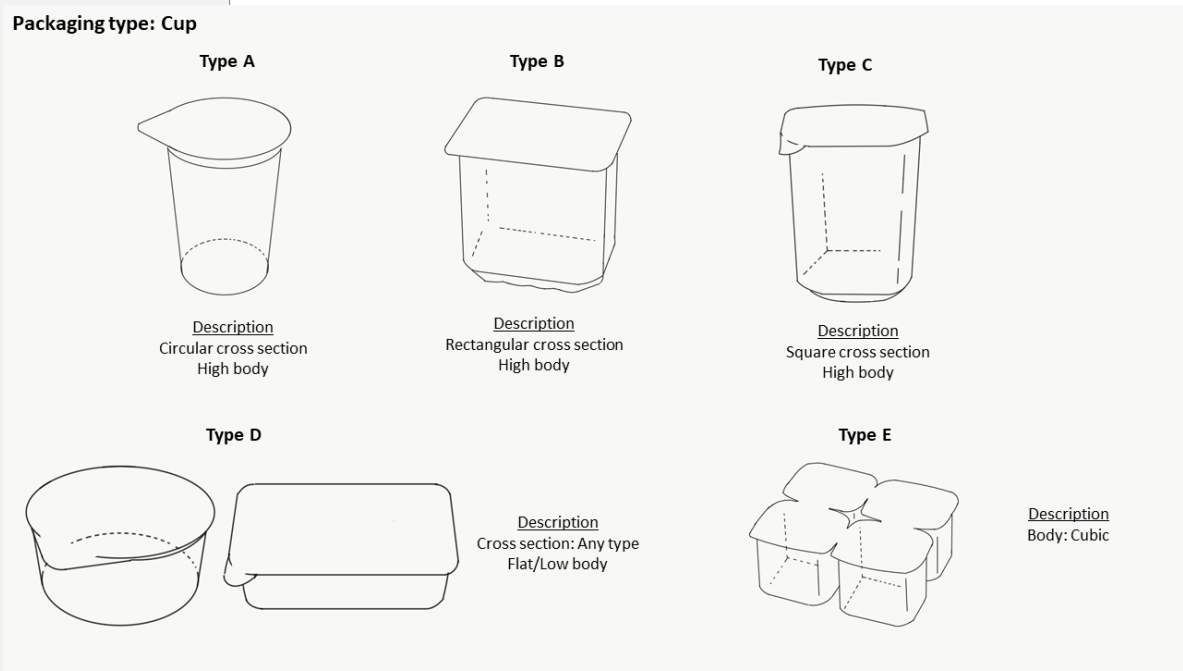
Classification image

3. Introduction to CHIRA

3.8 Create Packaging | Structure/Design - Packaging Geometry

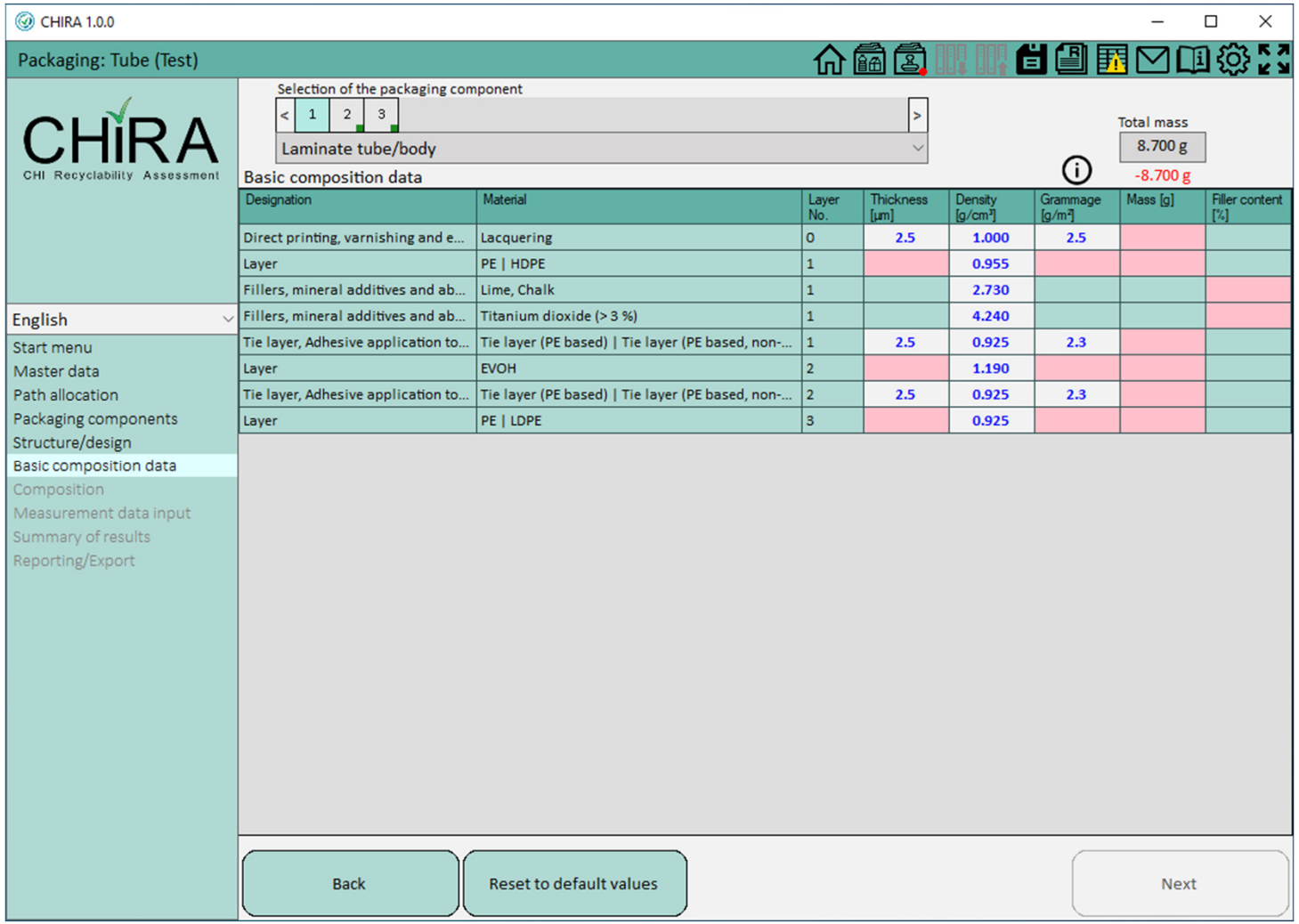


If the format of the packaging is also relevant, the geometry of the packaging can also be selected under the menu item **Structure/design**. The example of a cup is shown here for the selection of the packaging geometry.



3. Introduction to CHIRA

3.9 Create Packaging | Basic Composition Data



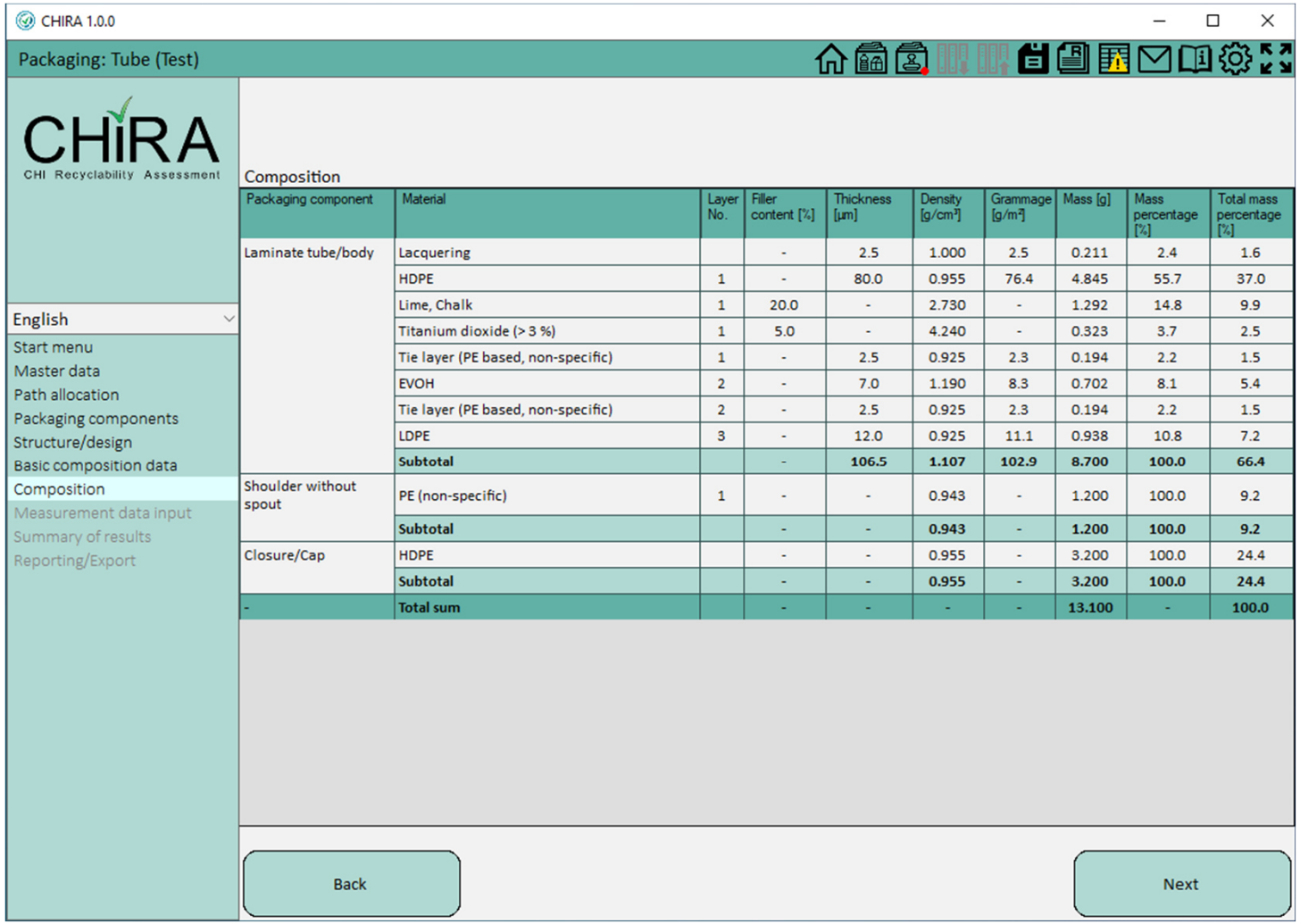
Designation	Material	Layer No.	Thickness [µm]	Density [g/cm³]	Grammage [g/m²]	Mass [g]	Filler content [%]
Direct printing, varnishing and e...	Lacquering	0	2.5	1.000	2.5		
Layer	PE | HDPE	1		0.955			
Fillers, mineral additives and ab...	Lime, Chalk	1		2.730			
Fillers, mineral additives and ab...	Titanium dioxide (> 3 %)	1		4.240			
Tie layer, Adhesive application to...	Tie layer (PE based) | Tie layer (PE based, non-...	1	2.5	0.925	2.3		
Layer	EVOH	2		1.190			
Tie layer, Adhesive application to...	Tie layer (PE based) | Tie layer (PE based, non-...	2	2.5	0.925	2.3		
Layer	PE | LDPE	3		0.925			

The material composition of the individual packaging components is specified in the menu item **Basic composition data**.

CHIRA has an extensive material database. The standard values stored in the material database are shown in blue, user entries are shown in black and the entries required to determine the results are indicated by the fields with a red background. The data can be entered either via layer thicknesses or basis weights or via the masses.

3. Introduction to CHIRA

3.10 Create Packaging | Composition

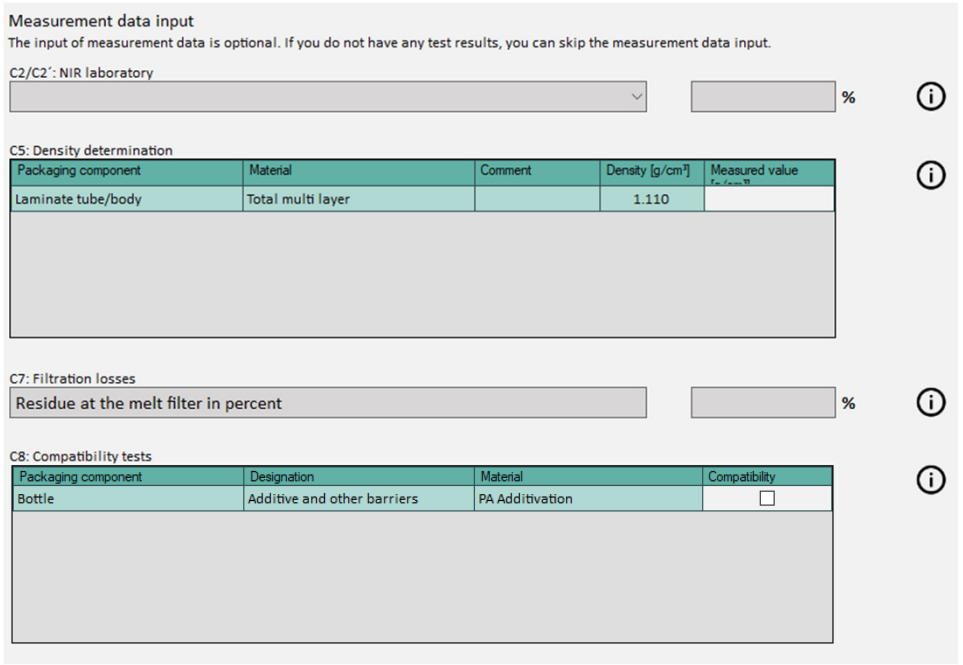


Packaging component	Material	Layer No.	Filler content [%]	Thickness [µm]	Density [g/cm³]	Grammage [g/m²]	Mass [g]	Mass percentage [%]	Total mass percentage [%]
Laminate tube/body	Lacquering		-	2.5	1.000	2.5	0.211	2.4	1.6
	HDPE	1	-	80.0	0.955	76.4	4.845	55.7	37.0
	Lime, Chalk	1	20.0	-	2.730	-	1.292	14.8	9.9
	Titanium dioxide (> 3 %)	1	5.0	-	4.240	-	0.323	3.7	2.5
	Tie layer (PE based, non-specific)	1	-	2.5	0.925	2.3	0.194	2.2	1.5
	EVOH	2	-	7.0	1.190	8.3	0.702	8.1	5.4
	Tie layer (PE based, non-specific)	2	-	2.5	0.925	2.3	0.194	2.2	1.5
	LDPE	3	-	12.0	0.925	11.1	0.938	10.8	7.2
	Subtotal		-	**106.5**	**1.107**	**102.9**	**8.700**	**100.0**	**66.4**
Shoulder without spout	PE (non-specific)	1	-	-	0.943	-	1.200	100.0	9.2
	Subtotal		-	-	**0.943**	-	**1.200**	**100.0**	**9.2**
Closure/Cap	HDPE		-	-	0.955	-	3.200	100.0	24.4
	Subtotal		-	-	**0.955**	-	**3.200**	**100.0**	**24.4**
-	**Total sum**		-	-	-	-	**13.100**	-	**100.0**

In the menu point **Composition**, the material composition is displayed as a tabular overview. All previously entered specifications of the packaging are listed.
The calculated mixing density of multilayer components and calculated mass shares of the packaging and its components are also displayed.

3. Introduction to CHIRA

3.11 Create Packaging | Measurement Data Input



The prognosis of individual criteria in CHIRA can be specified path-specifically in the menu item **Measurement data input** by available test results. The measurement data input for plastic packaging is shown here as an example.

For plastic packaging, the following measurement results can be deposited for the calculation:

- NIR laboratory
- Density determination
- Filtration losses (melt filter)
- Compatibility test

With density determination, for example, the calculated multilayer density can be replaced with a measured value.

With the option compatibility test, the entered components of CAT 3 (incompatibilities) are listed. If proof of recycling compatibility is available, this can be included in the calculation by the selection.

Intensity image | Classification image

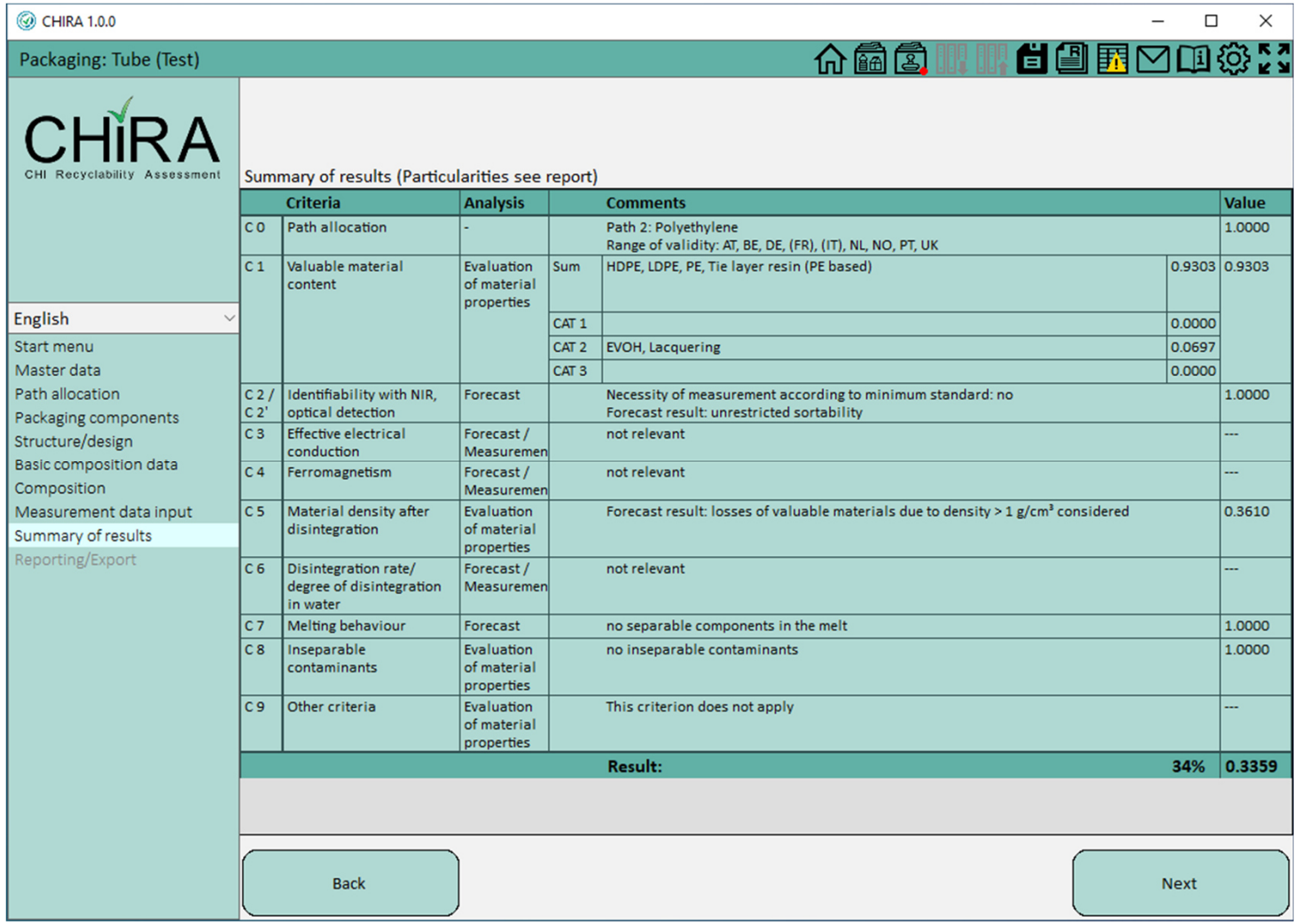
PE 3D

Example: NIR laboratory

Sensor-based sorting based on the principle of NIR spectrometric reflectance measurement is an elementary process step in the reprocessing of mainly lightweight packaging (LWP, "yellow bag/bin"). The measured spectra per pixel are compared with stored reference spectra.
The classification image (left) shows that the tested tube is fully identified as PE (Polyethylene) and therefore - based on the NIR detection - an unrestricted sorting is guaranteed. The user can enter such a measurement result in the menu Measurement data input to overwrite the predicted value with the measured value.

3. Introduction to CHIRA

3.12 Create Packaging | Summary of Results



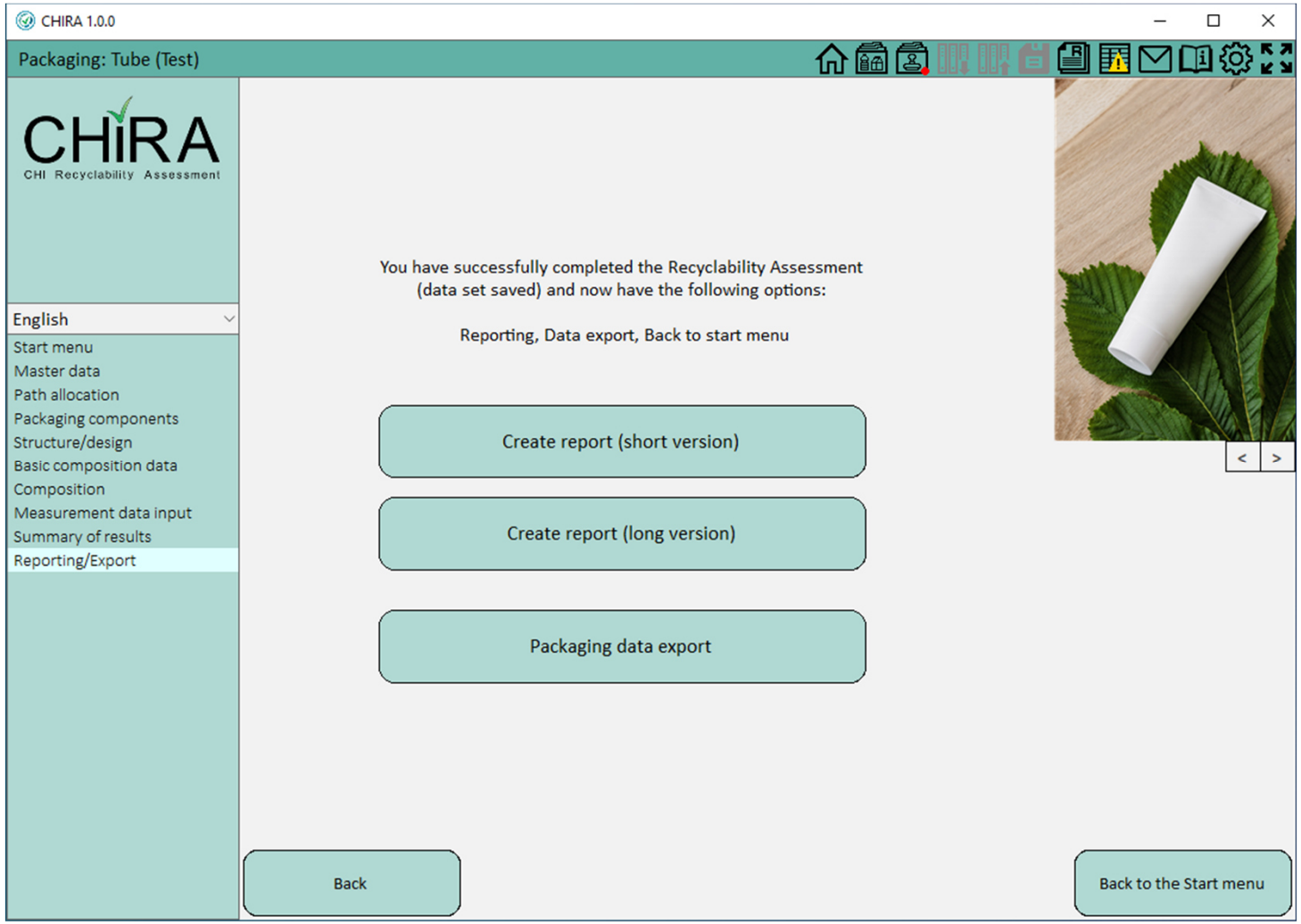
	Criteria	Analysis		Comments		Value
C 0	Path allocation	-		Path 2: Polyethylene Range of validity: AT, BE, DE, (FR), (IT), NL, NO, PT, UK		1.0000
C 1	Valuable material content	Evaluation of material properties	Sum	HDPE, LDPE, PE, Tie layer resin (PE based)	0.9303	0.9303
			CAT 1		0.0000	
			CAT 2	EVOH, Lacquering	0.0697	
			CAT 3		0.0000	
C 2 / C 2'	Identifiability with NIR, optical detection	Forecast		Necessity of measurement according to minimum standard: no Forecast result: unrestricted sortability		1.0000
C 3	Effective electrical conduction	Forecast / Measuremen		not relevant		---
C 4	Ferromagnetism	Forecast / Measuremen		not relevant		---
C 5	Material density after disintegration	Evaluation of material properties		Forecast result: losses of valuable materials due to density > 1 g/cm³ considered		0.3610
C 6	Disintegration rate/ degree of disintegration in water	Forecast / Measuremen		not relevant		---
C 7	Melting behaviour	Forecast		no separable components in the melt		1.0000
C 8	Inseparable contaminants	Evaluation of material properties		no inseparable contaminants		1.0000
C 9	Other criteria	Evaluation of material properties		This criterion does not apply		---
				Result:	**34%**	**0.3359**

In the table of the **summary of results**, a differentiated evaluation result from the 9 standard criteria of the CHI evaluation catalogue is summarised. Individual factors, such as C 2 (NIR detection) and C 6 (disintegration behaviour), are predicted by complex algorithms.

In addition, the scope of validity is shown country-specifically. For the countries indicated in without brackets, a recycling path exists and the collection and recycling structure is at least 50 % implemented. For the countries shown in brackets, the collection structure is under development and the recycling structure is supplied on an industrial scale.

3. Introduction to CHIRA

3.12 Create Packaging | Reporting/Export



The summary of result can be shown in the menu item **Reporting/Export** as a short or long report. The report is exported as a Word document for subsequent individual adaptation. For data transfer (e.g. for certification) a ZIP folder can be exported that contains the packaging data (CSV file) as well as photos and documents (e.g. technical data sheets, laboratory reports).

CHIRA Result Overview

CHIRA
CHI Recyclability Assessment

Main data

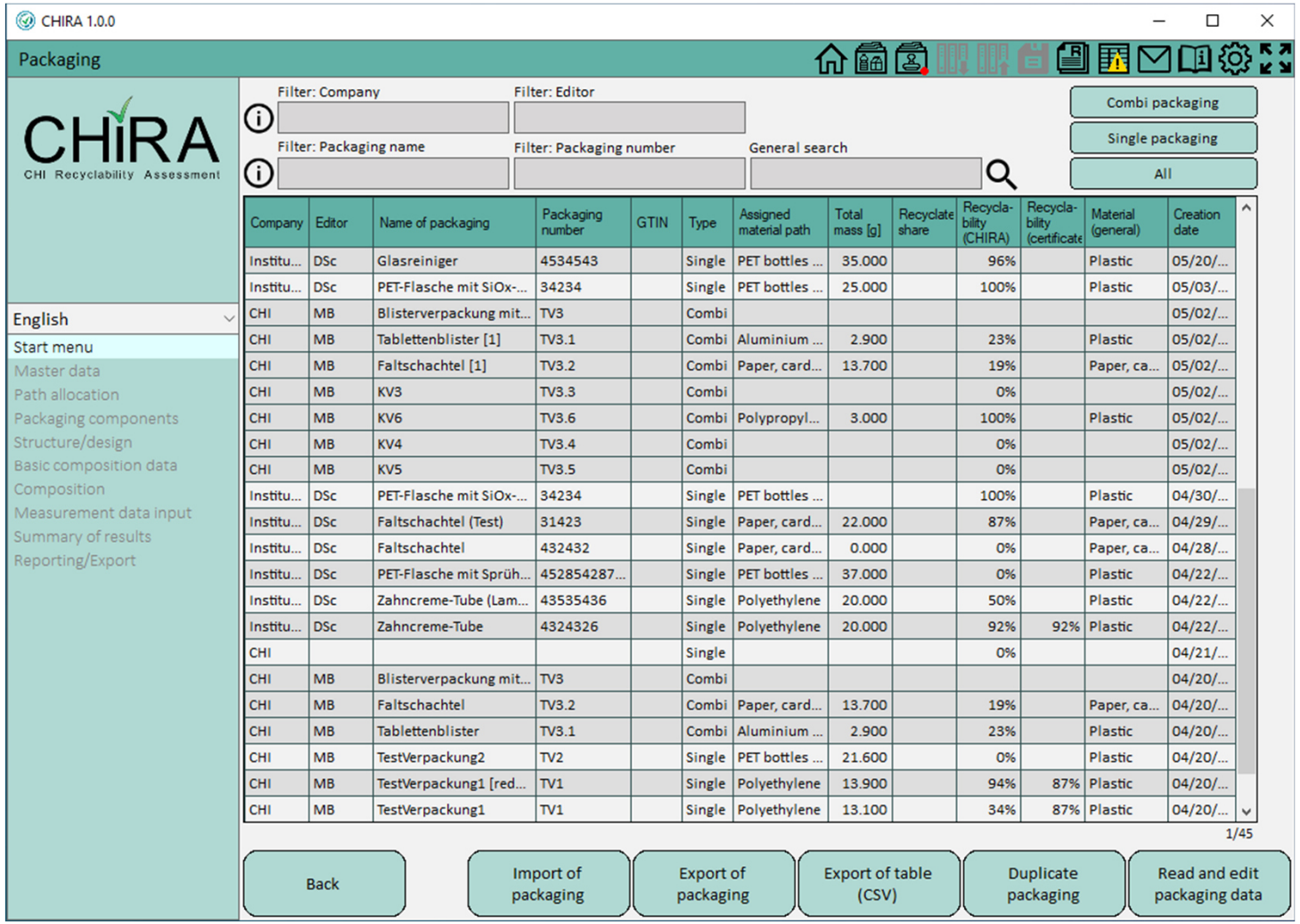
Company: Institut cyclos-HTP
Editor: Max Mustermann
Packaging designation: Tube (Test)
Article number of packaging: 123456
Article number of product: —
GTIN: —
Type of packaging: Single packaging
Certificate available: Yes

Results

Recyclability: 34%
Basis of determination: Forecast
Material stream: Path 2: Polyethylene
Countries with collection and recycling structure: AT, BE, DE, (FR), (IT), NL, NO, PT, UK

3. Introduction to CHIRA

3.13 Packaging Archive



The **packaging archive** provides an overview of all created packaging, so that even extensive product/packaging assortments can be documented, organised and managed in a user-friendly way with item number accuracy. The option of exporting data from the archives enables further processing and data use in tabular calculations or databases, e.g. for periodic tracking of your sustainability targets.

4. Summary and Outlook

- **Assessment of recyclability according to the CHI standard**
  - Sworn expert evaluation, objective, not interest-driven
  - For all packaging types and materials
  - Conforms to the minimum standard
  - EU-wide scope (with national differentiation)
  - Basis for awarding in accordance with EN ISO 14021

- **Multifunctionality tool with the following features**
  - Individual evaluation of packaging
  - Database for determining and tracking sustainability goals
  - Various export functions
  - Certificate archive

- **Continuous development**
  - Constant review and updating of the assessment basis
  - Modular, functional addition
    - Packaging component library
    - Alignment with Design for Recycling (D4R) guidelines
    - CO_2 footprint calculation
    - …

Contact

CHiRA
CHI Recyclability Assessment

Institut cyclos-HTP GmbH

Maria-Theresia-Allee 35

52064 Aachen

Germany

chira-support@cyclos-htp.de

www.cyclos-htp.de