PolSelec

Material selection and information system for plastics

User Manual

Material selection and Extras/additional functions

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Makrolar GbR Berlin

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1 Introduction

The designer of plastic products must have at least a general idea of the materials and manufacturing processes that can be used no later than after the task has been specified and the working principal solutions have been selected.

We therefore developed the PolSelec software for the preliminary selection of materials and processes, enabling the preselection of basic material types and the associated manufacturing processes. The conceptual approach to this decision-making algorithm was developed as early as 1978.

The display and printout of the basic plastic material types use abbreviations defined in accordance with ISO 1043 and DIN 7728, taking into account the respective DIN standards for moulding materials. PolSelec requires some modifications and additions to the standard abbreviation system, but these are largely consistent with familiar and commonly used notations.

The **Material selection** module helps you find the plastics that suit your component from about 870 materials. You describe your requirements, for example fire behaviour, media resistance, mechanical properties or the intended manufacturing technique, and PolSelec immediately shows which materials meet all of them.

For every material you can also open a detailed **material profile**. It shows the designation, the materials group, a short description and all properties assigned to the material.

In addition, the **Extras/additional functions** tab provides tools for forecasting regenerate content and heat aging, for climate-dependent water absorption, and climate maps of UV radiation and temperature.

This manual is intended for users who work with PolSelec to select materials. It explains the user interface, selecting materials by criteria, evaluating the results, saving and printing a selection as a project, and the additional functions.

2 The user interface

When you start PolSelec, the **Material selection** module opens. As long as no criteria are selected, the list shows all materials.

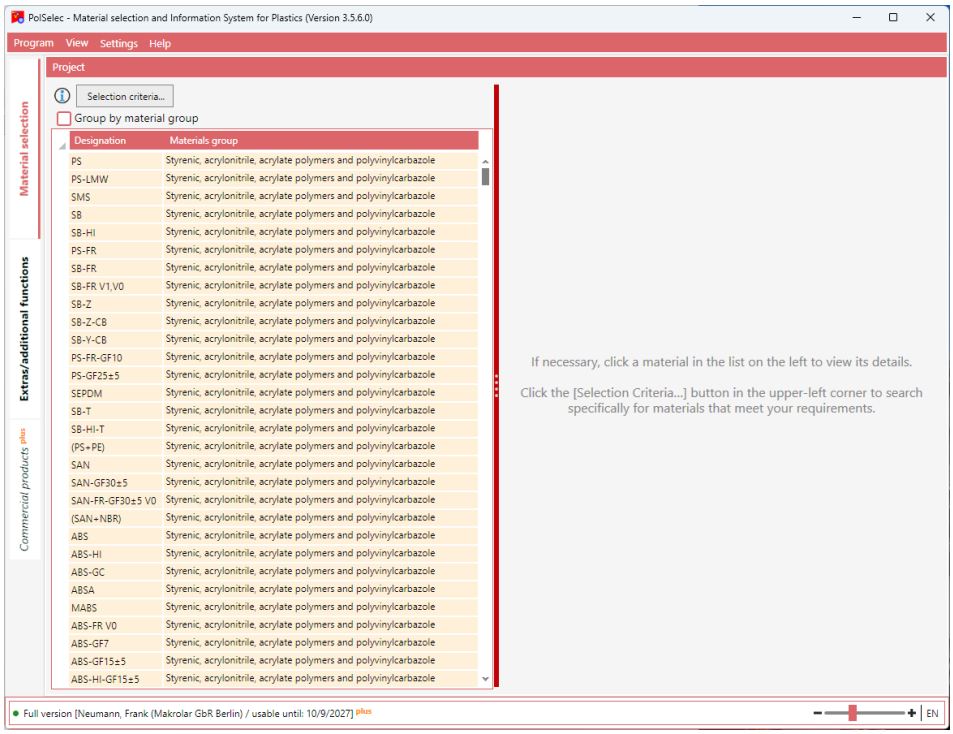


Figure 1: Main window after starting the program

Area	Purpose
Menu bar	**“Program”**, **“View”**, **“Settings”** and **“Help”**.
“Project” bar	Menu for creating, loading, saving and printing a selection project (see chapter 6).
Tabs on the left edge	Switch between the modules **“Material selection”**, **“Extras/additional functions”** and **“Commercial products plus”**.
Materials list (left)	All materials, or the materials found, with the columns **“Designation”** and **“Materials group”**.
Detail pane (right)	Material profile of the material selected in the list.
Splitter (centre)	Red vertical bar; drag it with the mouse to change the width of the two panes.
Status bar (bottom)	Licence information, slider for zooming the display in and out, and the current language (EN).

3 Viewing materials

3.1 Displaying the material profile

Click a material in the materials list. Its material profile appears on the right:

- **Material designation** – abbreviation of the material, e.g. **“PS”**.
- **Materials group** – the plastics group the material belongs to.
- **Description** – short characterisation, e.g. standard and density.
- **Table “Selection criterion path / Assignment”** – all properties of the material, sorted by criteria. The left column shows where the criterion is located in the criteria tree, the right column the applicable values.

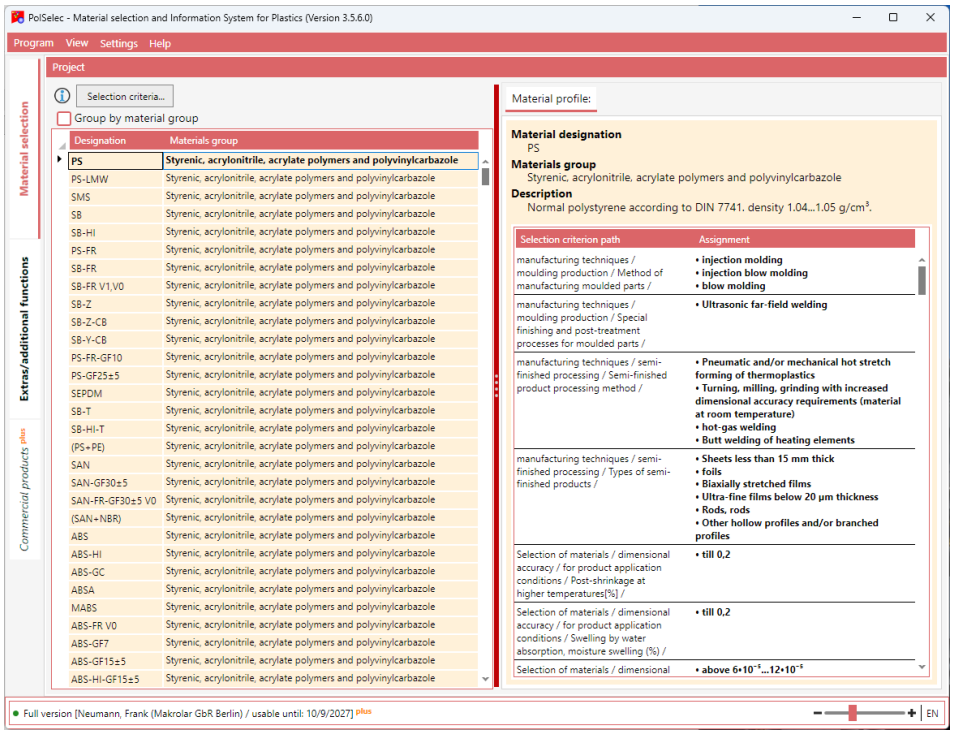


Figure 2: Material profile of the material PS

> **Tip:** Use the mouse wheel or the scroll bar to scroll through the material profile table. Use the arrow keys to move quickly to the next material in the materials list.

3.2 Grouping by material group

Select the check box **“Group by material group”**. The list then shows the material groups with the number of materials they contain in brackets.

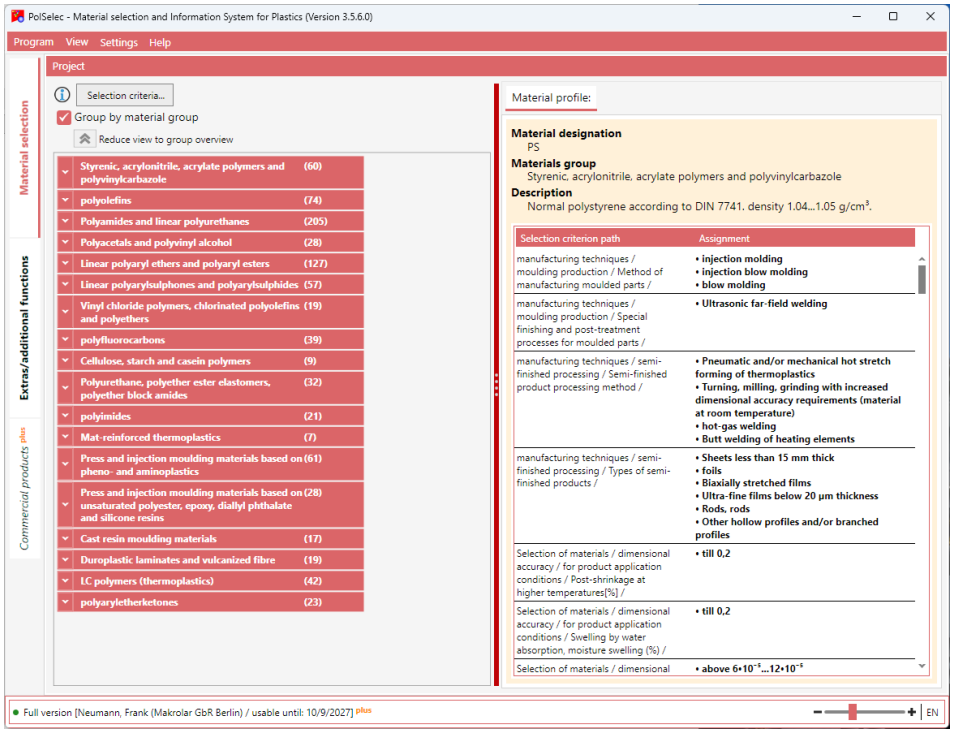


Figure 3: Materials list grouped by material group

Click a group to expand it and see its materials. Use the button **“Reduce view to group overview”** (double arrow) to return to the group overview. Clear the check box again to return to the plain list.

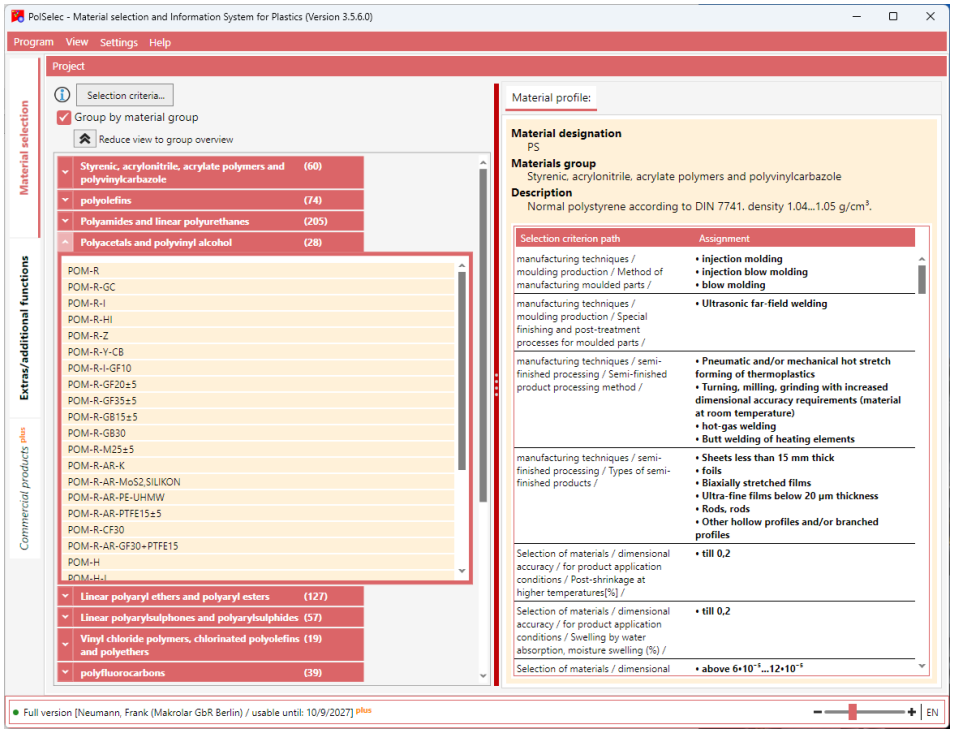


Figure 4: Expanded group “Polyacetals and polyvinyl alcohol”

4 Selecting materials by requirements

4.1 Opening the “Selection criteria” dialog

Click **“Selection criteria...”** in the upper left corner of the material selection. The dialog has two panes:

- **on the left** the criteria tree with the main branches **“Selection of materials”** (material properties) and **“manufacturing techniques”** (moulding production, semi-finished processing),
- **on the right** the list of currently selected criteria.

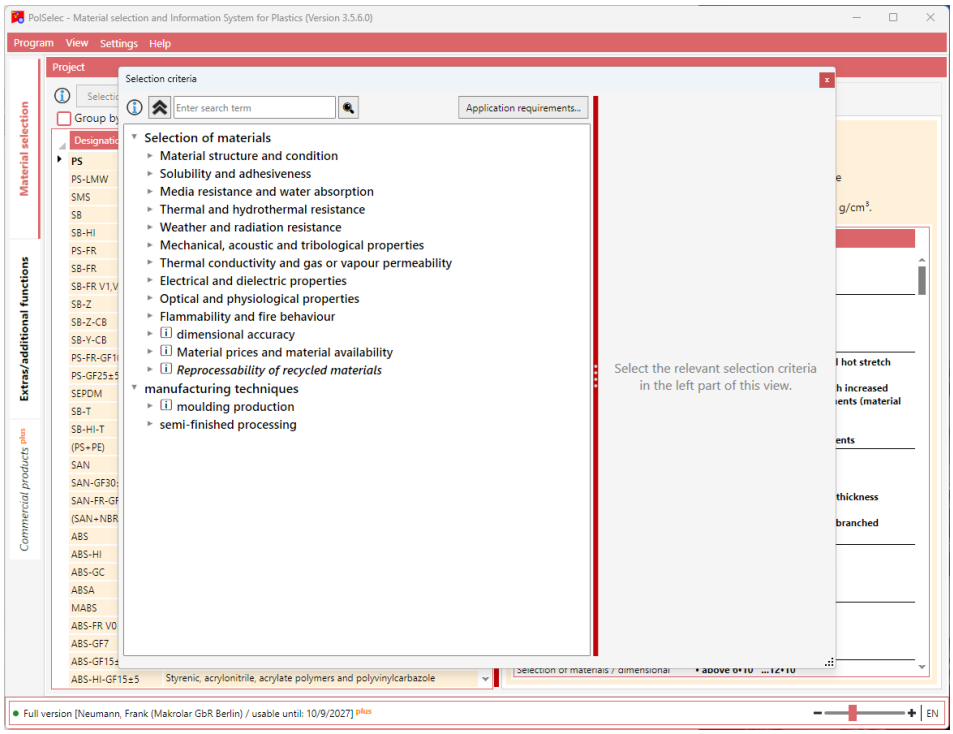


Figure 5: "Selection criteria" dialog with the criteria tree

> **Note:** You can leave the dialog open while you work. Every change takes effect immediately, and the result in the main window is updated continuously.

4.2 Selecting criteria

1. Expand the branch you need in the criteria tree by clicking the small triangle in front of the entry, e.g. **"Flammability and fire behaviour"** › **"flammability"** › **"Fire classes according to UL 94"**.
2. The lowest level contains the selectable values with check boxes.
3. Select the values your material must meet, e.g. **"V0 (lowest fire risk)"**.

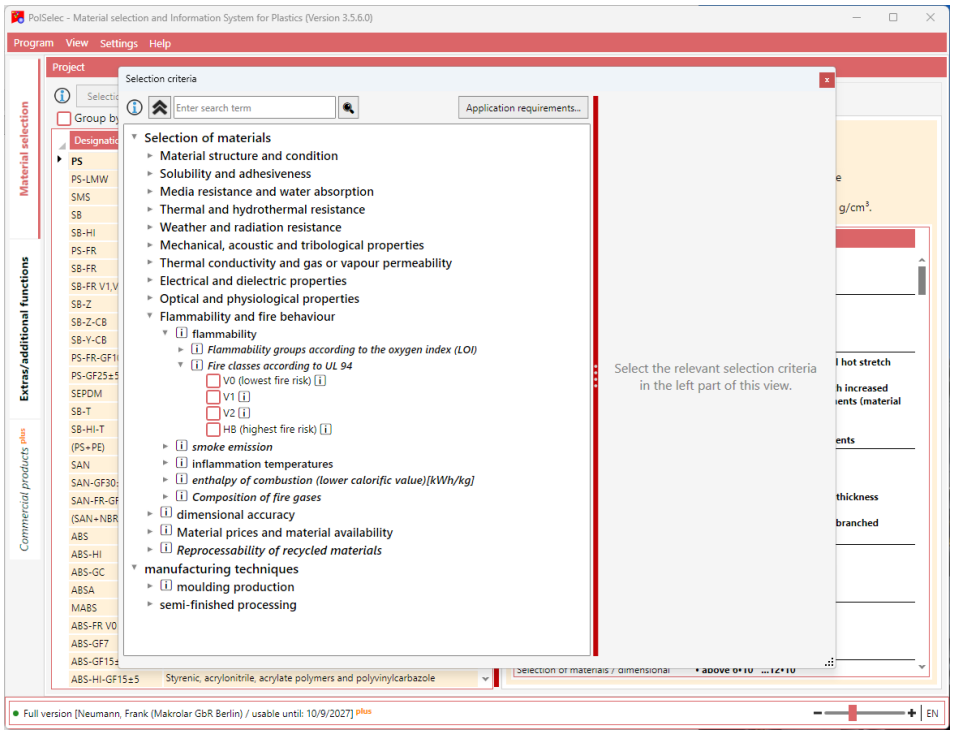


Figure 6: Expanded branch "Fire classes according to UL 94"

The selected criterion appears immediately in the list on the right. In the main window, the button **"Selection criteria..."** now shows the number of active criteria, e.g. **"1 Selection criteria..."**.

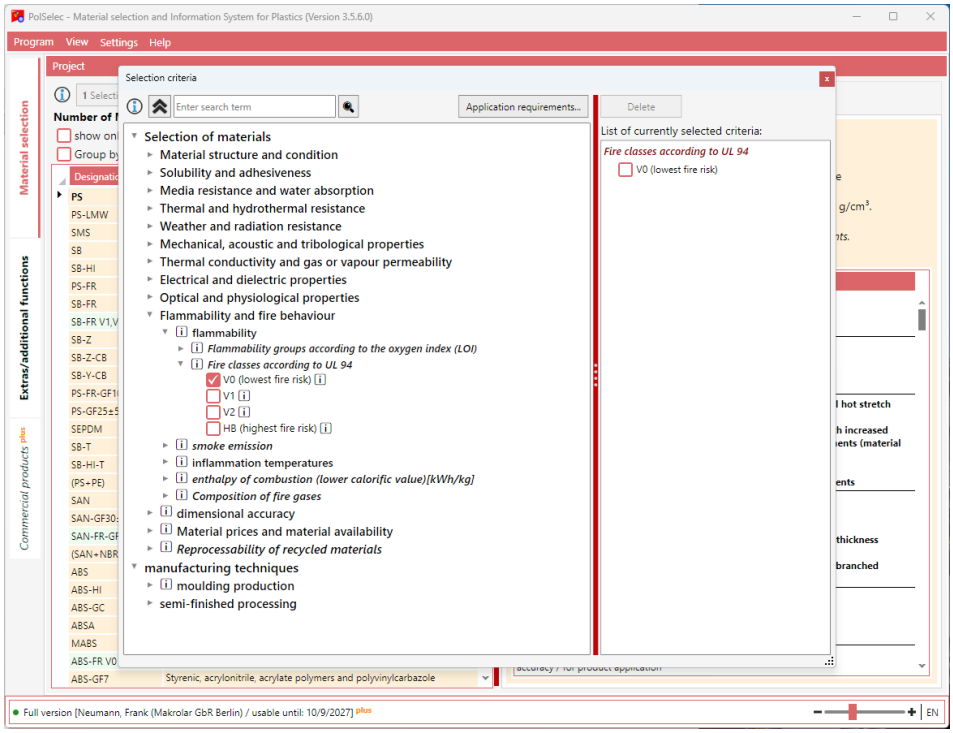


Figure 7: Criterion "V0" selected – it appears in the list of currently selected criteria on the right

> **Note:** You can combine any number of criteria from different branches. A material is considered suitable if it meets **all** selected requirements. If you select several values within one criterion (e.g. several ranges of water absorption), it is sufficient for one of them to apply.

4.3 Searching for criteria

If you do not know in which branch a criterion is located, use the search field:

1. Enter a search term in the field **“Enter search term”**, e.g. **“injection”**.
2. Click the magnifying glass to the right of the field. The number of hits is shown next to the magnifying glass, and the first hit is expanded and highlighted in the tree.
3. Click the magnifying glass again to jump to the next hit.

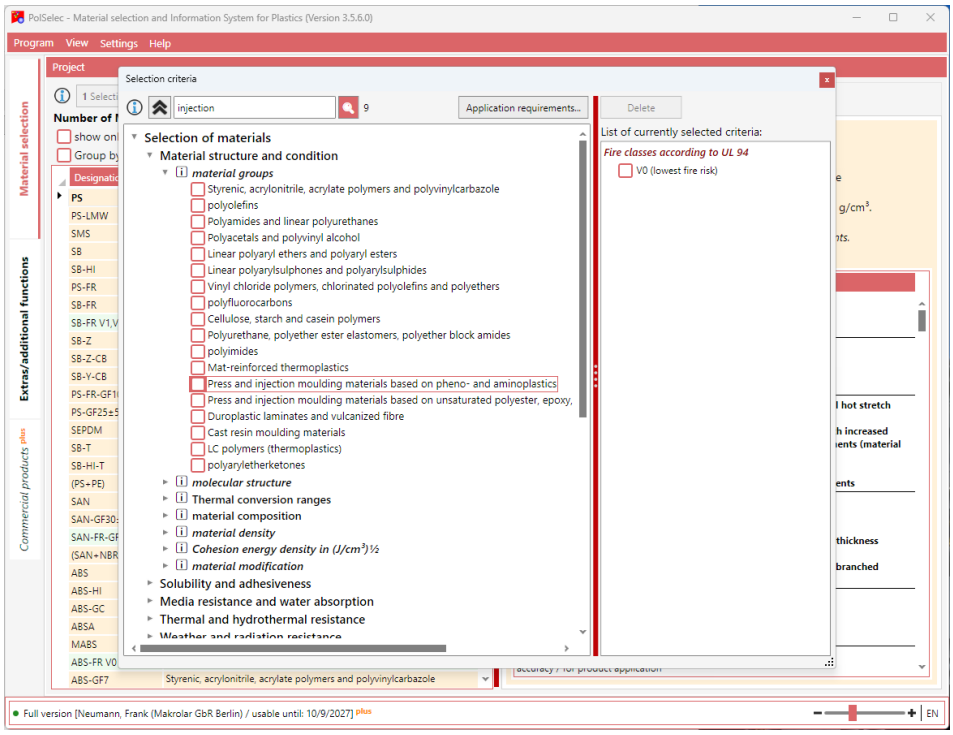


Figure 8: Search for “injection”: 9 hits, the first one is highlighted

> **Note:** The search is only started with the magnifying glass, not with the Enter key. The entire hierarchy of selection criteria is searched.

Use the button with the double arrow to the left of the search field to collapse the whole tree so that only the main branches are visible.

4.4 Displaying additional information

In many places you will find the information icon (a small **“i”**). Click it to display explanations:

- The information icon **in the upper left corner of the dialog** explains how to use the dialog.
- The information icon **next to a criterion** shows notes on that criterion, e.g. which materials are excluded by a selection.

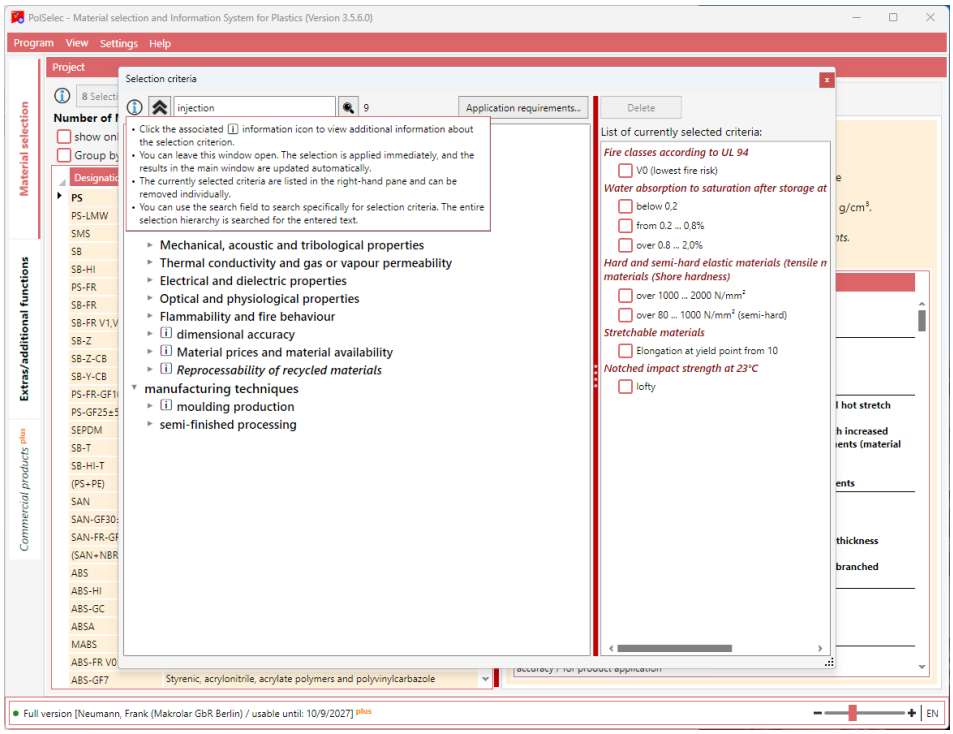


Figure 9: Instructions for the "Selection criteria" dialog

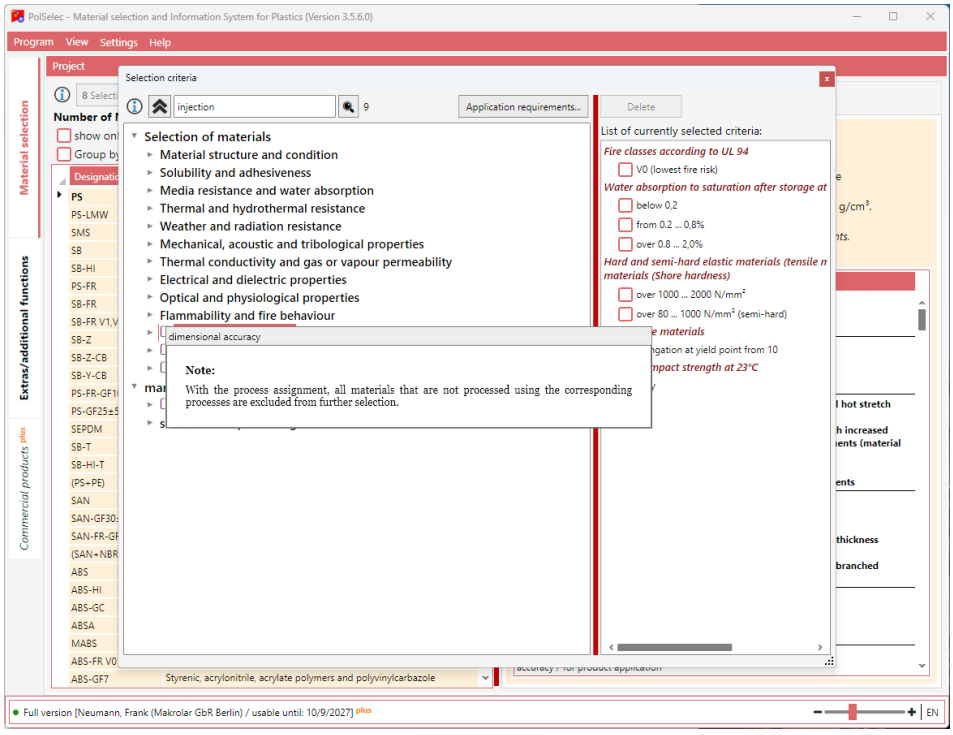


Figure 10: Note on the criterion "dimensional accuracy"

4.5 Using application requirements

For typical applications, ready-made combinations of criteria are available, the **application requirements**. You therefore do not have to put the individual criteria together yourself.

1. In the **"Selection criteria"** dialog, click **"Application requirements..."**.
2. On the left, select an application, e.g. **"Film hinge"**, **"Refrigerant resistance"**, **"Fuel Resistance"**, **"Gear and worm gears"** or **"Microwave suitability (heat resistant)"**. Each entry has a short description.

3. On the right, select the appropriate variant, e.g. **“high alternating bending frequencies”** › **“Operating temperature > 15°C”**.
4. Click **“apply selected requirement...”**.

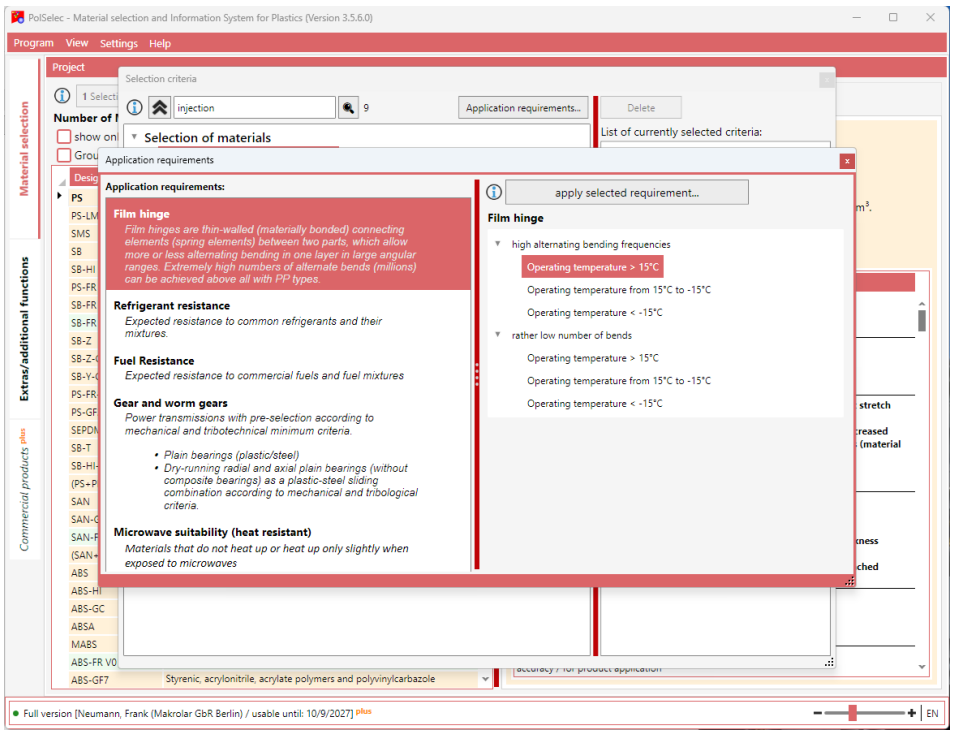


Figure 11: Application requirement “Film hinge” with the selected variant

The associated criteria are added to your selection. In the example, the number of active criteria increased from 1 to 9. Close the **“Application requirements”** window with the cross in the upper right corner. The criteria that were added are shown in the right-hand list of the **“Selection criteria”** dialog.

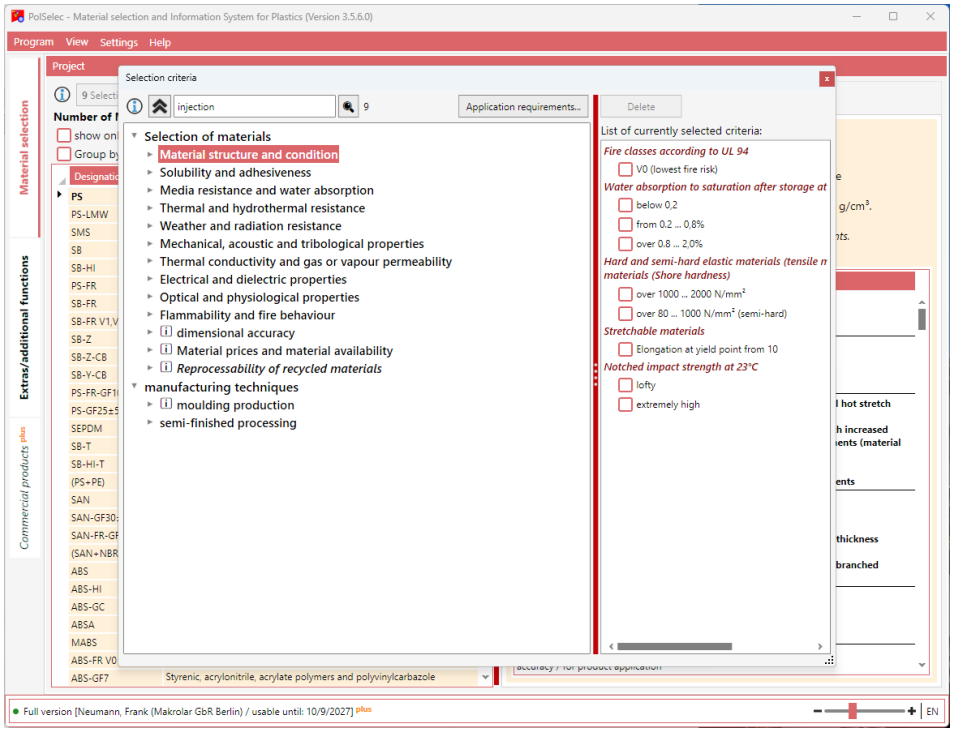


Figure 12: List of selected criteria after applying the application requirement

> **Tip:** You can then extend the added criteria or remove individual ones, just like criteria you selected yourself.

4.6 Removing criteria

1. In the list on the right (**“List of currently selected criteria”**), select the values you want to remove. They are highlighted in red.
2. Click **“Delete”** at the top right.

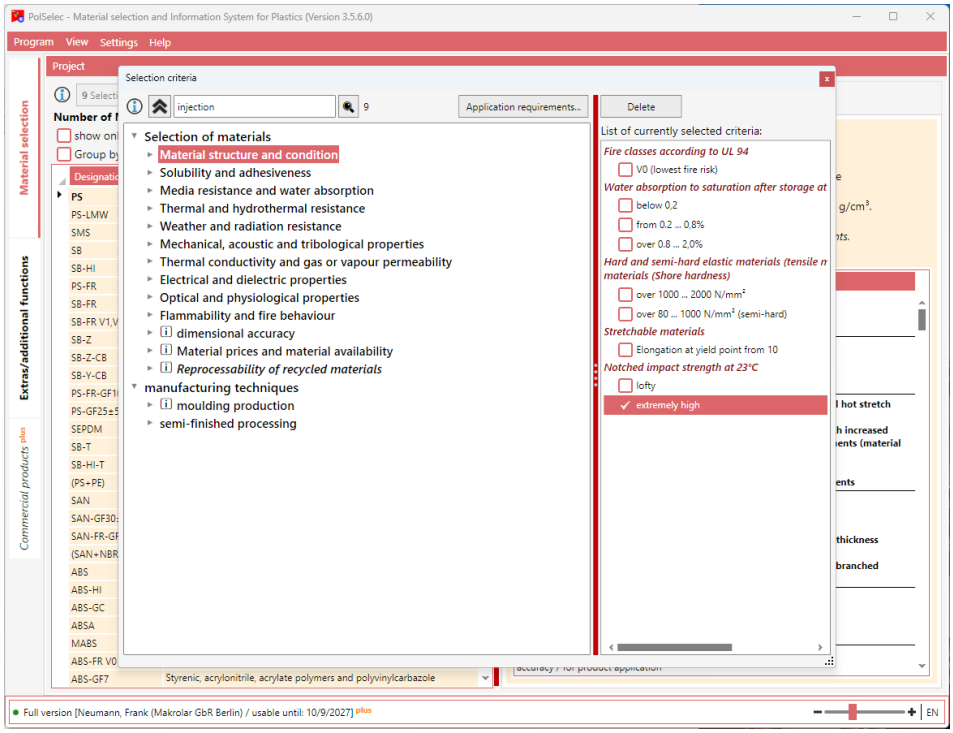


Figure 13: Criterion “extremely high” marked for removal – the “Delete” button is active

Alternatively, clear the check box directly in the criteria tree on the left.

5 Evaluating the result

5.1 Number and marking of the materials

Close the **“Selection criteria”** dialog or leave it open. Above the materials list you now see **“Number of Materials Found”**, e.g. **“6 / 868”**: 6 out of 868 materials meet all requirements.

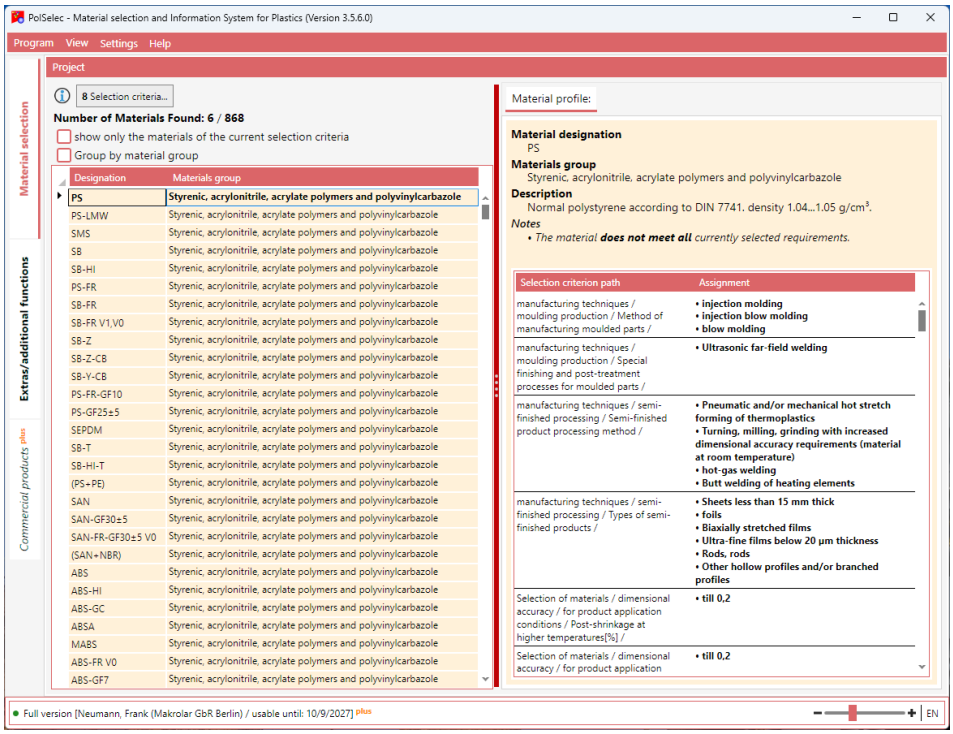


Figure 14: Main window with active selection criteria

In the materials list and in the material profile, the background colour shows whether a material is suitable:

Colour	Meaning
Green	The material **meets all** currently selected requirements.
Beige / orange	The material **does not meet all** currently selected requirements.

The material profile also states this under **“Notes”**.

5.2 Showing only suitable materials

Select **“show only the materials of the current selection criteria”**. The list then only shows the materials that meet all requirements.

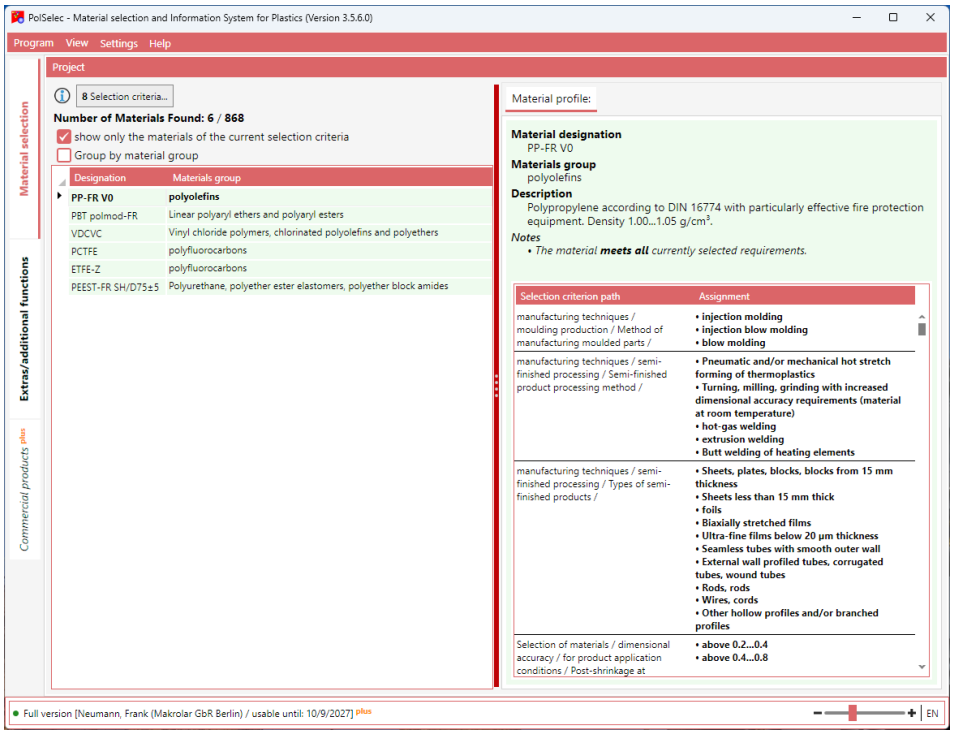


Figure 15: Only the 6 materials found are displayed

5.3 Identifying fulfilled criteria in the material profile

In the material profile, the values that match a selected criterion are marked with a **tick**. This lets you see at a glance why a material is suitable or which criterion it fails to meet.

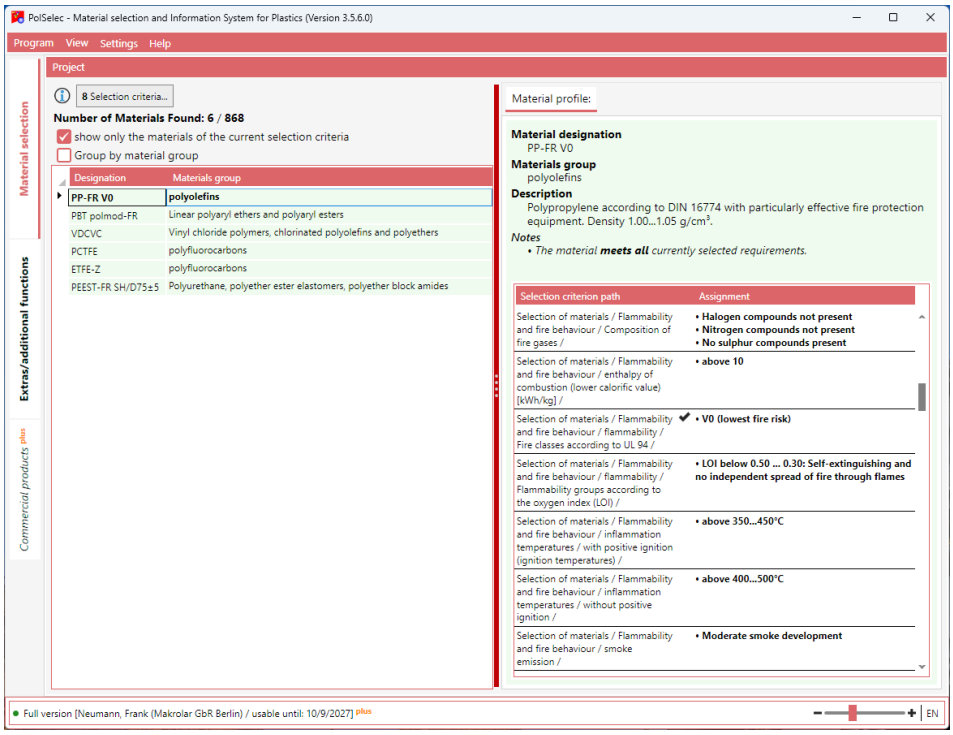


Figure 16: Tick at the fulfilled criterion "V0 (lowest fire risk)"

5.4 Legend

Click the information icon to the left of **"Selection criteria..."** to open the legend. It explains the colours and symbols used in the materials list:

- Umbrella symbol: weather-stabilized
- Flame symbol: heat-ageing-stabilised
- Tap symbol: hydrolysis- and wash liquor-stabilized
- Light bulb: preferred material in the current project (see section 6.2)

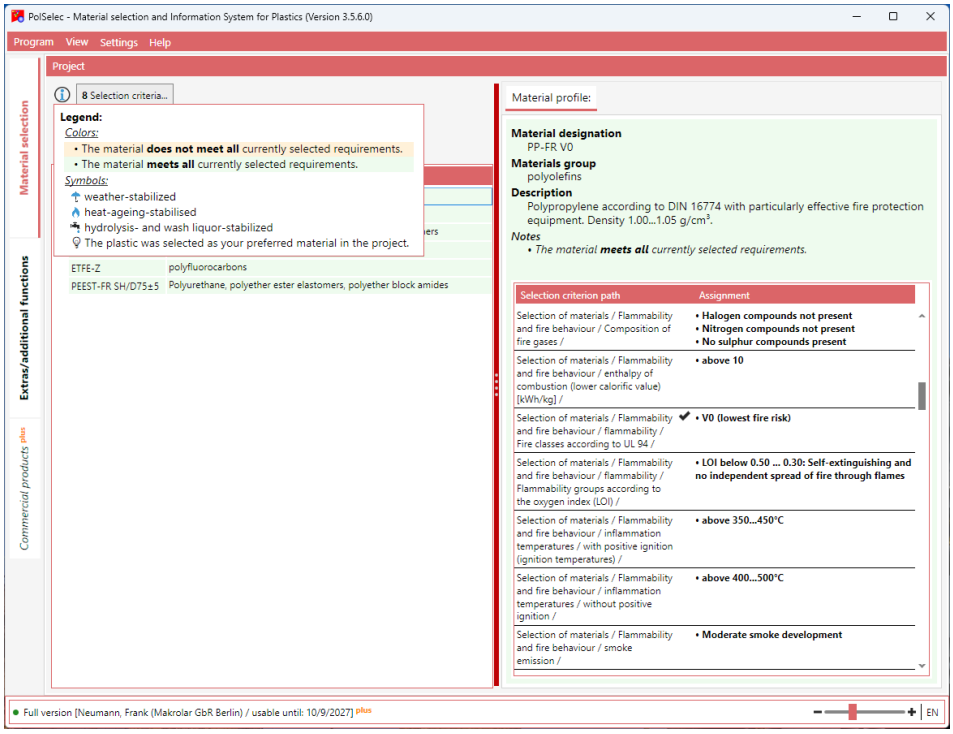


Figure 17: Legend of the materials list

6 Working with projects

You can save a selection, i.e. criteria, preferred materials and project details, as a **project** and load it again later. To do so, click the **“Project”** bar above the materials list.

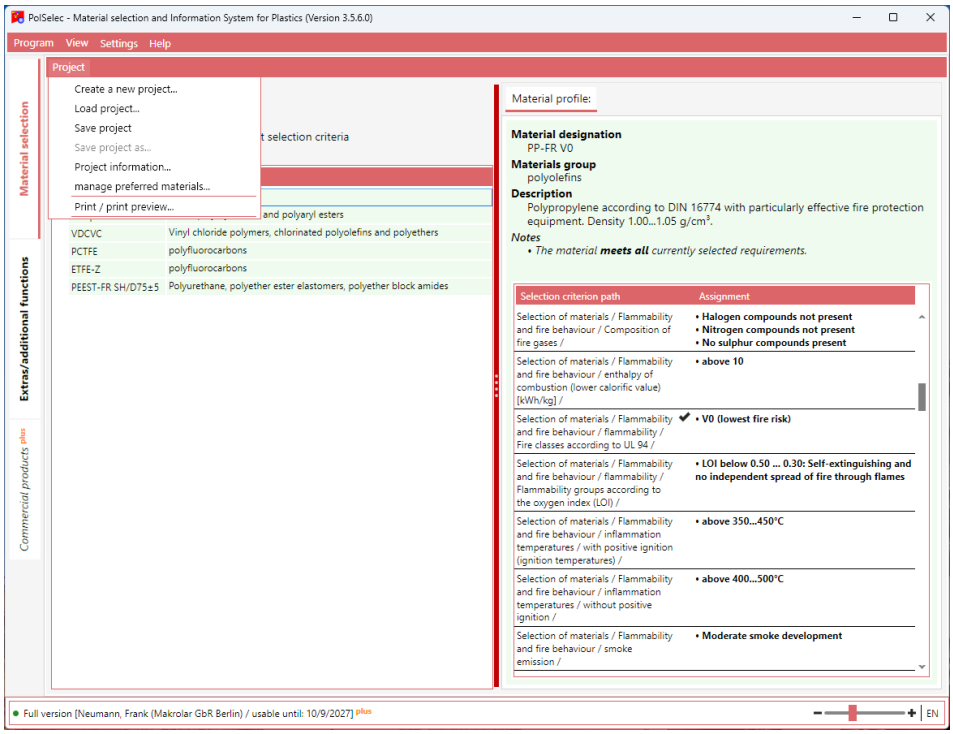


Figure 18: "Project" menu

Menu item	Function
Create a new project...	Starts a new, empty selection.
Load project...	Opens a saved project.
Save project / Save project as...	Saves the current selection as a project file.
Project information...	Enter the name, processor and description of the project.
manage preferred materials...	Mark materials as preferred.
Print / print preview...	Print the selection criteria and the list of results.

6.1 Project information

Under **"Project information..."** you enter the **Project name**, the **Processor** and a formatted **Description**. Confirm with **"Apply"**. The details also appear in the printout.

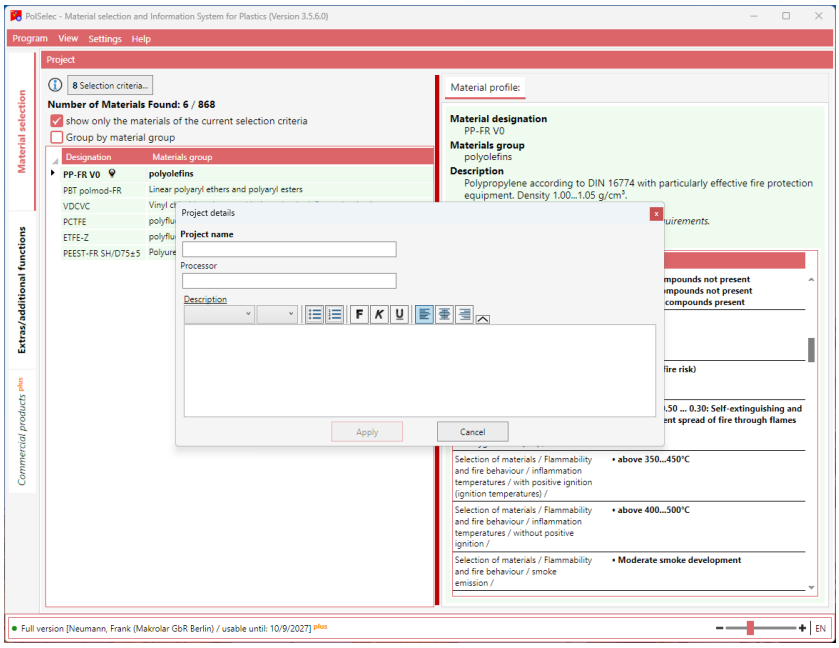


Figure 19: "Project details" dialog

6.2 Preferred materials

Materials that are preferred in your company, e.g. because they are already approved or available, can be specially marked in the project:

1. In the **"Project"** menu, choose **"manage preferred materials..."**.
2. Narrow down the list using the **"Search text"** field, e.g. with **"PP-FR"**.
3. Select the materials you want and click **"Add"**. They appear in the lower list.
4. Click **"Apply"**.

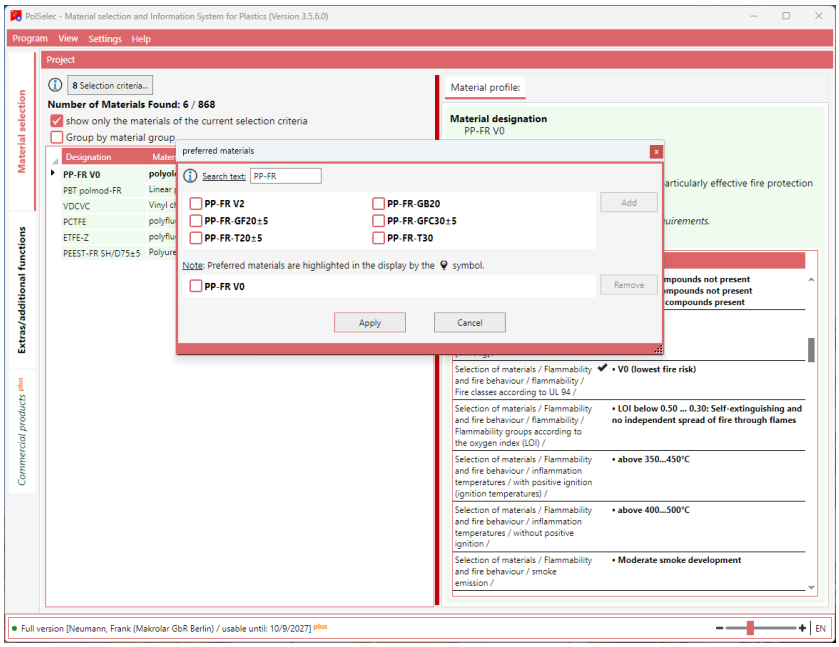


Figure 20: PP-FR V0 has been added as a preferred material

Preferred materials are marked with a **light bulb** in the materials list. To remove a material again, select it in the lower list of the dialog and click **"Remove"**.

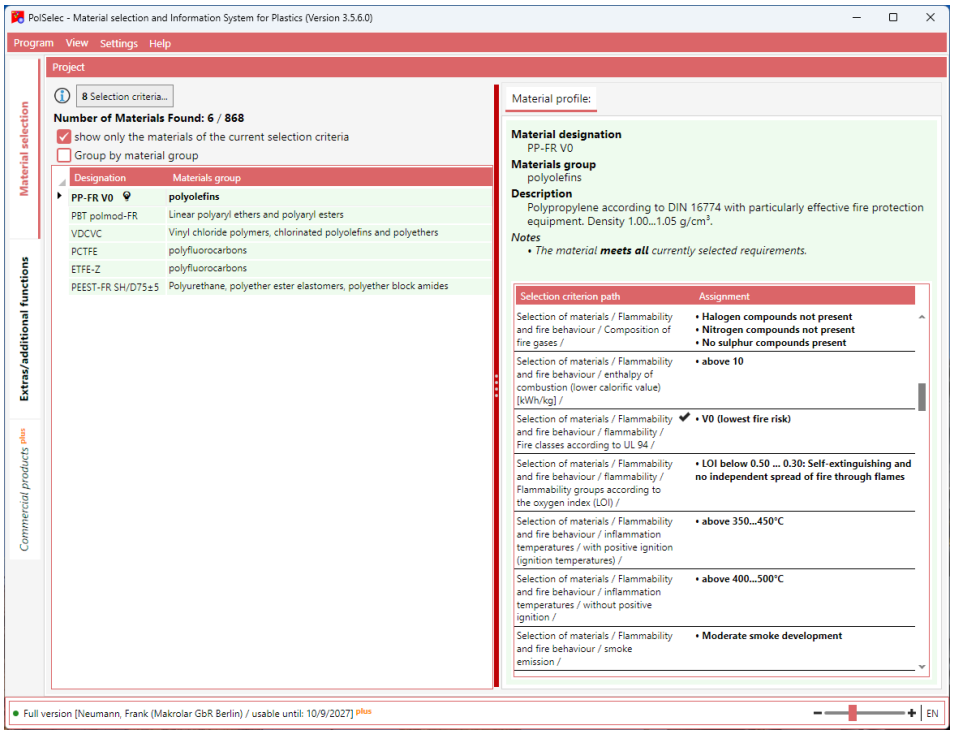


Figure 21: Preferred material with light bulb symbol in the materials list

6.3 Printing

“Print / print preview...” opens a preview containing the project details, all selection criteria with their path in the criteria tree, the legend and the list of results. Use the printer icon at the top to print the report. At the bottom right you can choose the page view and zoom the preview in or out.

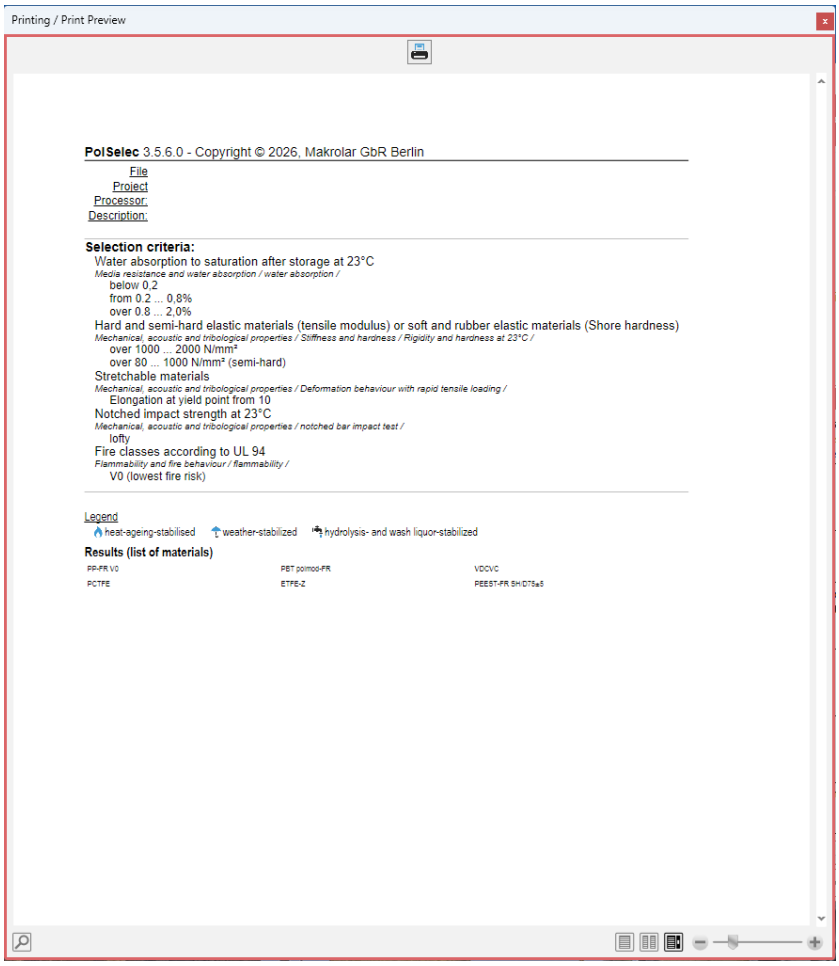


Figure 22: Print preview of a material selection

7 The “Extras/additional functions” tab

The **“Extras/additional functions”** tab on the left edge of the window gives access to four calculation and information tools. Select them with the sub-tabs at the top:

Sub-tab	Purpose
Percentage of regenerate (Thermoplastic processing)	Forecast of how a regenerate content affects a property over several processing cycles.
Heat aging (Application temperatures)	Expected application time of a material depending on the application temperature.
Continental and marine climate zones (Calculation of water saturation concentration)	Climate-dependent water saturation of the materials for a selected climate zone.
Climate maps (UV radiation and temperatures)	World maps of UV radiation and annual temperatures as a decision aid.

Some sub-tabs show a help text on the right. Use the **“Help”** tab on the right edge to hide and show it. With the help hidden, the chart has more space.

7.1 Percentage of regenerate

Here you determine how much regenerate (recycled material) you can add to a thermoplastic without a property limit being undershot or exceeded. The basis is a **measurement series** (master curve): it describes the measured course of a property at 100 % regenerate over several processing cycles. PolSelec contains about 200 such measurement series.

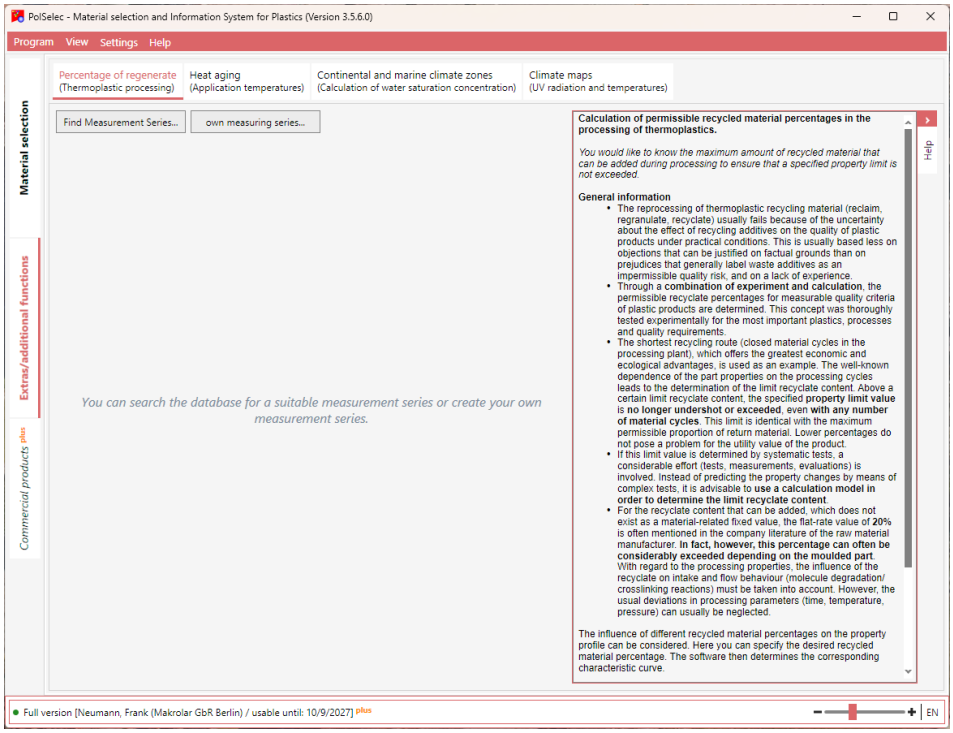


Figure 23: "Percentage of regenerate" sub-tab before a measurement series is selected

Selecting a measurement series:

1. Click **"Find Measurement Series..."**. The **"Search Measurement Series"** dialog lists all measurement series with moulding material/material, property, unit, manufacturing process and addition rule.
2. Narrow down the list using **"Material designation"** (e.g. **"PA6"**) and/or the **"Property"** drop-down list.
3. Double-click the measurement series you want, e.g. **"PA6 / tensile strength / Injection moulding"**. The lower part of the dialog shows the product designation, property specification, processing conditions and the source.
4. Close the dialog with the cross at the top right. The chart now shows the measurement series.

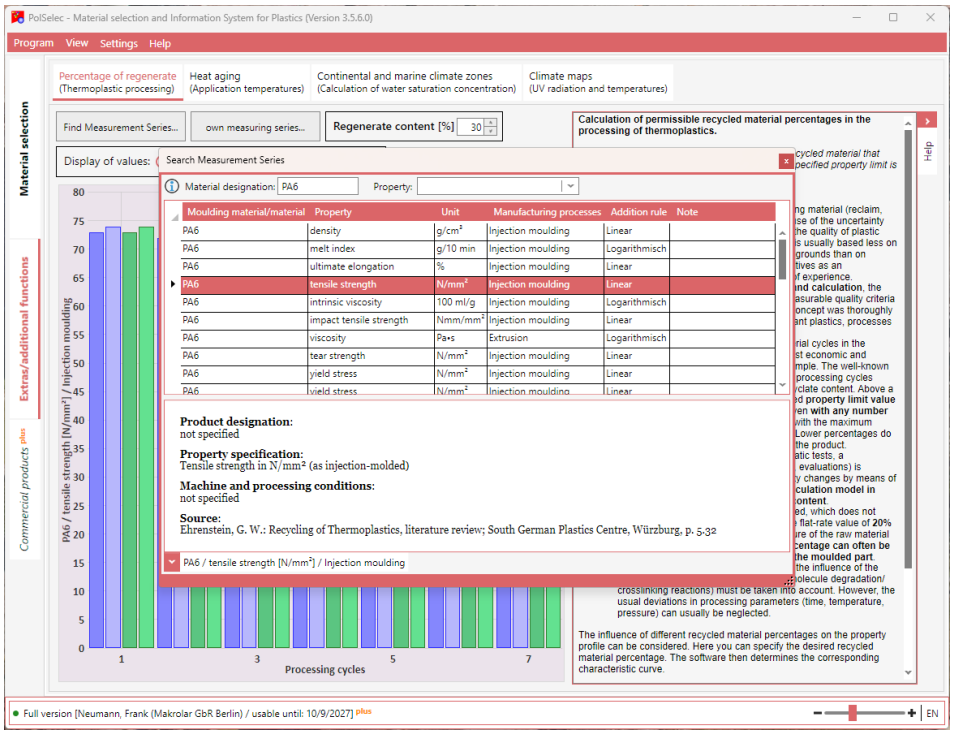


Figure 24: Selected measurement series with its source in the "Search Measurement Series" dialog

Reading the chart: The x-axis shows the processing cycles, the y-axis the selected property. For each cycle, the blue bars show the minimum and maximum values of the master curve (100 % regenerate), the green bars the calculated values for the regenerate content you have set. Point the mouse at a bar to display the values for that cycle.



Figure 25: Chart with the values for cycle 1 at 30 % regenerate content

Settings:

- **Regenerate content [%]** – enter the desired percentage or change it with the arrows. The chart is recalculated immediately.

- **Display of values “absolute”** – the y-axis starts at zero.
- **Display of values “relative”** – the y-axis is stretched to the range of the data, so that even small differences become visible.
- **Average Values** – instead of minimum and maximum, only the mean value of the master curve and of the regenerate content is shown per cycle.

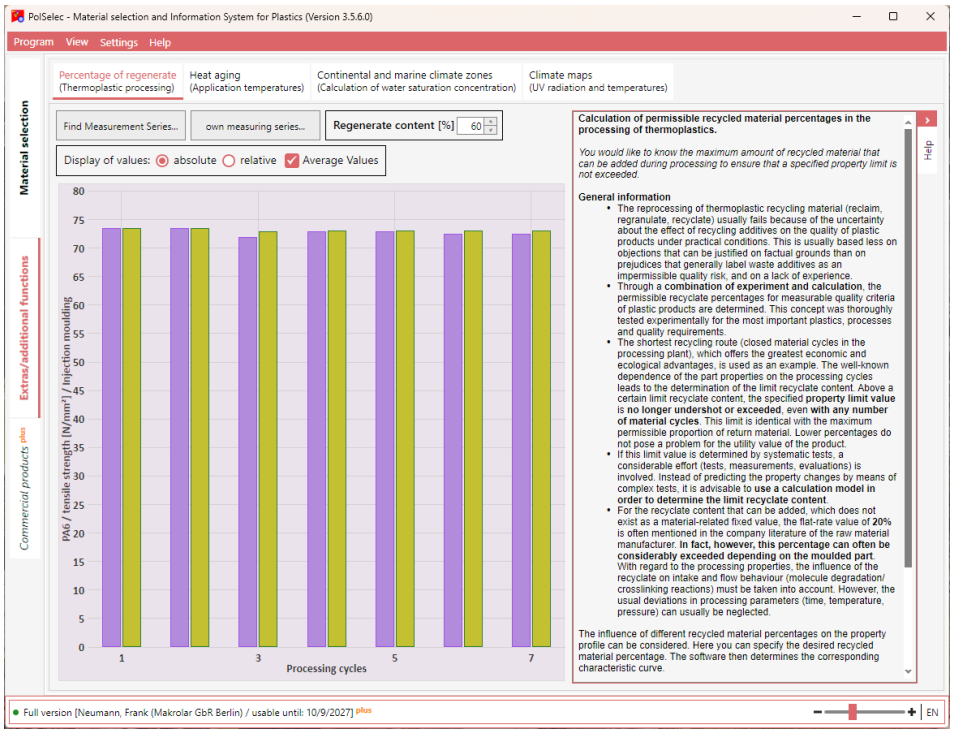


Figure 26: 60 % regenerate content, average values displayed

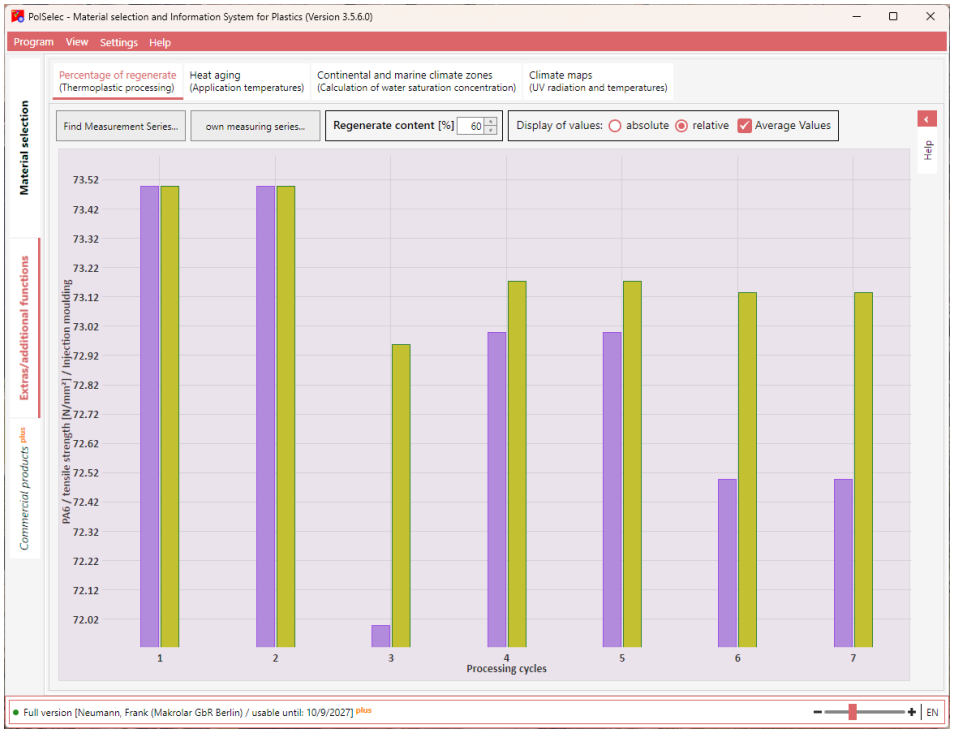


Figure 27: Relative display with the help text hidden

Creating your own measurement series: Use **“own measuring series...”** to enter your own measured values. Enter the moulding material/material, property, unit and manufacturing process, select the

addition rule and enter the values (from/to) for at least 6 processing cycles in the **“Measurement series”** table. **“Apply”** adds the measurement series to the chart.

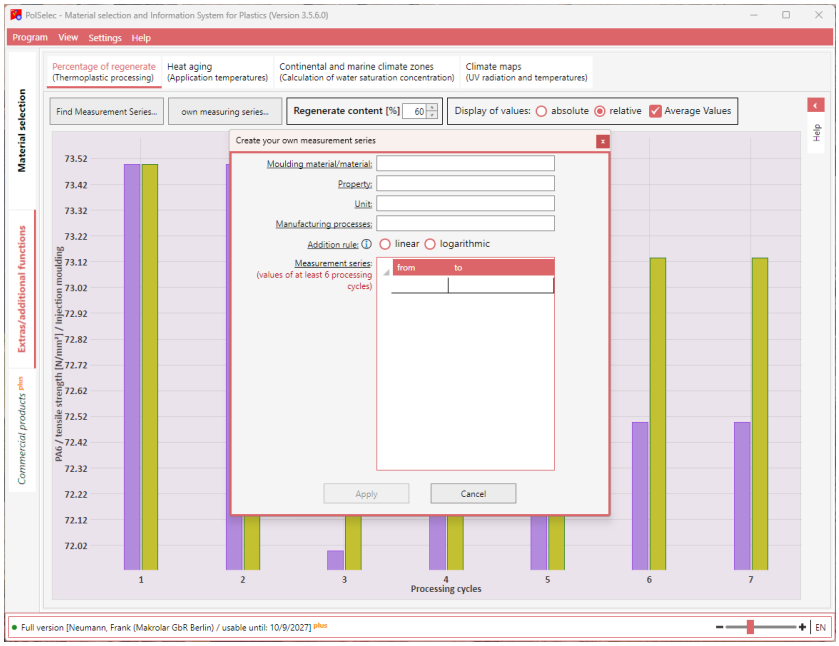


Figure 28: “Create your own measurement series” dialog

> **Note:** The **logarithmic model** applies to properties determined by heat or mass transport processes (e.g. viscosity, stress cracking, thermal conductivity). For all other properties the **linear model** is sufficient. This explanation is also available via the information icon next to **“Addition rule”**.

7.2 Heat aging

Here you can see how long a plastic can be used at a particular application temperature. PolSelec converts the stored continuous heat resistance (based on 3 years) to other temperatures using the Arrhenius law. A constant effect of the temperature is assumed.

1. Select a material in the **“PolSelec material”** list. You can also type the designation, e.g. **“PA6”**, and confirm with Enter.
2. PolSelec shows the permissible application temperature for 3 years of continuous temperature load, e.g. **“from 75 to 90°C”**.
3. The chart contains one curve for each temperature level in this range. It shows the application time in years over the application temperature.
4. Use **“Display range of application temperature – from:”** to set the lower limit of the x-axis.

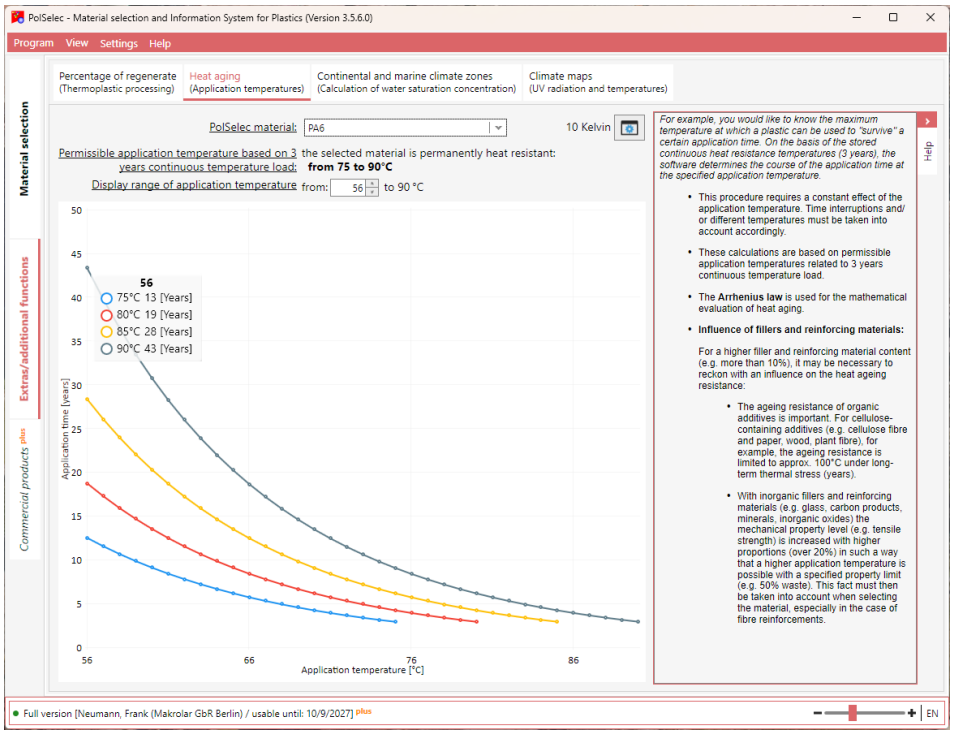


Figure 29: Heat aging for PA6 – values at an application temperature of 56 °C

Point the mouse at a point on a curve to see the application times of all curves for that temperature. In the example, PA6 of the 90 °C level can be used for about 43 years at 56 °C.

Options: The button next to **“10 Kelvin”** opens the **“Options”** dialog. There you specify the temperature change at which the service life of organic materials is halved (experience-based Montsinger rule, default 10 Kelvin). **“Apply”** recalculates, **“Default values”** restores the initial value.

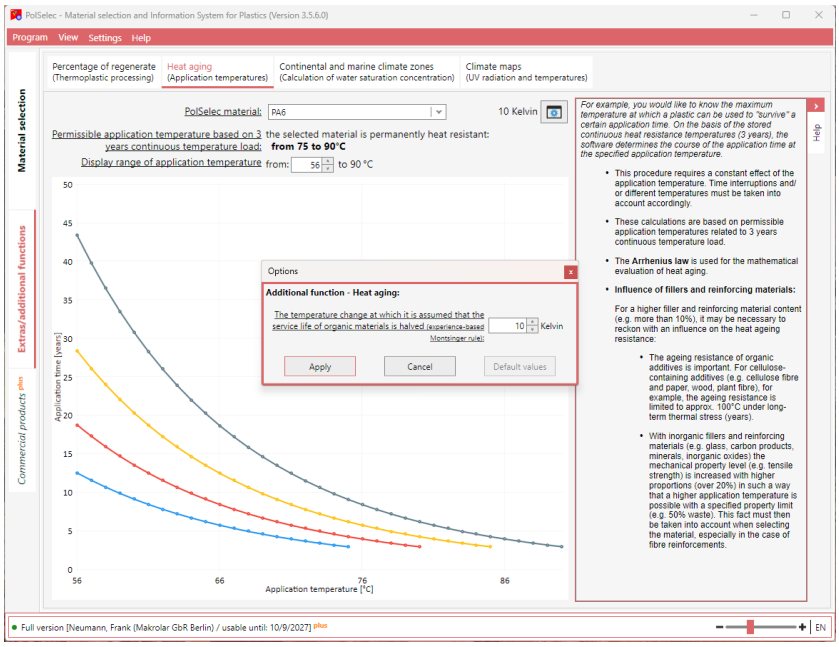


Figure 30: “Options” dialog for heat aging

> **Note:** With filler and reinforcing material contents above about 10 %, the heat ageing resistance may change. Notes on this can be found in the help text to the right of the chart.

7.3 Continental and marine climate zones

Plastics absorb different amounts of moisture depending on the climate. This sub-tab uses the water saturation concentration (water storage) to calculate the climate-dependent water saturation concentration for a selected climate zone.

1. On the left, select the **“Continental climate”** or **“Marine climate”** tab.
2. If required, use the **“Legend”** tab on the right edge to show the meaning of the colours.
3. Double-click the desired region on the map. The **“Climate-dependent water saturation concentration”** window opens.

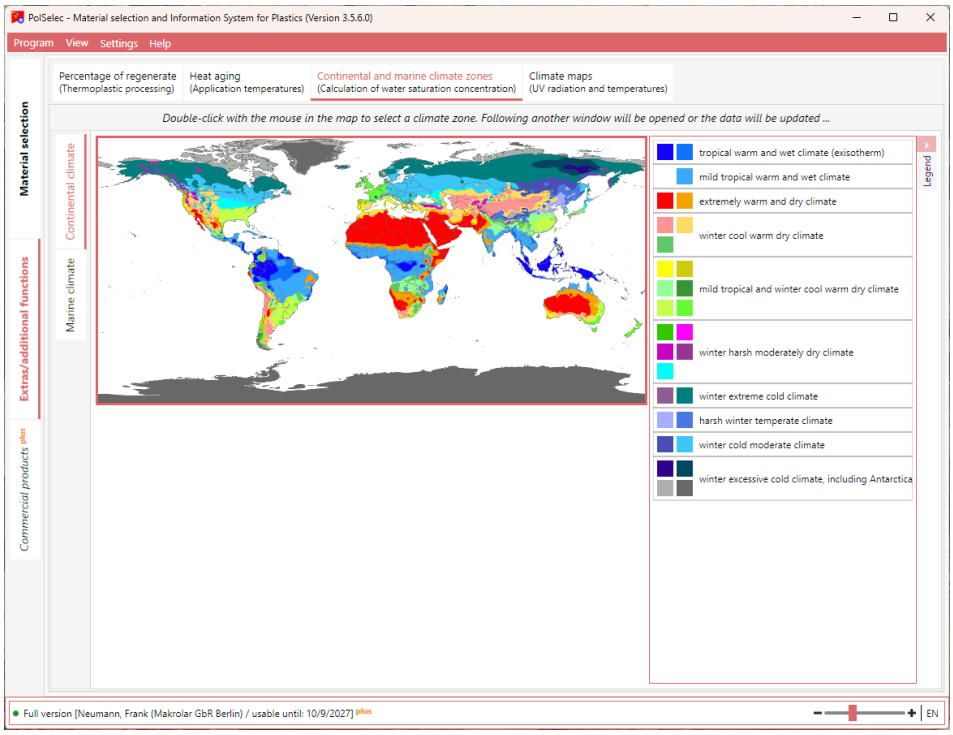


Figure 31: Map of the continental climate zones with the legend shown

> **Tip:** When you hover over the map, a magnifier appears. Double-click a clearly coloured area; areas without an assigned climate zone do not open a window.

The window shows the selected climate zone and the absolute humidity at the base point at the top. For each material, the table shows the water saturation concentration for water storage and, next to it, the **calculated climate-dependent** water saturation concentration.

- **Filter** – shows only materials whose designation contains the text entered (e.g. **“PA6”** also finds PA66).
- **own value of the water saturation concentration** – enter your own value; the climate-dependent value appears to the right.

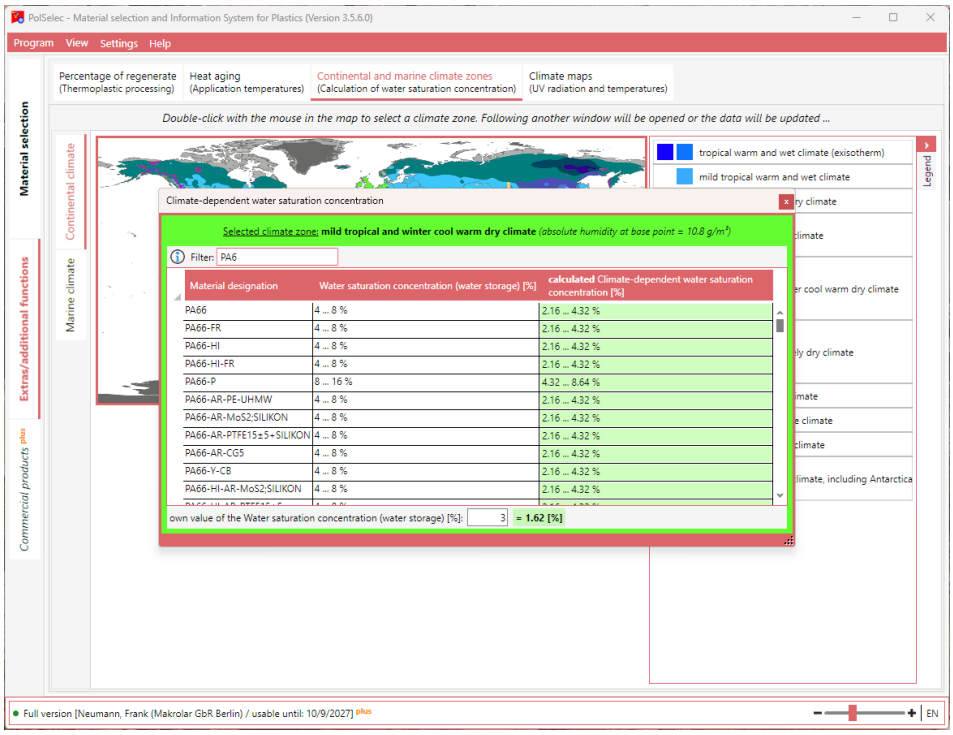


Figure 32: Result window for the mild tropical and winter cool warm dry climate, filtered by "PA6"

> **Tip:** You can leave the window open and double-click another region of the map. The values are then recalculated immediately for the new climate zone.

In the **"Marine climate"** tab, the map distinguishes between cold, temperate and warm marine climate. It is operated in the same way.

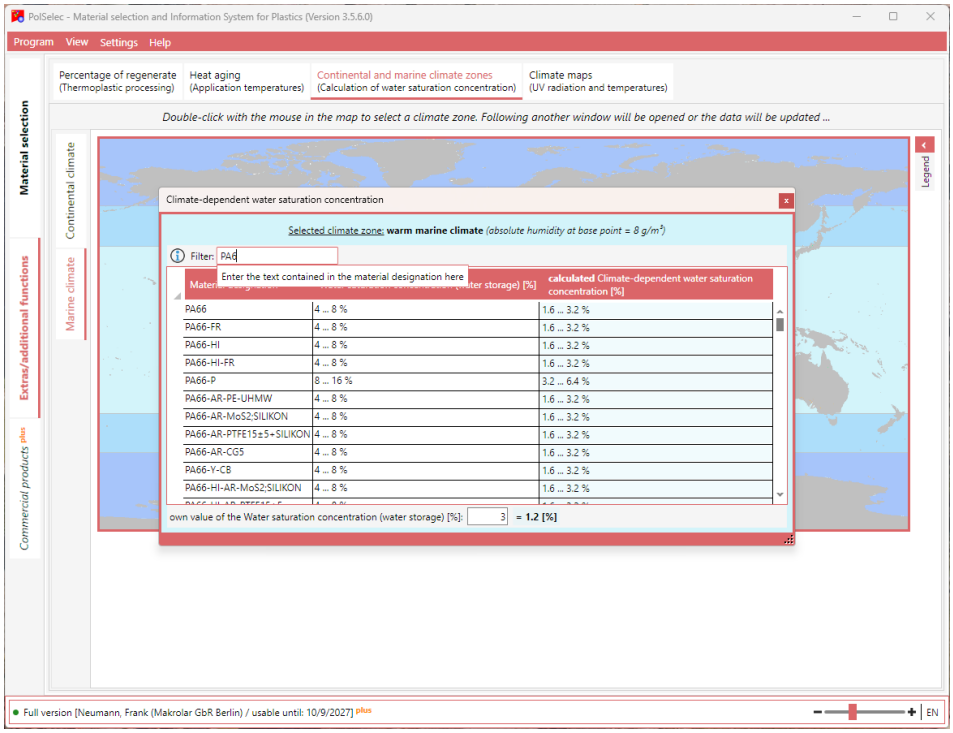


Figure 33: Result for the warm marine climate

7.4 Climate maps

The climate maps help you estimate the loads to which a component is exposed at its place of use.

- **Global UV radiation** – average annual global horizontal irradiation in kWh/m². The legend on the right classifies the ranges: below 1100 kWh/m² no UV stabilisation is required for many plastics, above 1800 kWh/m² the requirements for UV stability are highest.
- **Global annual temperatures** – select **“minimum temperature”**, **“maximum temperature”** or **“average temperature”** at the top to display the corresponding world map.

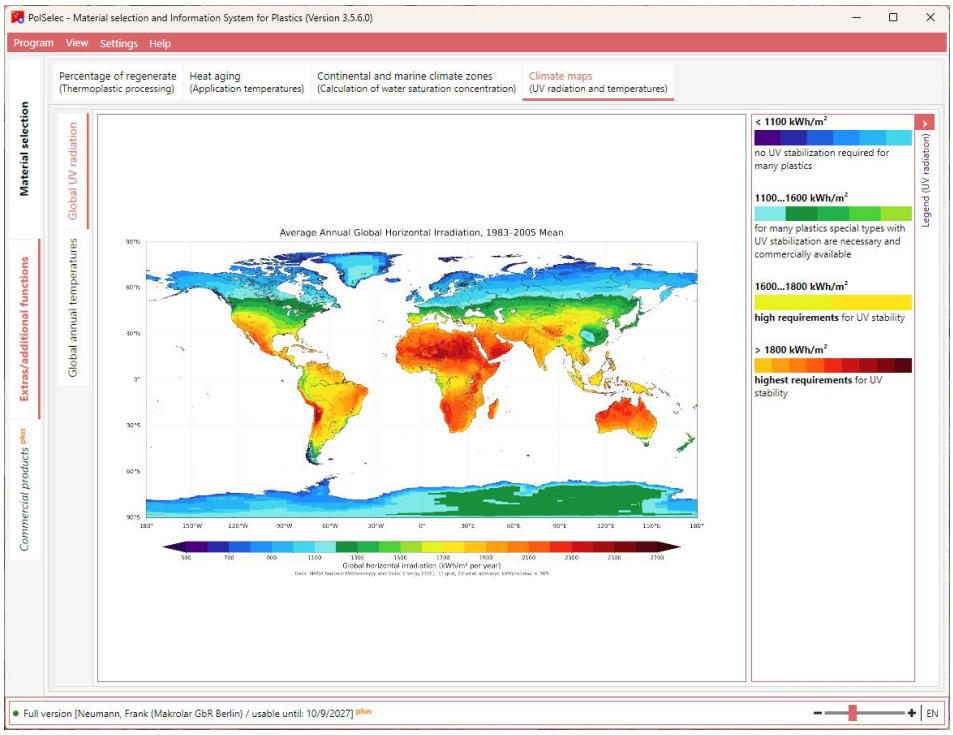


Figure 34: Global UV radiation with legend

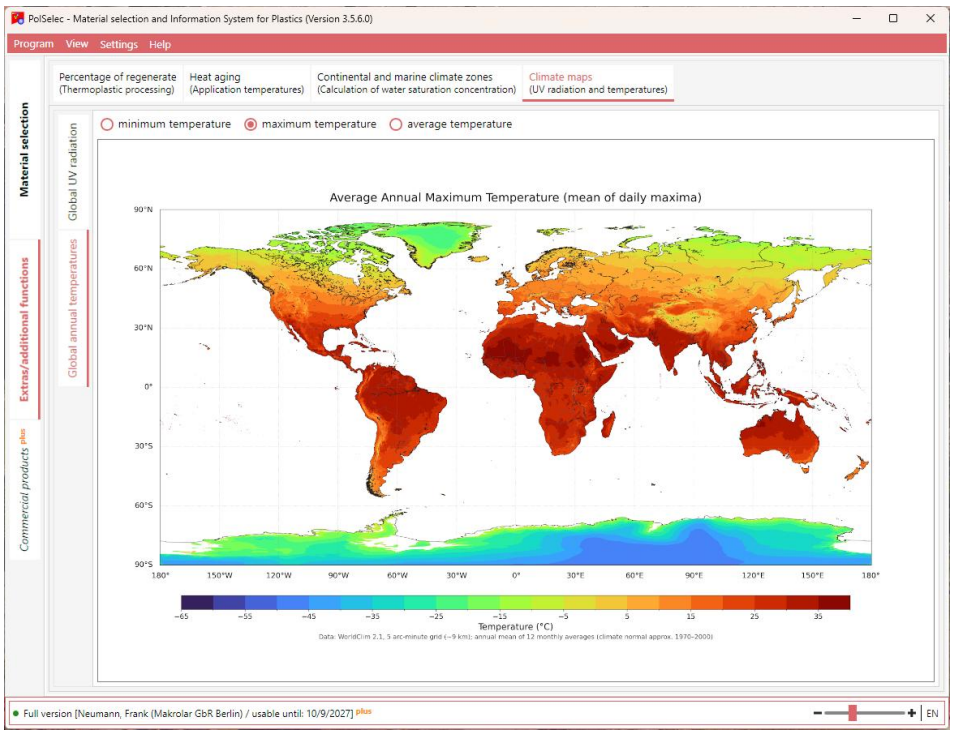


Figure 35: Average annual maximum temperature

8 Quick guide: five steps to the right material

1. Open **“Selection criteria...”**.
2. Select requirements in the criteria tree or apply a suitable application requirement; use the search if needed.
3. In the main window, select **“show only the materials of the current selection criteria”**.
4. Click the materials found one after the other and check the material profile. Ticks show the fulfilled criteria.
5. Save the selection as a project and print it if required.

9 Tips and frequently asked questions

Question	Answer
No materials are found.	The combination of requirements is too strict. Remove individual criteria or select further values within a criterion, and watch the **“Number of Materials Found”**.
The search in the criteria tree does not respond.	Start the search by clicking the magnifying glass, not with the Enter key.
I cannot see any ticks in the material profile.	Ticks only appear for criteria that are currently selected. Scroll down in the profile table if necessary.
The text is too small.	Zoom in using the slider (– / +) at the bottom right of the status bar.
What exactly does a criterion mean?	Click the information icon next to the criterion.
The chart under **“Extras/additional functions”** is too narrow.	Hide the help text using the **“Help”** tab on the right edge.
Which values are behind a bar or curve point?	Point the mouse at it; a tooltip shows the values.