User's Guide to the Educational Version of RAWMATMIX®

(edu.rawmatmix.com)

RAWMATMIX® is a cloud-based software which is used in melting plants, where raw materials are mixed and melted to produce a specific target product. This software can calculate the result of mixing of different raw materials, which are melt analysis and energy consumption, and also optimize the usage of raw materials, which means the cheapest mixture of raw materials is calculated.

The educational version of RAWMATMIX® consists of the different sections, shown in the left menu of the page when you log in. There are three libraries: Furnace, Material/Energy and Target Product. Libraries are not modifiable by the users. Users can start to make to charges and do calculations in Start Melting, and all calculations done by the users are available in User Charges & Assignment Result. All sections are described in details as follows:

Furnace Library

There are there types of furnaces defined in the system:

1- Electric Arc Furnace
2- Induction Furnace
3- Gas-Fired Furnace

Information for each furnace is shown by clicking on the furnace name on the left menu.

Each furnace includes Energy Setup, Furnace Setup and Plant Data describes as follows:

Energy Setup: energy sources selected for each furnace which can include electricity, burner, carbon, oxygen and water based on the selected furnace. The price and carbon foot print (CO_2 production) for each energy source can be shown by mouse over the energy source name.

Furnace Setup: the defined parameters are tap temperature, tap weight, average power on, average power on Heat loss, average power off time, average idle, average idle time, and idle/power off heat loss.

Plant Data: the defined parameters based on the selected furnace can be furnace availability, staff costs, overhead, maintenance, melt production and slag disposal.

Material/Energy Library

There are eight types of materials:

1. Scraps, alloys, DRI/HBI
2. Carbon sources
3. Electricity
4. Slag formers
5. Energy gas
6. Media
7. Process gas
8. Reduction agent

There are different material groups which contain one or several materials which can be visible by clicking on the blue arrow close to the material group name.

The first type (Scrap, alloys, DRI/HBI) is categorized based on final production type, Iron based, Copper based or Aluminum based. The rest of materials (2 – 8) lie under the general category.

Information for each material is shown by clicking on the material name.

The common parameters defined for all materials are price and carbon foot print (kg CO_2eq per kg or GJ). The first type (Scrap, alloys, DRI/HBI) has percentage of foreign material and melt and slag composition in which concentration of each element is defined.

Target Product Library

There are different target product groups which contain one or several target products which can be visible by clicking on the blue arrow close to the target product group name. Target products can be Iron based, Copper based or Aluminum based.

Information for each target product group is shown by clicking on the target product group name, and information for each target product is shown by clicking on the target product name.

Parameters defined for each target product groups are:

- Distribution Factors

For each metallic element, *i*, a distribution factor is defined as:

$$d_i = \frac{m_i^{melt}}{m_i^{melt} + m_i^{slag}}$$

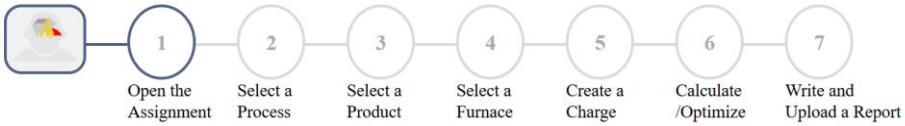
, where m_i^{melt} is mass of element *i* in melt, and m_i^{slag} is mass of element *i* in slag.

- Charged materials

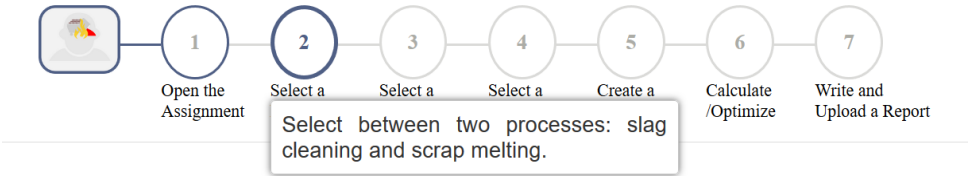
Name of charged materials and their prices are listed. The composition of each raw material is shown by mouse over the material name.

Start Melting

This is the first step in making calculations, and it consists of several stages, as shown below:



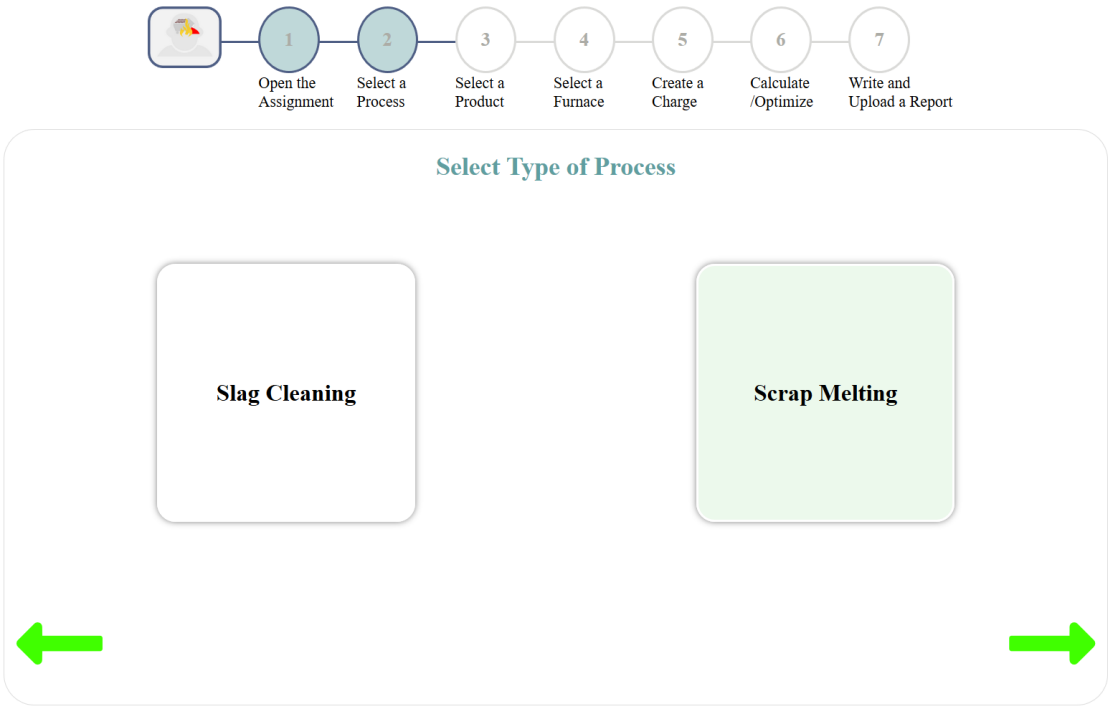
By putting the mouse over each step, you can see more explanations about that step:



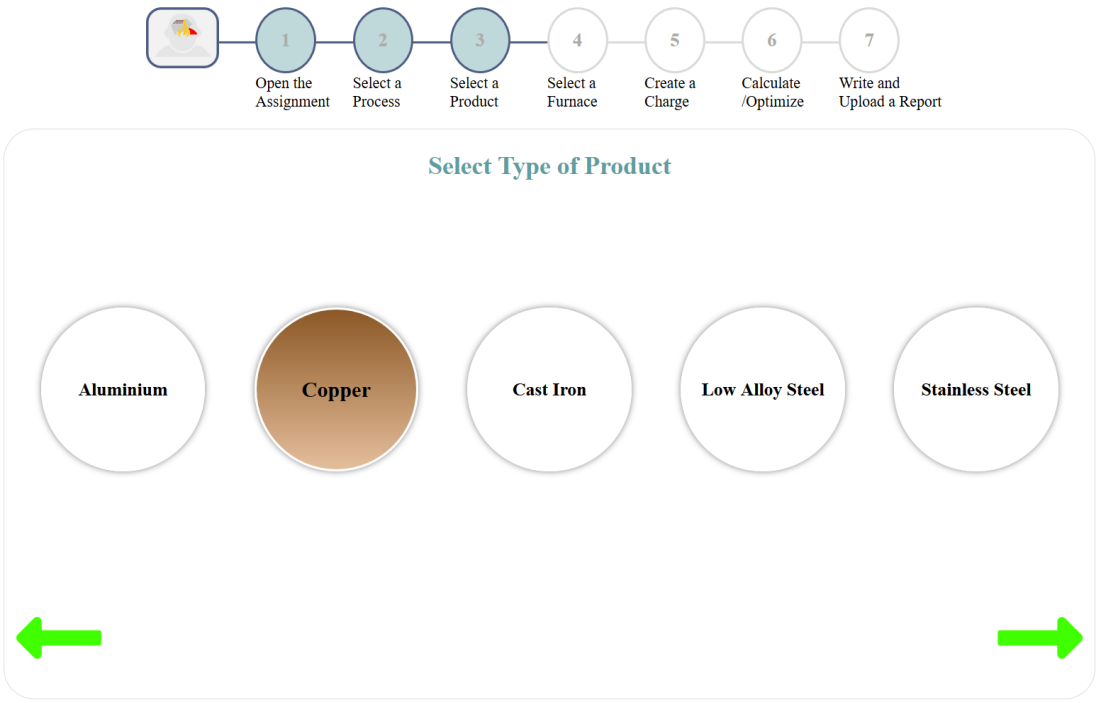
In order to proceed to the next stage, you need to select an option, and then click on an arrow down to the page which has become green or in some stages, click on buttons.

1. Open the Assignment: This stage is shown for students. At this stage, students can open the assignment uploaded by the course administrator by clicking on the assignment picture. They should read the assignment description carefully, before they go to the next stage.

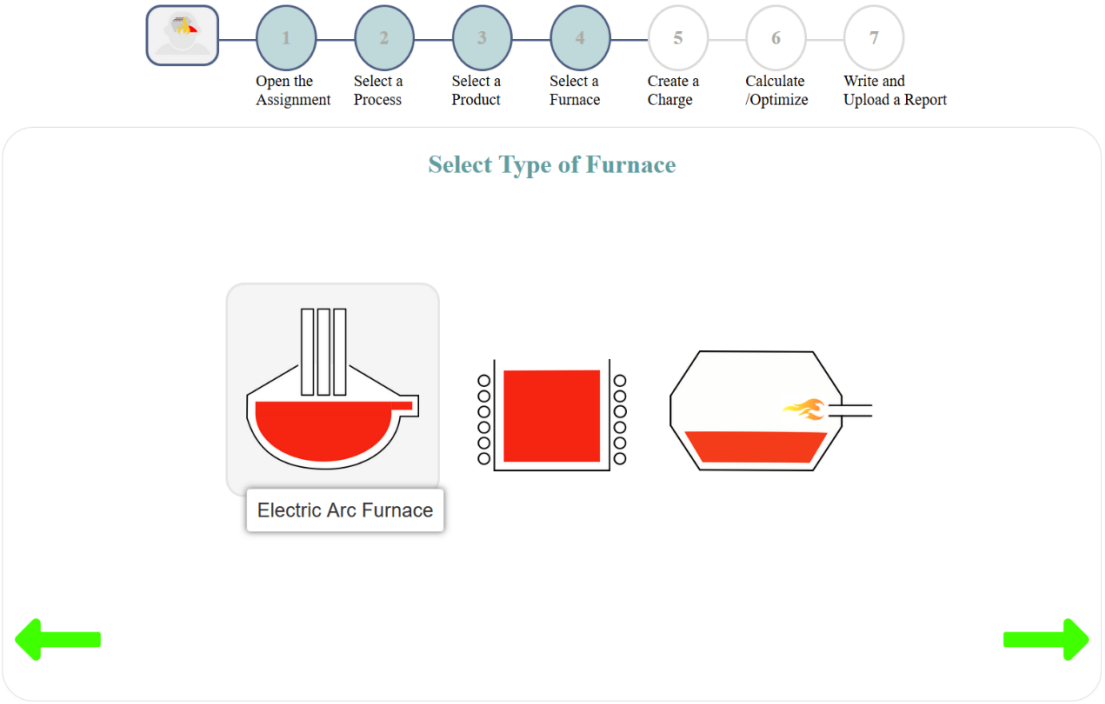
2. Select a Process: The process can be Slag Cleaning which is cleaning copper matte smelting slag, or Scrap Melting.



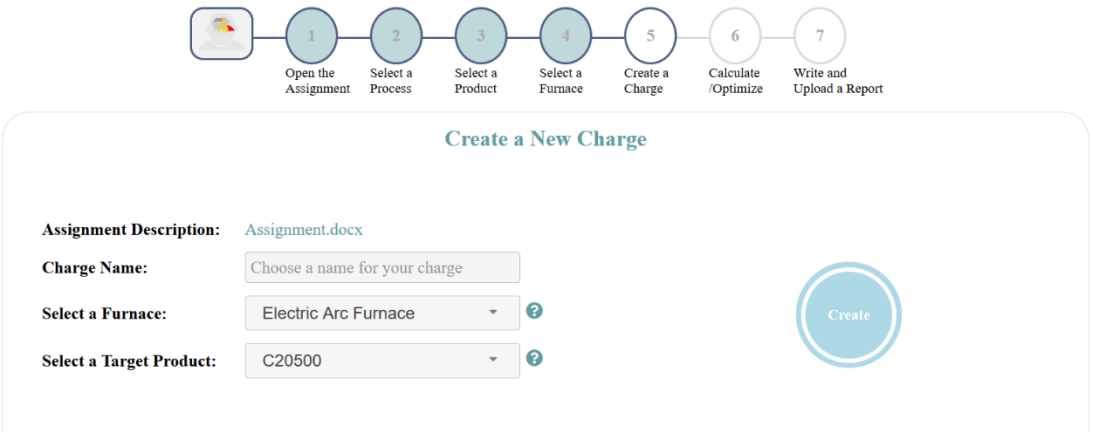
3. Select a Product: type of product you need to melt is selected as: Aluminum, Copper, Cast Iron, Low Alloy Steel or Stainless Steel. If the Slag Cleaning process is selected in the previous stage, only the copper product can be selected.



4. Select a Furnace: Type of Furnace is selected which can be Electric Arc Furnace, Induction Furnace or Gas-Fired Furnace. The Gas-Fired Furnace cannot be used for the Slag Cleaning process.

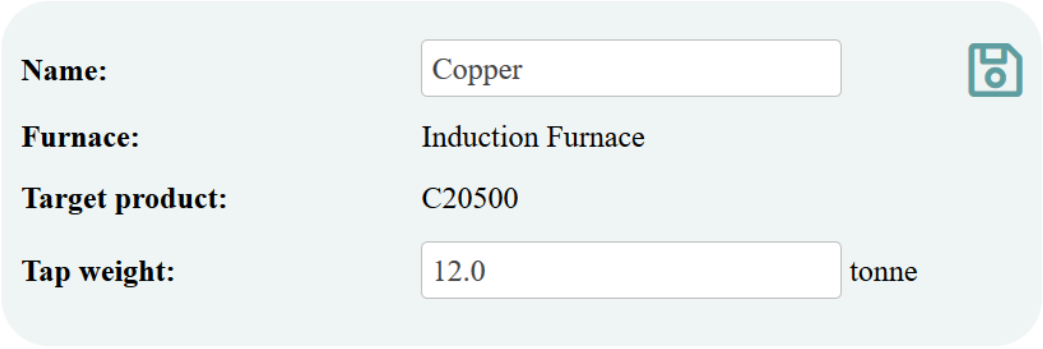


5. Create a Charge: You need to write a name for the charge you want to create, and select a target product based on the assignment description.

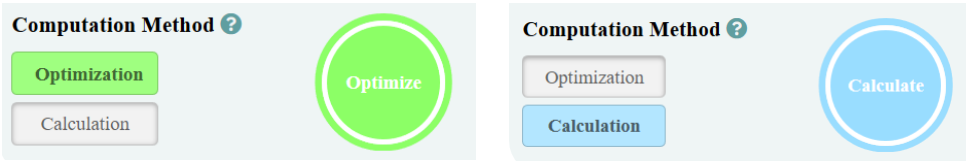


6. Calculate/Optimize: The charge is created and is ready for calculation/optimization. The page includes the following sections:

- At the top left side of the page, you can rename the charge and change the tap weight. The selected furnace and target product are shown in this section.

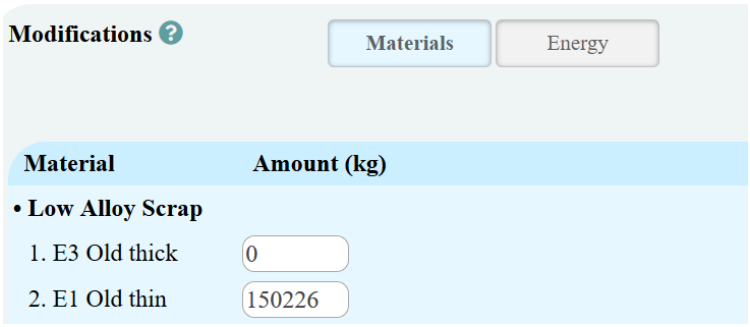


- At the top right side of the page, you can see the assignment description uploaded by the course administrator. You can select a computation method, Calculation or Optimization by clicking on the corresponding buttons, shown below:

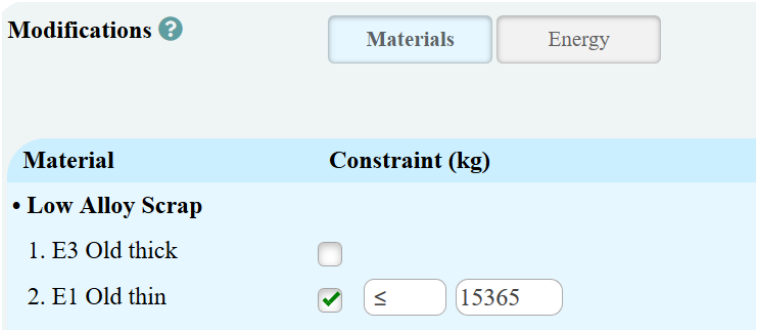


For the Slag Cleaning process, only calculation option can be used.

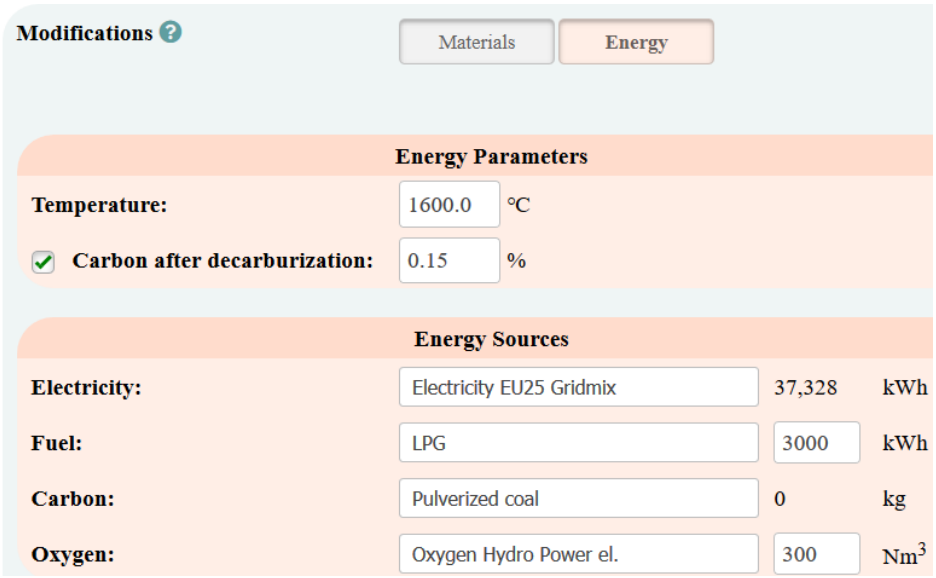
- At the bottom left side of the page, you can modify materials and energy.
If Calculation is selected, you can add the amount of materials. You can see the composition and price of each material by mouse over the material name, shown below:



If Optimization is selected, you can put constraints on materials by clicking on the checkbox in front of each material, shown below:



The energy modification is selected by clicking on the energy button. Energy parameters and energy sources can be modified at this section, shown below:



The modifications done in Materials and Energy should be based on the assignment questions. When the required modifications are done, you can start calculation or optimization by clicking on the round button at the top right side of the page. You might need to run the calculation/optimization a few times and each time remodify Materials or Energy.

- At the bottom right side of the page, you can see the results after optimization or calculation. The results can be downloaded as an excel file shown at the right side of the result section. The results include the following parts:

  - General Results: It includes 1) weight of melt/matte and slag, 2) cost of materials, energy, production and decarburization, and 3) power on time, power off time, idle time and tap to tap time.

  - Charge Recipe: the amount and cost of each material used in the calculation/optimization is shown.

  - Energy Usage: It includes the energy input from different sources which can be electricity, burners, decarburization, oxidation, carbon injection and the energy use which can be melting of materials, power on loss, off gas loss, power off loss and idle loss.

  - Analysis: It includes melt/matt composition and slag composition. For melt, it can be seen the result together with minimum and maximum set for that specific target product. If dust amount is higher than zero, dust composition is also shown.

  - Carbon footprint: CO_2 emission per charge and per tonne metal is shown for both CO_2 upstream and CO_2 process.

7. Write and Upload a Report: Fill the assignment description file with your answers. Then, you can go to the next page, and upload your assignment. This charge will be selected by evaluation.

User Charges & Assignment Results

The assignment uploaded by you is shown at the top of the page, which can be replaced by a new file. When the assignment is not yet evaluated by your course administrator, Not Reviewed Yet text is shown. After the evaluation, you will see the result as: Approved and Not Approved Yet. If the assignment is approved by your course administrator, you are not able to modify charges and modify your uploaded assignment.

The charges created by you are also listed, as shown below. You can open each charge by clicking on the button with the charge name. You can delete each charge by clicking on the bin icon. You can change the selected charge for evaluation by clicking on the checkbox and then clicking on the save bottom close to the check box.

Charges

	Charge	Date	Valid Result	Select a Charge for Evaluation
	Aluminium	08 November 2019	Yes	
	Cast Iron	07 November 2019	Yes	