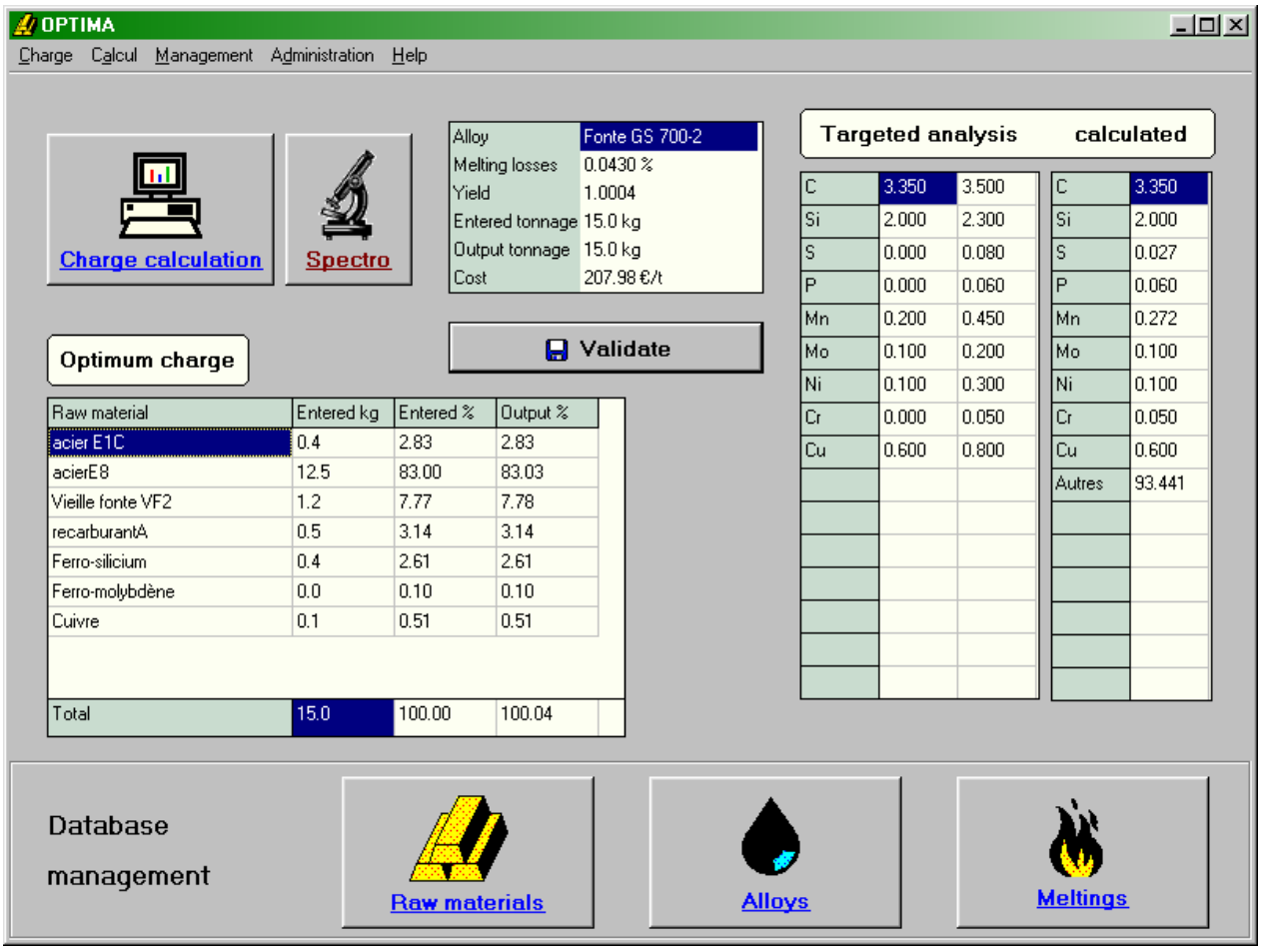
OPTIMA
version 2.02

User manual



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Installation and configuration

Minimum configuration required

Hardware

PC, 200MHz Pentium with 32MB RAM and 20MB free space on the hard disc;
CD-ROM drive;
800x600 screen, 256 colors.

Operating system

Windows 95/98/Me/NT4/2000/XP.

Installation on a single workstation

- Insert the CD in your CD-ROM drive.
- The installation program starts automatically. If not, double-click on "Setup.exe".
- Follow the instructions displayed on screen.
- After installation, you can drag the Optima shortcut icon onto the desktop to facilitate starting the application.
- Start the program by double-clicking on the icon.
- A message informs you that the software is protected by a key. To unlock it, contact CTIF, which will provide you with the required unlocking code.

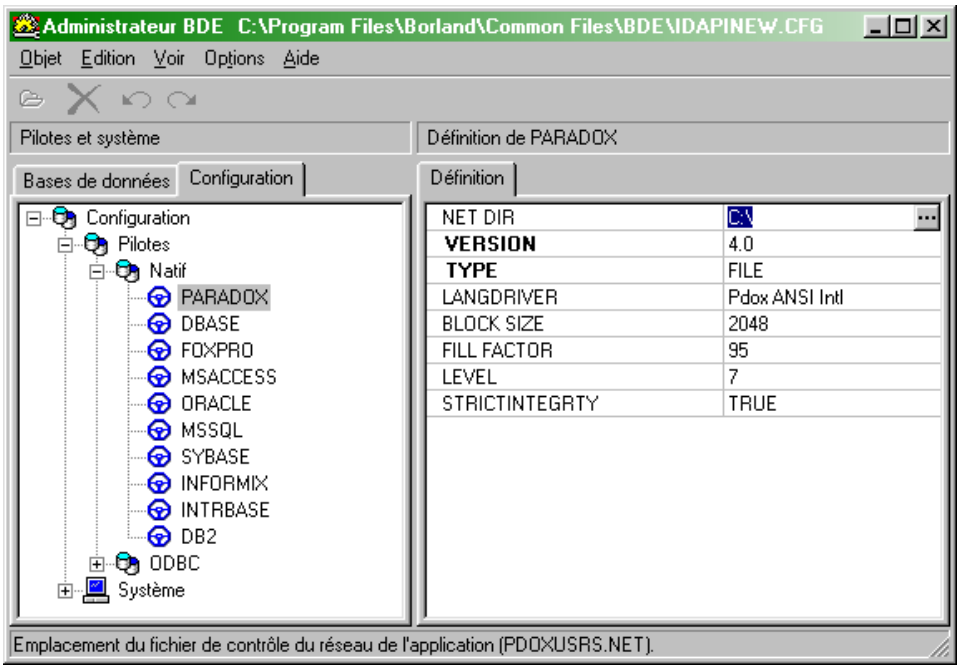
Network installation

OPTIMA is designed to be installed on several networked computers. The various machines running OPTIMA are connected to the same database, which must be accessible from all of the client workstations, so the best solution is to install it on the server.

Create a shared directory on the server, accessible to future users. For example **V:\BdOptima**.

For each installation of OPTIMA on a workstation you must:

- When a database destination is selected, indicate the path on the server. In our example **V:\BdOptima**.
- Click on the *Start* button of Windows, select *Parameters, Configuration panel, BDE administrator*. A window like the one shown below is displayed. In the *NET DIR* field, in place of *C:*, specify the location of the database in the network. In our example **V:\BdOptima**.



Update from version 1.0

If you use version 1.0 of OPTIMA, you can recover the information from your old database to use it with version 2.0. To do this, proceed as follows:

- As a precaution, make backup copies of the files from your OPTIMA 1.0 database (c:\program files\ctif\optima\bd*.*) on a disquette or other medium;
- Exit from OPTIMA if it is in use;
- Uninstall version 1.0 (Configuration panel - Add/Delete programs) ;
- Install the new version, specifying an access path to the database that points to your old database (c:\program files\ctif\optima\bd);
- Start the update utility (Start menu - Programs - Optima - Update data base).

Presentation

What is OPTIMA for?

OPTIMA software calculates a charge having the lowest possible cost for the preparation of a given alloy. The chemical composition of the alloy, given in the form of a range, determines the choice and tonnage of the raw materials necessary for the melting. The cost of this charge will be minimized for a given stock of raw materials and returns and given melting losses.

OPTIMA lets you impose levels of use (min., max., between) for the raw materials, so you can in particular favor the use of certain returns in the charge.

The system performs the calculations using two databases, one for the alloys and the other for the raw materials, of which it manages the stocks.

In addition to the classical charge calculation, OPTIMA also calculates the correction of the chemical analyses of the baths using the result found by spectrometry.

The chemical compositions found are recorded in a melting log that can be used for statistical purposes

The charge optimization principle

OPTIMA uses the Simplex method to calculate the least expensive charge from which the alloy can be made given the constraints introduced by the user. The latter can be of two kinds:

- The constraint of the weight of alloy to be made

Given the various melting losses (raw materials and various additions), Optima adjusts the proportions of the ingredients so as to attain the weight the producer wants.

- Constraints on the alloy to be made

The alloy is made up of a number of chemical elements (up to a maximum of 15 in Optima), for each of which the user specifies minimum and maximum contents.

For example, a cast iron having the chemical composition:

in %	C	Si	S	P	Mn	Cu
Min.	3.35	1.95	0.05	0.00	0.40	0.30
Max.	3.45	2.10	0.12	0.12	0.60	0.50

- Constraints on the proportions of materials in the charge

When the user chooses a target alloy, OPTIMA calls up the list of raw materials to be used to make it. It is possible to impose levels of use on these materials.

For example, it may be desired that the charge should contain at least 30% chips, between 5 and 8% Cobalt, an no pure copper.

The corresponding constraints are :

Chips > 30 %
5 % < Cobalt < 8 %
Pure copper = 0 %

- Allowance for melting losses

OPTIMA makes allowance for the melting losses that can affect some chemical elements during melting. For this purpose, a yield is assigned to each chemical element of a raw material or of an addition made at the time of charging (100% is the default).

Concurrently, correction yields (Rdt C) are used to allow for melting losses when ferro-alloys are added to a liquid bath.

In the case of implicit chemical elements, such as iron in ferrous alloys, OPTIMA lets you introduce a *Yield on unmentioned elements* R_0 (Administration menu - Options).

The databases

The software includes two databases, used to manage the stock of raw materials, master alloys, pure metals, and ferro-alloys and the grades of alloys prepared.

The raw materials of the stock are displayed in a table for their management.

For each material, there is a form in which the user specifies the price, the current stock, and the contents of the chemical elements. The yield is used to allow for possible melting losses on some elements.

The management of the alloys is organized along the same lines, and it is very easy to add, modify, or delete an alloy in the base.

All charge calculations that have been validated by the operator are recorded in the log. It is therefore easy to retrieve the details of meltings performed on a certain date.

OPTIMA software provides the possibility of editing statistics on the consumption of the raw materials over a given period.

The various calculations in OPTIMA

OPTIMA performs charge calculations and, from version 2, allows calculations of bath and mixture corrections.

The charge calculation

In OPTIMA, the "charge calculation" is the calculation of the solid charge initially put into the furnace.

The bath correction

The bath correction calculation, for its part, minimizes such ingredients as ferro-alloys, pure metals, and master alloys to be added to a bath of known composition and tonnage to bring its chemical analysis into the required intervals. The user must first enter a chemical composition to be obtained after melting.
Remark : the spectrometric data can also be transferred directly to Optima if the format of the

computer file is suitable. See “File format” on page 16.

In this calculation option, the yields taken into account are the correction yields (Rdt C), not the classical yields (Rdt).
Optima is designed to be installed on a melting platform, notably as a means of dealing with repetitive corrections of baths of liquid alloys.

The mixture calculation

The mixture calculation is a response to preparation needs when use is made, for example, of the "Tap and charge" charging mode in a low-frequency furnace or of a channel type casting and holding furnace in which the producer mixes the heel and the ladle. In other cases, it may be applied to a solid charge in a liquid bath to change the grade.

Examples of situations:
Bath of stored liquid alloy with analysis A + solid charge with analysis B = bath with analysis C
Bath of stored alloy with analysis A + liquid with analysis B = Bath with analysis C
The mixture calculation gives you the weight of the ingredients or the analysis of the liquid bath to be added to an "initial" bath to obtain a "final" bath.

The bath is supposed to have no impact on economic calculation, so Optima does not cost it.

Important remark : the final weight resulting from a mixture (heel + solid or liquids A+B) determines in particular the final resolution of Optima. In effect, the proportions added to the existing bath lead to reaching or failing to reach the desired chemical analysis as a result of mixing.

For this reason, you should not hesitate to decrease or increase the desired final weight in order to approach the limit threshold of the mixture satisfying your expectations.
For example, on a heel of 150kg, the calculation succeeds for 206kg of mixture but is impossible at 205kg.

Networked use

This new version makes it possible to use OPTIMA on several computers sharing the same database. Three user profiles are available; they allow access to different functions of the software.

The highest level is the *Administrator* mode. The *Administrator* user has access to all of the software and can modify the stock of materials and the alloys database, perform calculations and validate them, store spectrometric analyses, etc. Also, only *Administrator* users can configure the software.

The *Operator* user cannot modify the raw materials or the alloys of the data base, or configure the software, but can perform calculations, validate them, and store spectrometric analyses.

Finally, the *Read-only* user is allowed only to consult the database and use the information in the log (statistics, control charts, etc.), but cannot validate calculations or record spectrometric analysis.

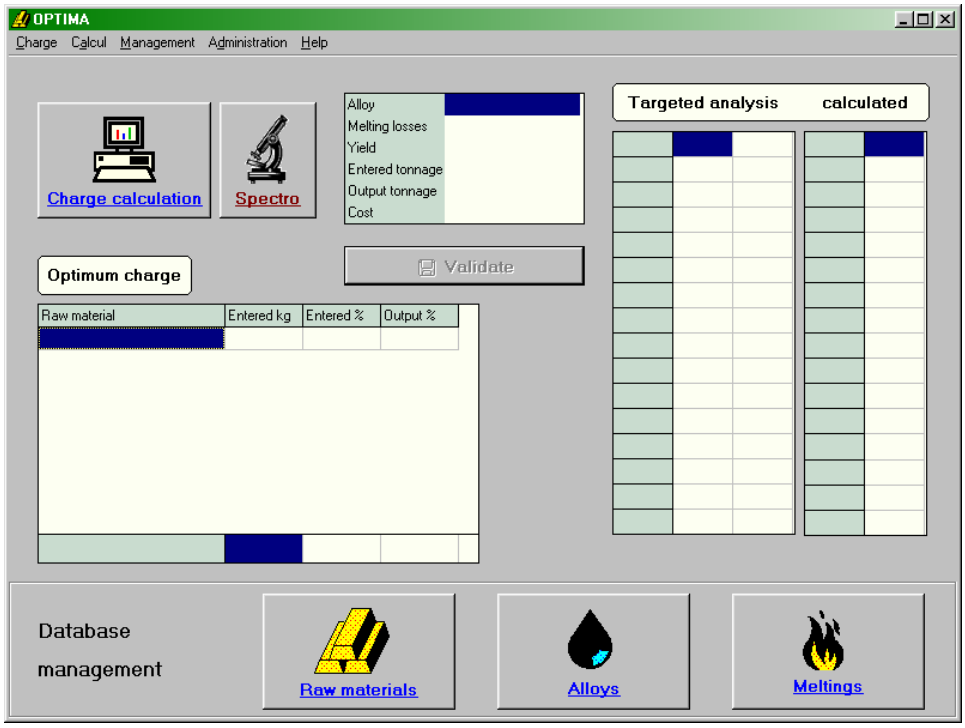
How to use OPTIMA

Starting the software

You can start OPTIMA in two ways:

- Click on the "**Start**" button of Windows, select the "**Programs**" menu, "**Optima**", then click on "**Optima**".
- Double-click on the "**Optima**" icon you placed on the desktop when you installed the software.

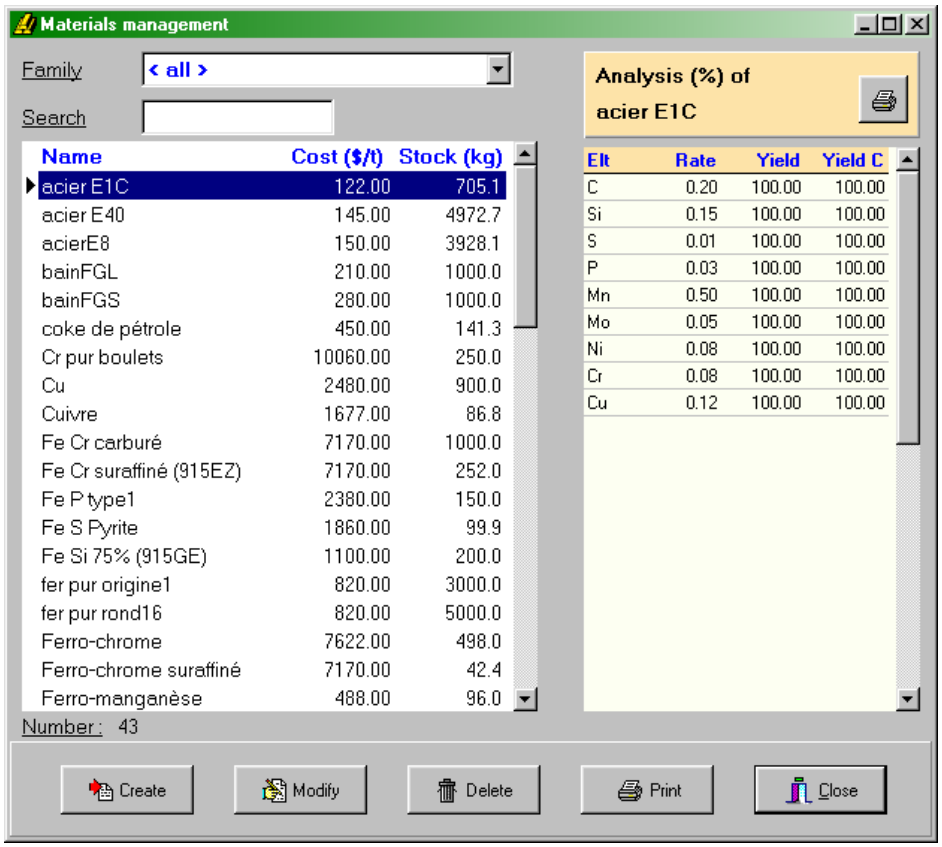
The following screen appears.



Adding raw materials to the database

To enrich your database, click on the "**Raw materials**" button at the bottom left.

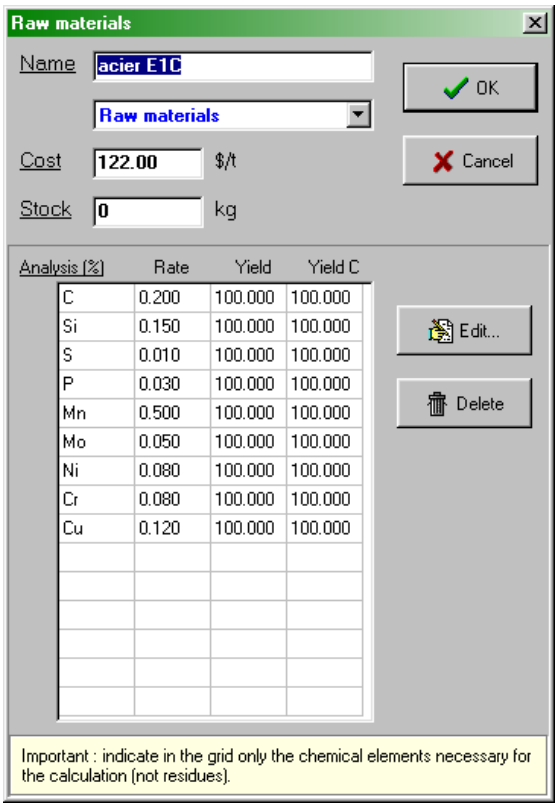
The following dialogue box is displayed. At this stage, you can enter information concerning the materials.



A material is characterized by its name, its price, the quantity in stock, and its chemical composition.

For example, to enter the data concerning a cast iron, click on the "**Create**" button and fill the entry fields as follows. When you enter a new chemical element, its content and yield are initialized to 0 and 100% respectively, so you have no need to enter the yield for an element that exhibits no melting loss.

Warning: for OPTIMA to be able to use the material in the calculations, make sure that you have not specified chemical elements that are not desired in the alloys to be made.



You can also edit or delete a chemical element in the analysis form by selecting the line, then clicking on the "**Edit...**" or "**Delete**" button.

Click on the "**OK**" button to record the new material in the database.

Similarly, you can modify the information concerning materials already recorded, for example, to update the prices. To do this, select the material concerned in the left-hand list, then click on "**Modify**". Enter the desired fields and click on "**OK**" to validate.

To print the status of your stock, click on the "**Print**" button.

Entering and defining the alloys to be prepared

The alloys to be prepared, just like the stock of materials, are kept in a database, so there is no need to re-enter the minimum and maximum contents of the elements of your metal and the list of ingredients for each charge calculation.

An alloy is defined by:

- its name;
- its analysis and its ingredients* for the charges and the mixture;
- its analysis and its ingredients* for bath corrections.

*Note that ingredients - raw materials and ferro-alloys or master alloys - are selected in advance for each alloy to be prepared. This restricts the calculation with respect to the possible ingredients to constitute the charge or bath correction.

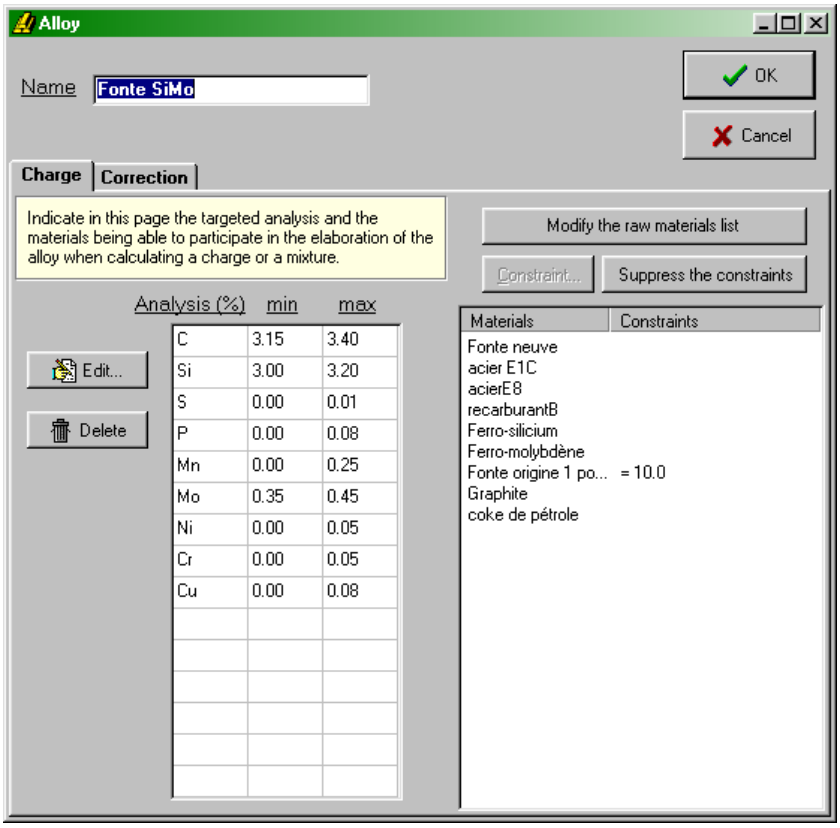
Example: for a bath correction, you want to do the calculation with SiC, not FeSi and graphite.

To make entries in the alloys database, click on the "**Alloys**" button at the bottom of the main screen.
The commands are identical to those for management of the stock.

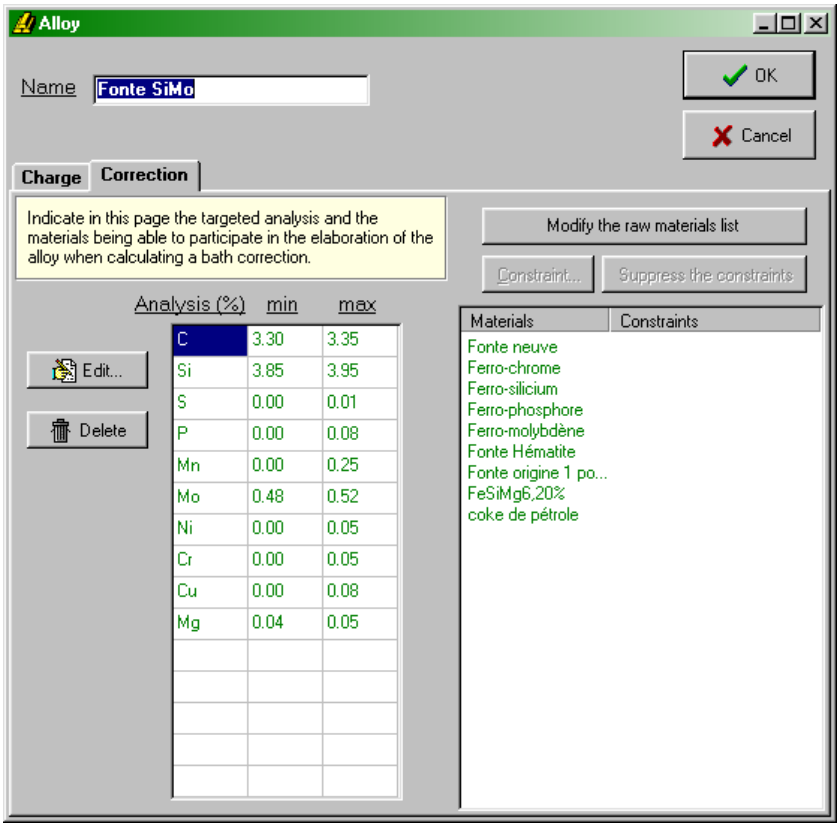
Given the risks of dispersion in chemical analysis, especially when used metals are recycled, often in batches that are heterogeneous mixtures, and of drift of the weighing instrument, Optima proposes **two target chemical analyses, one use to calculate the charge, the other to reach exactly the chemical analysis required in the castings to be produced after the melting of the solids.**
This operation therefore lets you define a first target analysis in which the elements may limited by the **default values or a broader interval allowed.** In addition to the control chart, OPTIMA calculates the mean, span, standard deviation, and capability for the period indicated and displays them at the bottom of the window.

The example below illustrates the operation proposed by Optima:

Definition of SiMo cast iron for the charge and mixture calculations

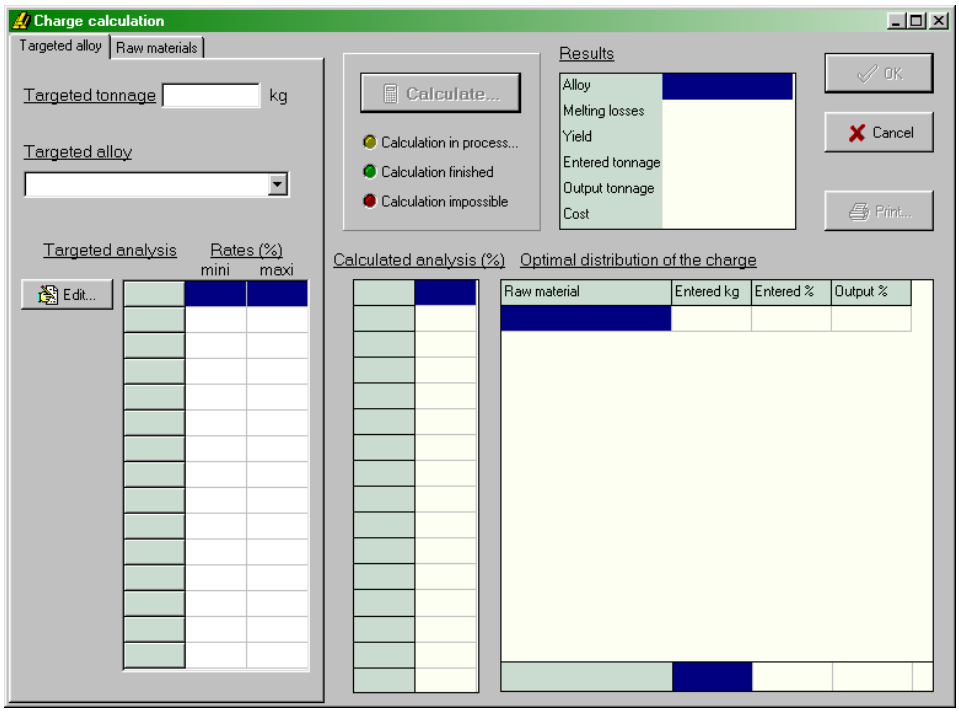


Definition of SiMo cast iron for the bath correction calculations



Starting a charge calculation

From the main screen, click on the "**Charge calculation**" button. The following screen appears.

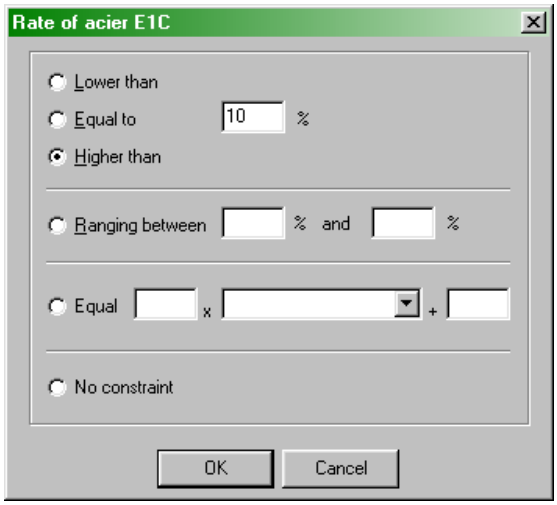


Enter the weight of the charge in the "**Target tonnage**" field.

Select the alloy you want to make.

If desired, modify the ranges of its composition by double-clicking on the chemical element concerned. This modification is then strictly limited to the current calculation.

If you want to impose constraints on the proportions of some materials in the charge, double-click on the raw material to which you want to add a constraint.



In the dialogue box above, specify the type of constraint and the threshold. In this example, the presence of more than 10% E1C steel in the charge is imposed.

Click on the "**Calculate**" button.

The computer displays the result of the optimization:

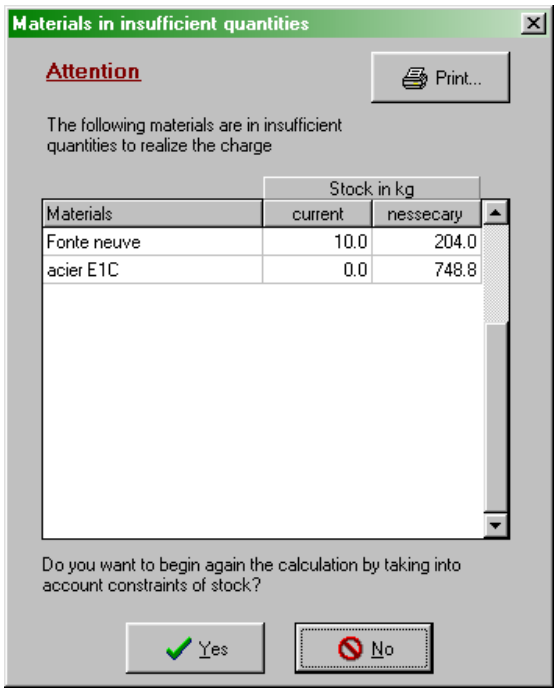
- Composition of the alloy obtained;
- Charge composition in kg and %;
- Cost.

Recording the charge to start a melting

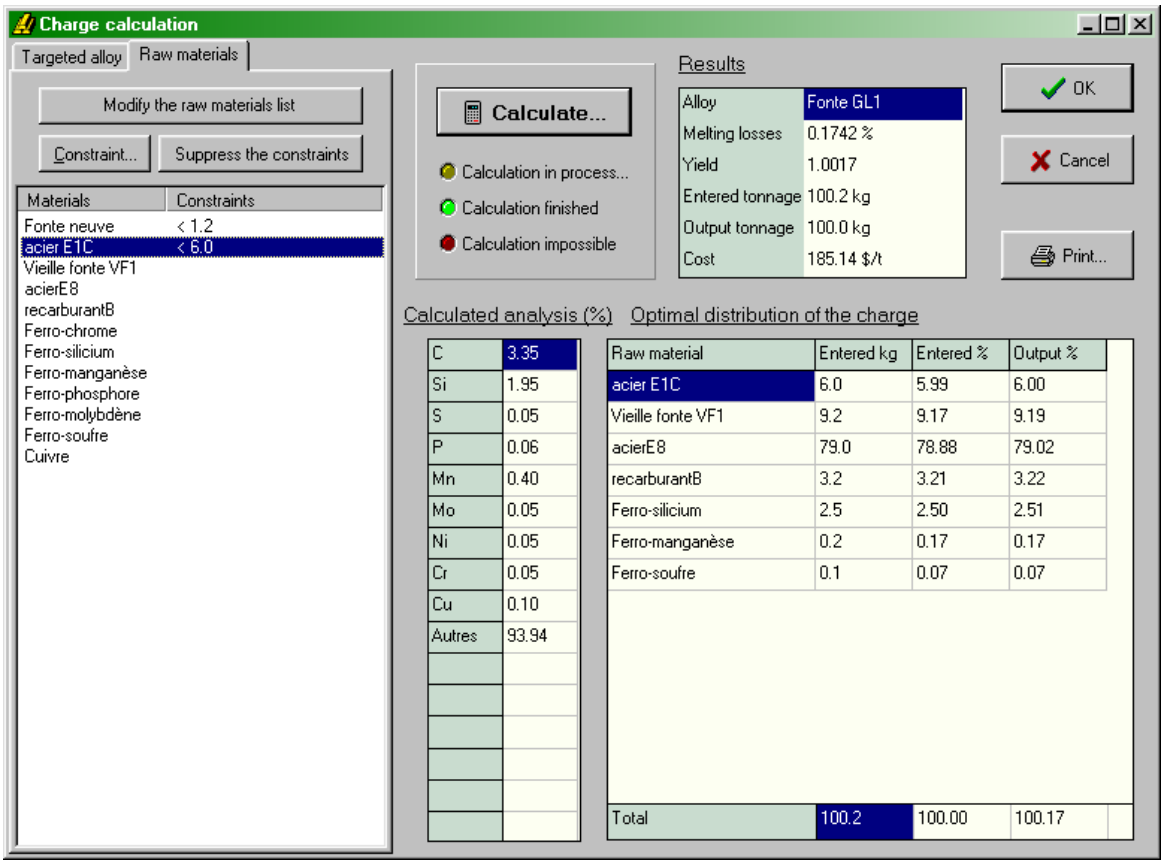
When the calculation has been performed, click on "**OK**" to return to the main screen.

If you want OPTIMA to take account of the calculation and update the stocks of materials, click on the "**Validate**" button. Warning: this validation removes the materials used from stock, modifying the materials database.

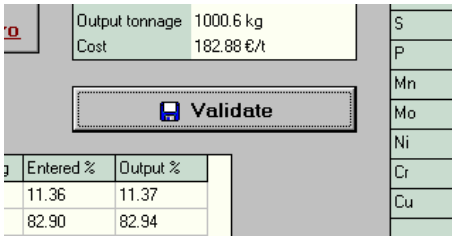
OPTIMA studies the status of the stocks to make sure that the quantities of materials chosen by the calculation are in fact available. If this is not the case, a window like the one shown below is displayed to alert you.



OPTIMA displays those materials of which the quantities are insufficient and proposes repeating the calculation with the constraints on the relevant materials fixed automatically.
If you click on "**Yes**", the calculation screen reappears.



Click on "Calculate", then "**OK**".

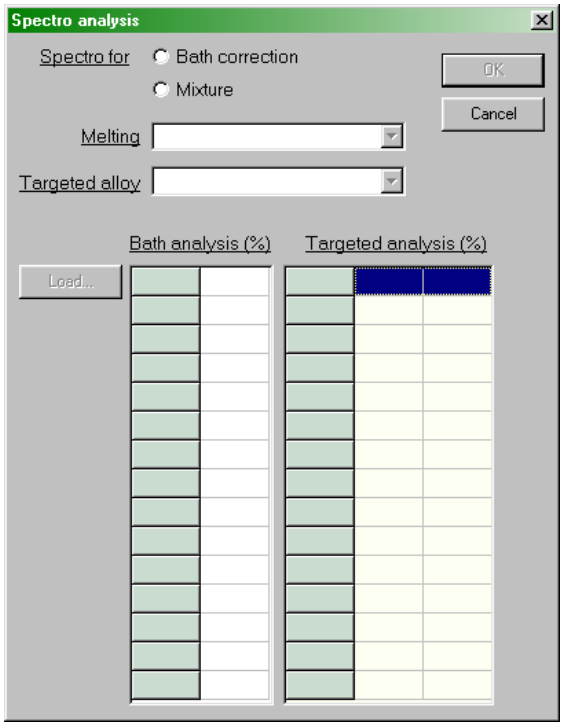


Click on "**Validate**".

If the stocks are sufficient, your calculation is recorded in the log; otherwise, restart the calculation by clicking on "**Yes**".

Starting a bath correction calculation

To make a correction, you must first have validated a charge calculation with a melting number.
From the main screen, click on the "**Spectro**" button. The following screen appears.



Check the "**Bath correction**" option.

Select the melting concerned.

Enter the bath composition determined by the spectrometric analysis or click on "**Charge...**" to import the analysis from a file from the spectrometer.
The file must be a "text" file structured as follows:

File format

[melting number1]
Elt1=x1
Elt2=x2
Elt3=x3
...
[melting number2]
Elt1=x1
Elt2=x2
...

The contents of the chemical elements must be expressed in %.

Click on "**OK**" to validate.

If the measured chemical composition does not match the target analysis, OPTIMA proposes a bath correction calculation.

As for a classical charge calculation, click on "**Calculate**".

If the results suit you, click on "**OK**" to return to the screen main. You can then "**Validate**" the correction to update the stocks and record the operation in the log.

Quality assurance and metallurgical imperative

We felt that the correction of chemical analyses required the same validation as the removal of materials from stock, in order both to constitute statistics on the actual chemical analyses that led up to the pouring of the castings and to constitute a check of the actual values by the operator before pouring. For the bath correction, Optima becomes a tool for the checking and release of the prepared baths.

Several bath corrections can be performed in a single melting.

Starting a mixture calculation

To perform a mixture calculation, proceed as for the bath correction, by clicking on the "**Spectro**" button on the main screen.

Select the "**Mixture**" option, then the melting concerned.

Enter the analysis measured by the spectrometer (or imported from a file).

Click on "**OK**" to validate.

The calculation window is displayed and prompts you to enter the total target tonnage to result from the mixing.

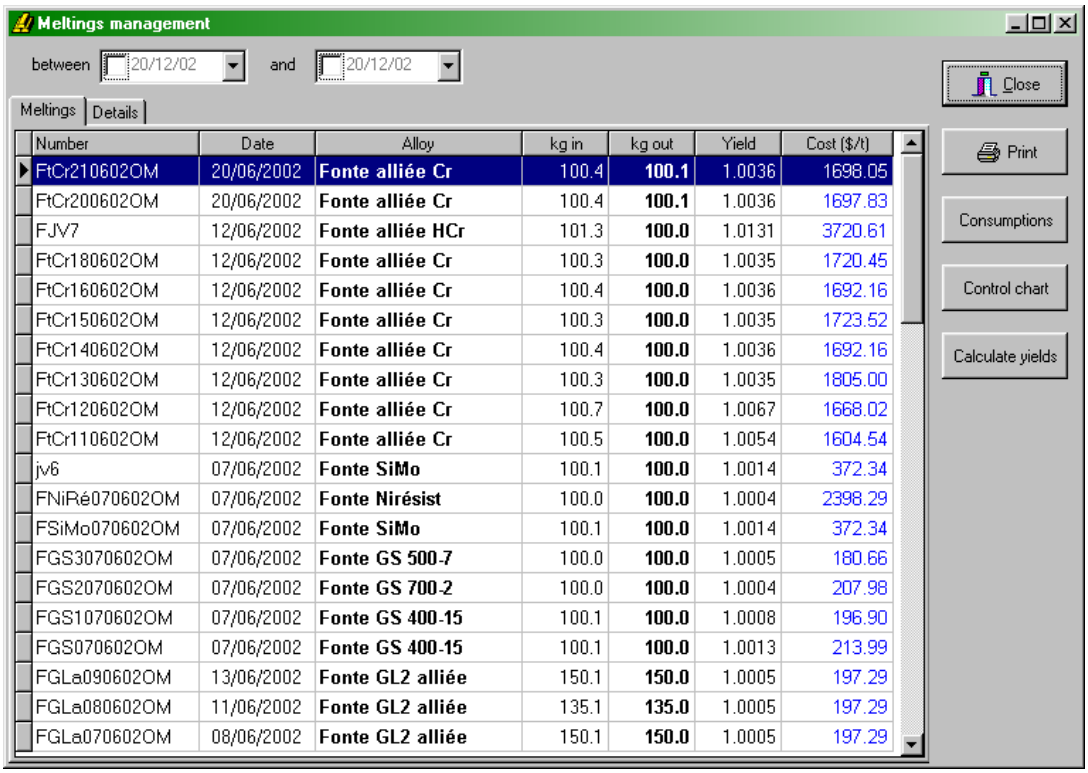
Click on "**Calculate**" to start the optimization calculation.

If the results suit you, click on "**OK**" to return to the main screen. You can then "**Validate**" the mixture to update the stocks and record the operation in the log.

Meltings log

When a charge calculation is validated, OPTIMA asks you for a number and a melting date that will be recorded in the log with the details of the charge, of the alloy, of the cost, and of any constraints.

This part is very important, since the quality department can used it to ensure the traceability of the alloys cast. Optima can store up to 1000 meltings. Beyond the oldest data are lost. It is recommended to save regularly the data base on a diskette or any other storage medium.

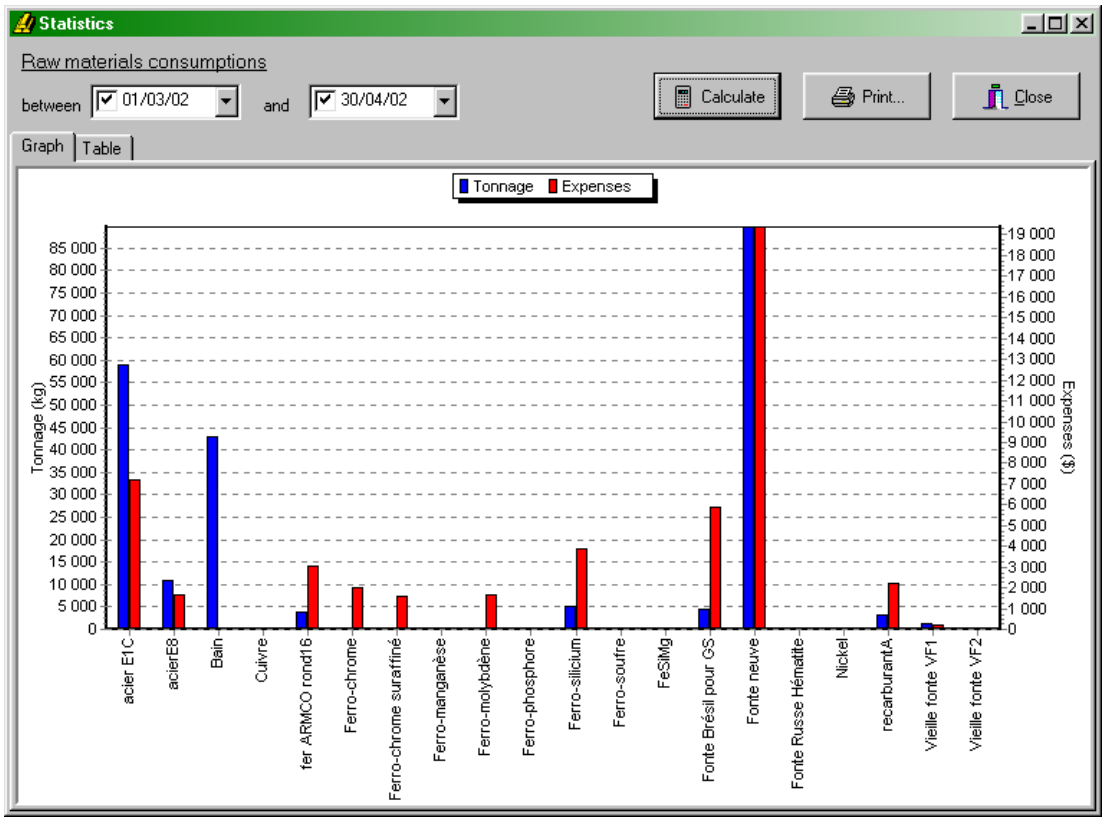


Number	Date	Alloy	kg in	kg out	Yield	Cost ($/t)
FtCr210602OM	20/06/2002	**Fonte alliée Cr**	100.4	**100.1**	1.0036	1698.05
FtCr200602OM	20/06/2002	**Fonte alliée Cr**	100.4	**100.1**	1.0036	1697.83
FJV7	12/06/2002	**Fonte alliée HCr**	101.3	**100.0**	1.0131	3720.61
FtCr180602OM	12/06/2002	**Fonte alliée Cr**	100.3	**100.0**	1.0035	1720.45
FtCr160602OM	12/06/2002	**Fonte alliée Cr**	100.4	**100.0**	1.0036	1692.16
FtCr150602OM	12/06/2002	**Fonte alliée Cr**	100.3	**100.0**	1.0035	1723.52
FtCr140602OM	12/06/2002	**Fonte alliée Cr**	100.4	**100.0**	1.0036	1692.16
FtCr130602OM	12/06/2002	**Fonte alliée Cr**	100.3	**100.0**	1.0035	1805.00
FtCr120602OM	12/06/2002	**Fonte alliée Cr**	100.7	**100.0**	1.0067	1668.02
FtCr110602OM	12/06/2002	**Fonte alliée Cr**	100.5	**100.0**	1.0054	1604.54
jv6	07/06/2002	**Fonte SiMo**	100.1	**100.0**	1.0014	372.34
FNiRé070602OM	07/06/2002	**Fonte Nirésist**	100.0	**100.0**	1.0004	2398.29
FSiMo070602OM	07/06/2002	**Fonte SiMo**	100.1	**100.0**	1.0014	372.34
FGS3070602OM	07/06/2002	**Fonte GS 500-7**	100.0	**100.0**	1.0005	180.66
FGS2070602OM	07/06/2002	**Fonte GS 700-2**	100.0	**100.0**	1.0004	207.98
FGS1070602OM	07/06/2002	**Fonte GS 400-15**	100.1	**100.0**	1.0008	196.90
FGS070602OM	07/06/2002	**Fonte GS 400-15**	100.1	**100.0**	1.0013	213.99
FGLa090602OM	13/06/2002	**Fonte GL2 alliée**	150.1	**150.0**	1.0005	197.29
FGLa080602OM	11/06/2002	**Fonte GL2 alliée**	135.1	**135.0**	1.0005	197.29
FGLa070602OM	08/06/2002	**Fonte GL2 alliée**	150.1	**150.0**	1.0005	197.29

The log can be consulted at any time by clicking on the "**Meltings**" button of the main screen. This means that you can consult the details of meltings on a given date by double-clicking on the relevant line in the list.

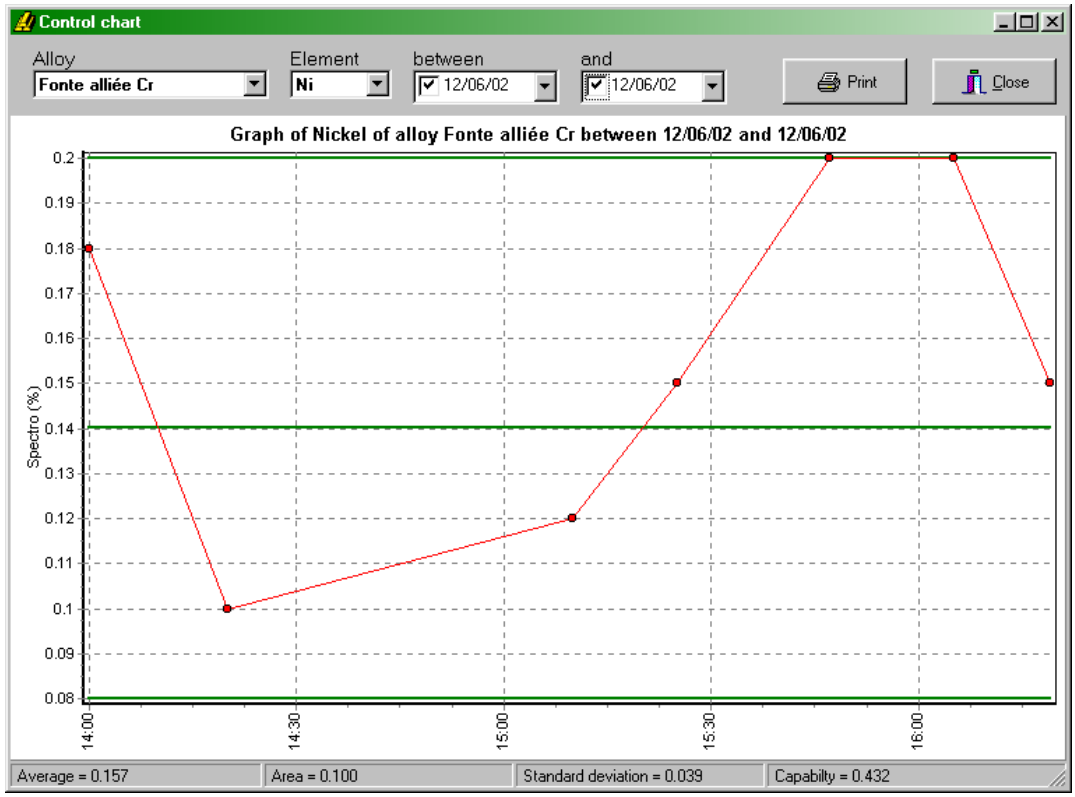
Consumptions

To learn the consumption of each raw material during a given period, click on the "**Consumptions**" button. If you want to perform the calculation on all meltings, do not enter the date fields. Click on "**Calculate**" to display the results in table or graph form.



Control charts

The "**Control chart**" function lets you track, in graphic form, the evolution of the content of a chemical element in an alloy over a given period.



To use this option, you must have entered or transferred actual chemical analyses (spectrometry).

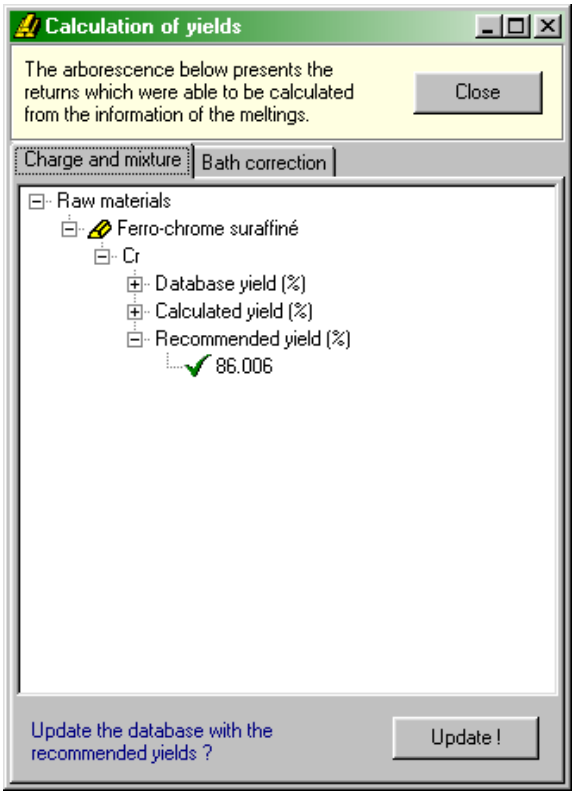
In addition to the control chart, OPTIMA calculates the mean, spans, standard deviations, capabilities and Cpk for the period indicated and displays them at the bottom of the window.

Note: Cpk is given as an indication provided the law is "normal" and that the number of samples is sufficient.

Calculation of yields

The "Calculation of yields" function studies the various charges recorded in the log in the specified period to deduce yields for each chemical element contained in the master alloys, ferro-alloys, or pure metals.

They appear in a tree as shown below.



The "Database" yields are the current values specified in the raw materials database.

The "Calculated" yields indicate, for a given material and alloy, the experimental values deduced from analysis of the charges in the log.

The recommended values are the means of the calculated values.
You can if desired modify the recommended values by clicking on them.

Click on the "**Update**" button to update the raw materials database with the selected yield values (preceded by the ✓ sign).

To avoid updating certain yields, unselect them by double-clicking on them. OPTIMA uses the ⊘ sign to indicate yields that will not be updated.

Administration

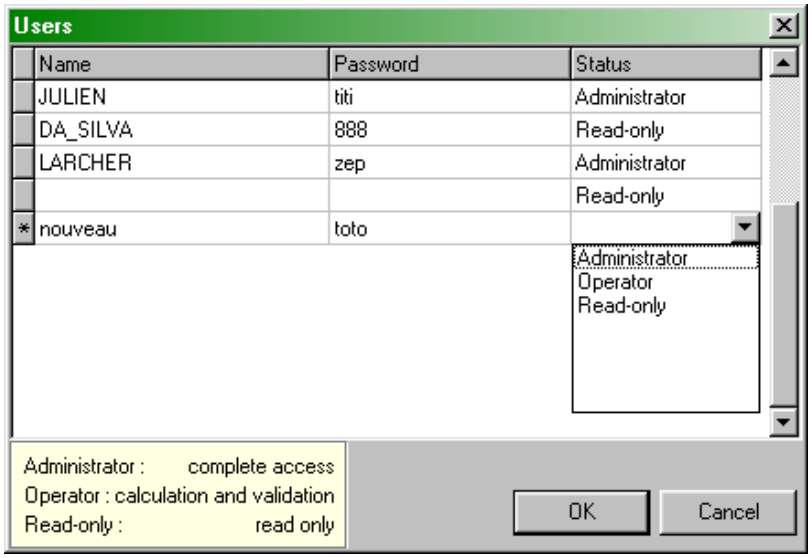
The "**Administration**" menu lets you parameterize various aspects of the software.
In the case of network use, only "Administrator" users have access to the parameterizing.

Users

In the users window, you indicate who is authorized to use OPTIMA, and under what conditions.

To add a new user:

- Click on the last line of the table.
- Press the "down arrow" key to create a new line.
- Enter the name and the password.
- Click twice in the "Status" box to display the list as shown below.



- Select the desired mode, then validate.

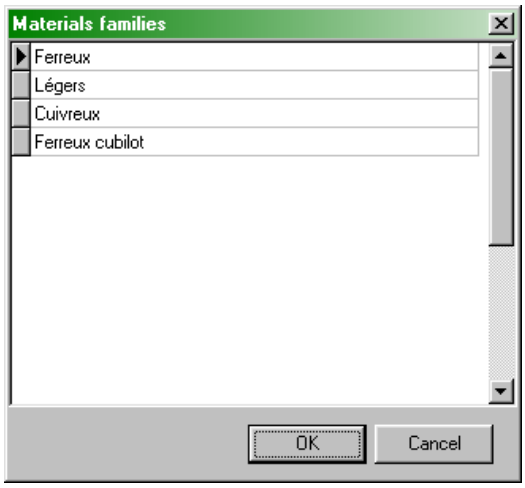
The passwords are optional. In the example above, a line without a name and without a password allows anyone to use OPTIMA in consultation only (Read-only mode).

To delete a user, click on the line concerned, then press the "Ctrl" + "Del" keys.

Families

It is possible to classify the raw materials by family and so facilitate management of the stock. You can for example organize your stock into three families: ferrous, light, and copper.

To do this, before entering data in your raw materials database, select "**Families**" in the "**Administration**" menu.
Fill the table as shown below.



The entry principle is the same as for entry in the table of users.

Subsequently, when you create a material, you will select the family to which it belongs.

Options

The "**Options**" window concerns the general settings of the software.

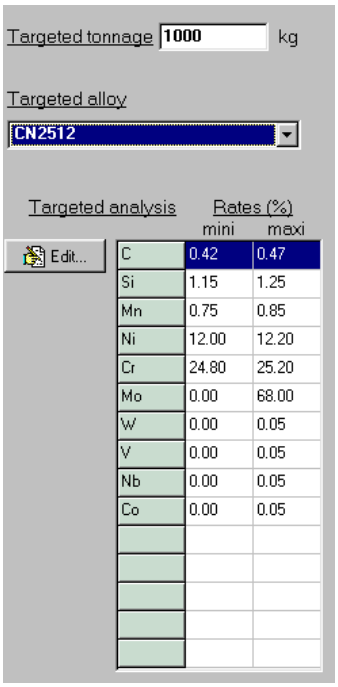
You can increase or decrease the number of decimal places in the analyses and tonnages displayed in the various screens, de-activate management of stocks, etc.

In the case of implicit chemical elements, such as iron in ferrous alloys, OPTIMA lets you enter a default *Yield on elements not mentioned* R_0 equal to 100%.

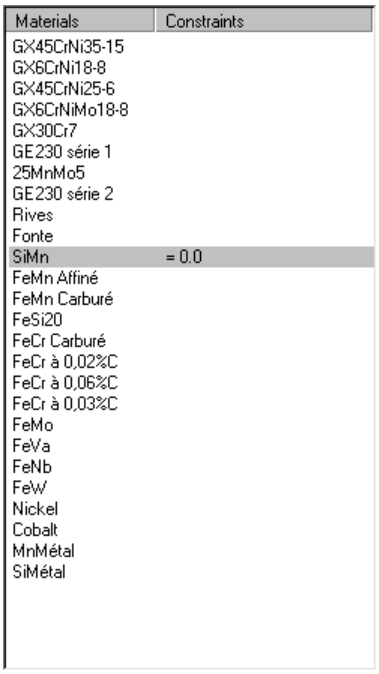
Example of application

You want to perform a melting to produce 1000kg of CN2512 alloy without using SiMn.

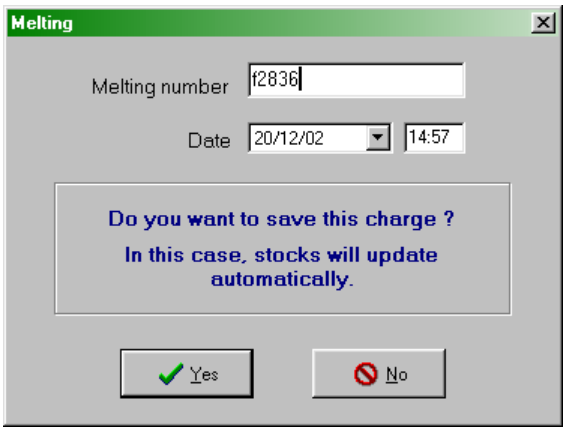
- In the main screen, click on the "**Charge calculation**" button.
- The calculation window appears.
- In the "**Target tonnage**" field, enter 1000kg.
- Choose the "CN2512" alloy in the pull-down list of target alloys.
- OPTIMA searches the alloys database for the composition of the metal and displays it as follows. You can modify the ranges by double-clicking on the line of the element to be modified or by selecting the line, then clicking on the "**Edit...**" button.



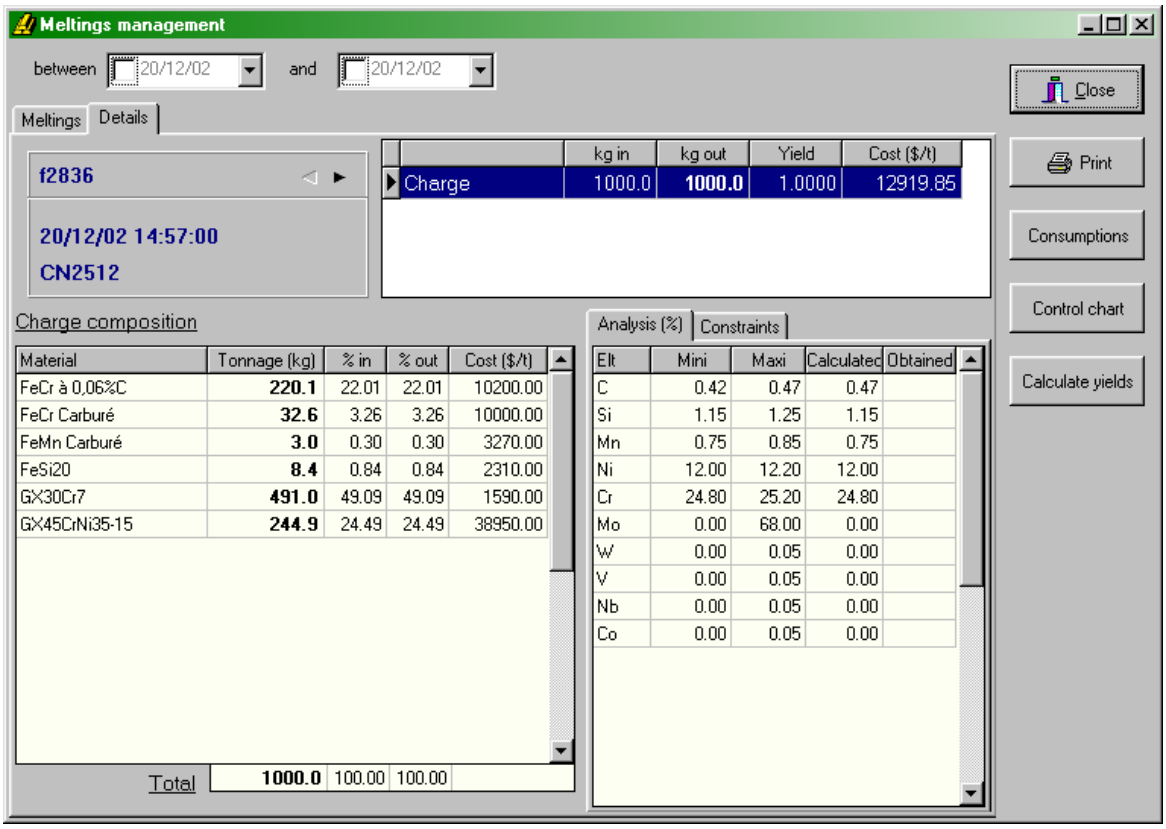
- Select the "**Raw materials**" tab to view the list of raw materials likely to be included in the charge. Double-click on the line where SiMn appears to impose a level of 0%.



- Click on the "**Calculate**" button. The results of the charge calculation are displayed.
- Click on the "**OK**" button.
- To record the melting in the log, click on the "**Validate"** button.
- OPTIMA warns you that the stock of GX45CRNi25-6 is 100kg and that the charge requires 594kg of it.
- Click on "**Yes**" to repeat the calculation with allowance for this stock constraint.
- The calculation screen reappears and you can see that OPTIMA has itself fixed GX45CRNi25-6 < 16.7%.
- Click again on "**Calculate**", "**OK**", then "**Validate"**.
- The software now reports that the new calculation requires 95kg of GX30Cr7 but the stock is only 80kg.
- Repeat the calculation by clicking on "**Yes**", "**Calculate**", "**OK**", and "**Validate**".
- Since this third calculation is compatible with the stock, OPTIMA asks you for a melting number in order to record all data in the log and update the quantities in the database.

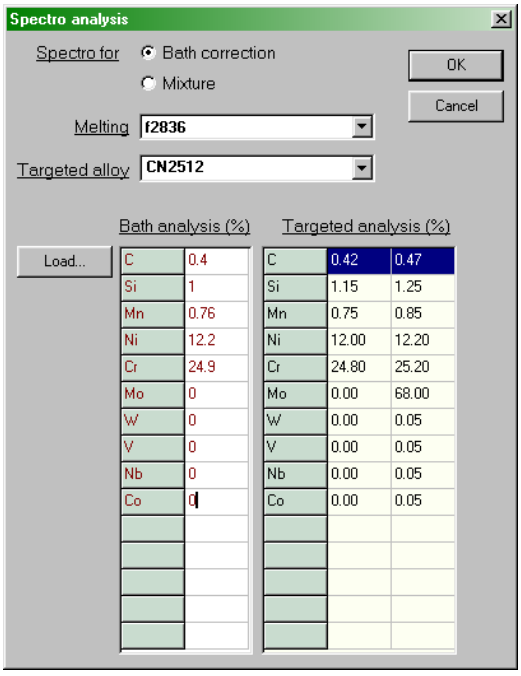


When you click on "**Yes**", details of the charge are displayed.



You have just made a spectrometric measurement of your bath.

- Click on the "**Spectro**" button of the main screen.
- Select "**Bath correction**", then melting "f2836".
- Enter the analysis.

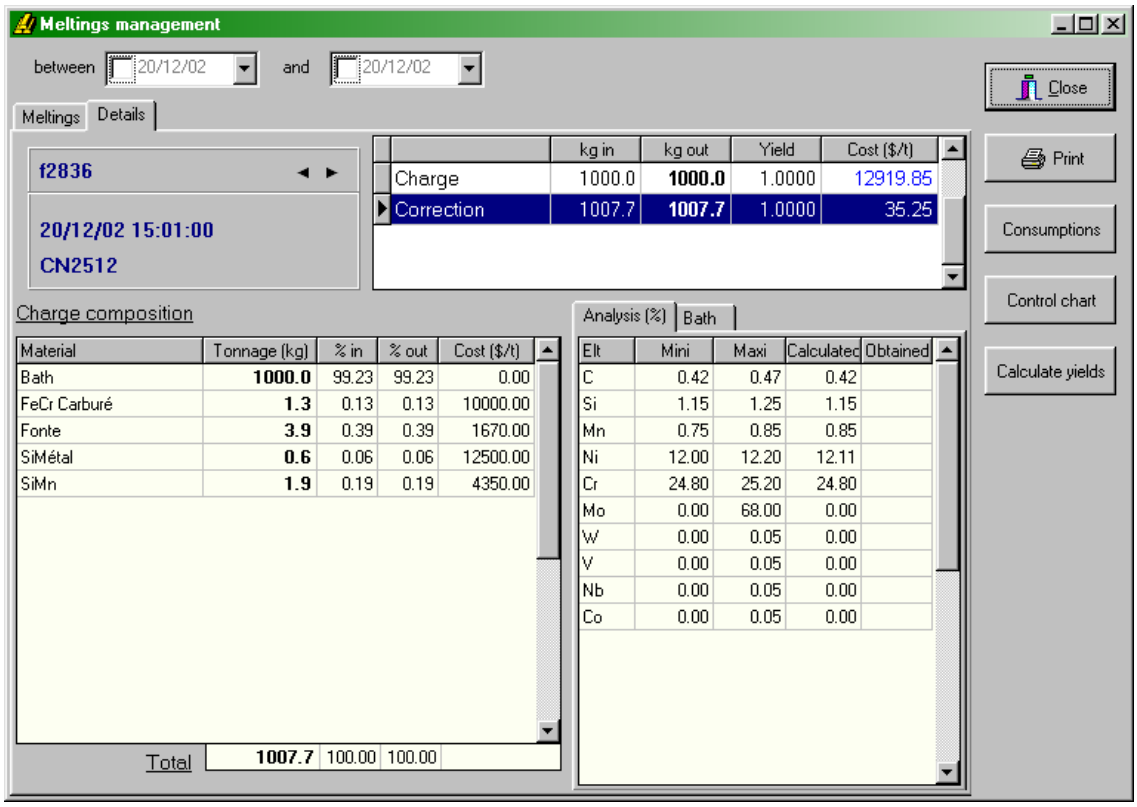


Validate by "**OK**".
When the calculation screen is displayed, click on "**Calculate**", then "**OK**".

You return to the main screen.

Click on "**Validate**", then confirm by "**Yes**" to record the correction in the log.

The log opens on the details of the bath correction of melting "f2836".



If a new spectrometric analysis reaches you.

- Return to the main screen and start the "Spectro" function of OPTIMA.
- As before, enter the analysis, then validate.

In practice, a melting may include a charge and several successive corrections.

Tips for use

To use OPTIMA effectively, comply with the following principles:

Only raw materials that contain no elements other than those defined in the target alloy are included in the calculation.

Recommended proceeding

The steps in the work should be organized in the following order:

- constitute your inventory of raw materials,
- create the database of alloys to be prepared by selecting the materials and possible or acceptable additions,
- mention your constraints,
- etc..

Avoid entering overly broad ranges for residual chemical elements, since there would then be a risk of unexpected contamination. In the case of the major elements, on the other hand, if the ranges are made too narrow, the calculation may not conclude.

If, in your analyses, you do not specify the content of the predominant element (e.g. iron in a ferrous alloy), and if the element has melting losses, indicate the yield value in the "Options - Yield on elements not mentioned" menu. The default value is 100%.

The software does not take the state of stocks into account in the calculation. It is only when the user decides to validate it that OPTIMA checks if the theoretical charge can in fact be made. If not, OPTIMA proposes constraints to be entered on the raw materials.

The correction and validation by Optima of the chemical analyses are necessarily subsequent to the validation of a charge. In this way, each entry or transfer of a chemical analysis result is tied to a melting number.

For a melting platform that works with a single charge but prepares several grades, each alloy bath for which there is a check of the chemical analysis must be preceded by a validation of the calculation of a charge. This operation does not interfere with the work of operating furnaces on a melting platform, since calculation times in Optima are short (a few seconds).

Possible problems

The charge calculation in Optima failed; how can this be remedied?

In this case, where the indicated analysis cannot be reached, you must proceed by trial and error.

- Modify the tolerance on a chemical element for which you can be less demanding.
- The materials selected for the calculation do not provide enough possibilities of adjustment of the many parameters of the chemical analysis. Add more materials.
- Some constraints on proportions that you have selected are incompatible and the calculation fails to converge. Remove a constraint or broaden its threshold.
- Residual elements are bounded by very low maxima but the raw materials contain more of them. Modify your maxima on the residuals.