DW-CS-8820
Carbon & Sulfur Analyzer

DRAWELL
Artist of Science

Please read operating manual before installation and operation.

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1. General Introduction

1.1 Application and Performance

DW-CS-8820 Infrared Carbon & Sulfur Analyzer, being used coordinately with WF-T88 High-Frequency Induction Combustion Furnace, can determine the quality fraction of carbon and sulfur contained in steel, iron, alloy, non-ferrous metal, cement, ore, activator, glass, ceramic and other materials rapidly and accurately. This set of equipment is the high-tech product integrating optical, mechanical, electronic, computerization and analytical technologies. It characterizes itself in having wide range of measurement, precise and reliable results of analysis and the like advantages. Due to application of computerized technology, it has so far reached the advanced level domestically in respect to intellectualization of the instrument, the screen display of images and graphs, and collection and processing of data. It can be regarded as an ideal analyzer for various sectors to determine carbon and sulfur contents.

1.2 Component and Structure

This instrument consists of infrared testing unit, high-frequency induction heating unit, computer, printer and electronic balance. See fig. (1) The following text will mainly describe the internal structure of high-frequency induction heating unit and infrared testing unit.

Fig. (1) – Outline picture of the whole set

The high-frequency induction heating unit in frame structure has three layers. (Upper, middle and low layer) In the upper layer there are the high frequency inducting

circuit, the over-current and over-time protection circuit and the electromagnetic valve control circuit; in the middle layer there are power source, the gas path breaking switch, the components for filtration and drying of the analytical gases; in the lower layer there are the HV transformer, the dust collector, and compress valve etc. From the front view, the left upper section includes plate current indication ammeter, grid current indication ammeter, supporting oxygen pressure gauge and adjusting knob, top oxygen flow regulator and analytical gas flow regulator. The lower part includes the furnace uplift & descent switch, over-current & over-time reset button, automatic cleaning button, power switch and the dryer. The right section is the combustion area for the furnace of which the upper part is mounted with the filtration and cleaning systems for the gases released after combustion while the lower part bearing the cylinder which is used for transmitting the testing sample into the combustion area during the sample analysis and taking the testing sample out of the combustion area at the end of combustion.

The infrared testing unit has two layers. In the upper layer there are modular power and Control PCB. In the lower layer, there is the gas analysis room, which consists of a carbon analysis tank, sulfur-analysis tank and current stabilizer.

1.3 Technical index

1.3.1 Range of Measurement:

Carbon: 0.0005%-6.0000% (extendable to 99.99%)
Sulfur: 0.0005%-0.5000% (extendable to 99.99%)

1.3.2 Accuracy and Precision:

Accuracy: Carbon confirms to the Standards ISO9556
Sulfur confirms to the Standards ISO4935
Precision: confirms National Metrological Verification Standards JJG395-97

1.3.3 Time of Analysis: Adjustable at 25~60 seconds, but generally at about 35 seconds.

1.3.4 Min. reading: 0.00001%

1.3.5 Electronic Balance:
Weighing range: 0~120 g, Precision of readers: 0.0001 g

2. Installation of the instrument

2.1 Preparation before the installation

Note: The user should make appropriate working preparation before the arrival of company installation staff.

2.1.1 Analyzing room: be far away from the erosion gas such as acid, alkali, dust, vibration, testing disturbance.

2.1.2 Analyzing room size: > 2×3m

2.1.3 Working condition: Room temperature: 10-30℃, Relative humidity: <75%

2.1.4 Power supply:

well earthing is required, Voltage: AC220V±5%, Frequency: 50/60Hz, No disturbance from harmonic wave

2.1.5 Voltage stabilizing equipment

Power: 5kW, Voltage stabilizing precision<2%

Note: If there is disturbance from intermediate frequency furnace in the work power supply, the equipment should be equipped with AC Regulated Power Supply.

2.1.6 Gas: Oxygen: purity≧99.5%

2.1.7 Power gas: Nitrogen or Compressed air (Purified: without water, oil and contamination).

2.1.8 Tool: Box opening tool and regular tools.

2.2 Installation of HF Furnace

2.2.1 Unpack the case to take out the instrument, use a screw driver and an adjustable wrench to remove the back cover-plate and right side-plate, unscrew the stainless steel cover-plate for the interior hood at the right side to take out the furnace core. Fix one end of the vacuum capacitor to the core plate with a screw; fix the other end with a copper strip to the capacitor and the heating coil. Use screw driver to tighten all the retaining screws for the core components. Replace the core, take out the electron tube and insert it to its seat; use the screw driver to tighten the upper radiator and the copper strip.

2.2.2 Use a wrench to take off the rubber hoses for the oxygen intake connector and the furnace gas connector, loosen Fastener by hand to remove the cavity, place the quartz tube into its stand from the top and let the tube go through the induction coil at the center of the stand. Refit the cavity with the upper part of the quartz tube into original position. Place the red silica gel coated washer to the bottom portion of the quartz tube.

2.2.3 Check to see if the interior screws are loose and if there are foreign objects inside the chassis.

2.2.4 Make sure to fix the core, all the retaining screws and all the screws for the interior stainless steel hood covers; install the right side plate and the rear plate.

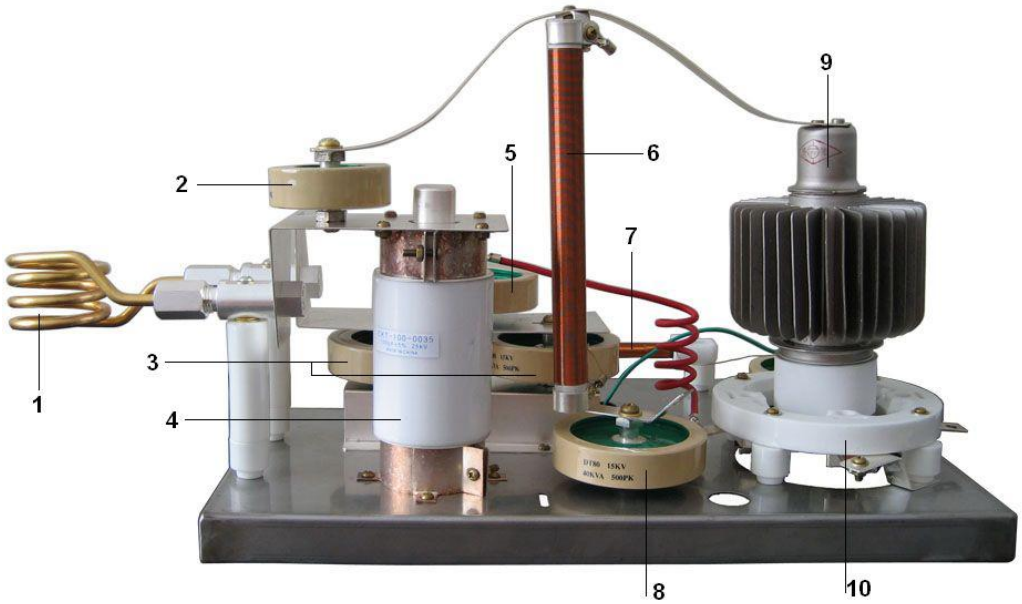


Fig (2)—High-frequency oscillation circuit

1	**High-frequency heating coil**	**2**	**Coupling capacitor**
3	**Capacitor bank of main oscillation circuit**	**4**	**Vacuum capacitor**
5	**Grid plate feedback voltage coupling capacitor**	**6**	**Plate electrode choke coil**
7	**Grid plate high-frequency choke coil**	**8**	**Filter capacitor**
9	**High-frequency oscillation tube**	**10**	**Electron tube socket**

2.3 Installation of infrared testing unit

2.3.1 Unpack the case to take out all the component of the instrument, and have it properly placed as the outline structure.

2.3.2 Open the upper and lower back door of the infrared testing unit to check if there is any loosen problems in the printed circuit breadboard and various connectors. Try to plug the balance connection line, USB line and optical fiber in order. (See Fig (3))

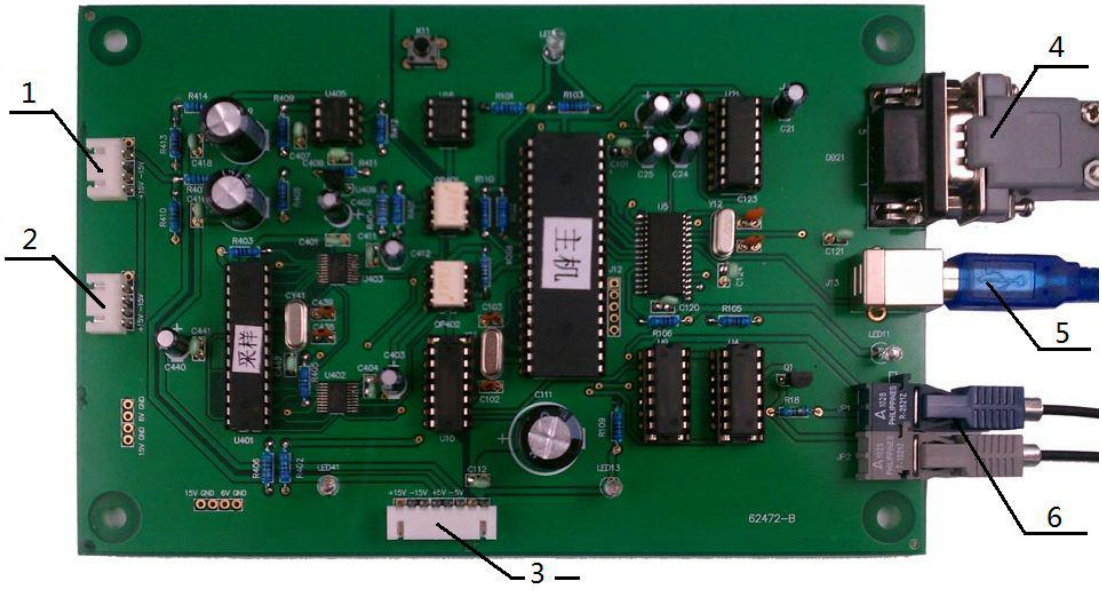


Fig (3)—Control circuit board

1 Connection with carbon amplifying board

2 Connection with sulphur amplifying board

3 Connection with modulating motor and light source

4 DC power input

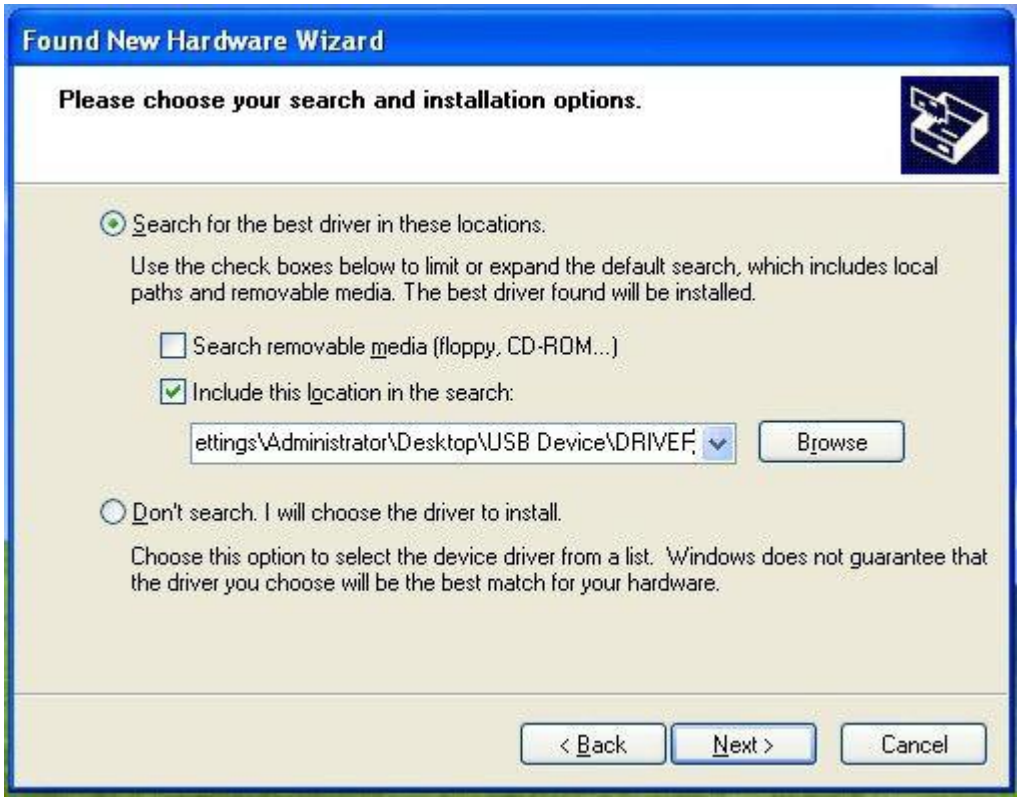
5 Balance connecting wire

6 USB communication wire

7 Optical-fiber communication wire

Installation of USB drive: connect two ends of USB cable to the USB ports of the control circuit board and computer, turn power on.
After the system prompts the USB CH372/375 hardware is found, select “install from the list”or “install from the specified location”, and click Next.

As shown in figure below open the drive at the specified location E:\USB drive\DRIVE, and click Next.
Note: E at the specified location represents U disk, which directories may be different for different computers.



The system will automatically install newly found USB CH375 drive.

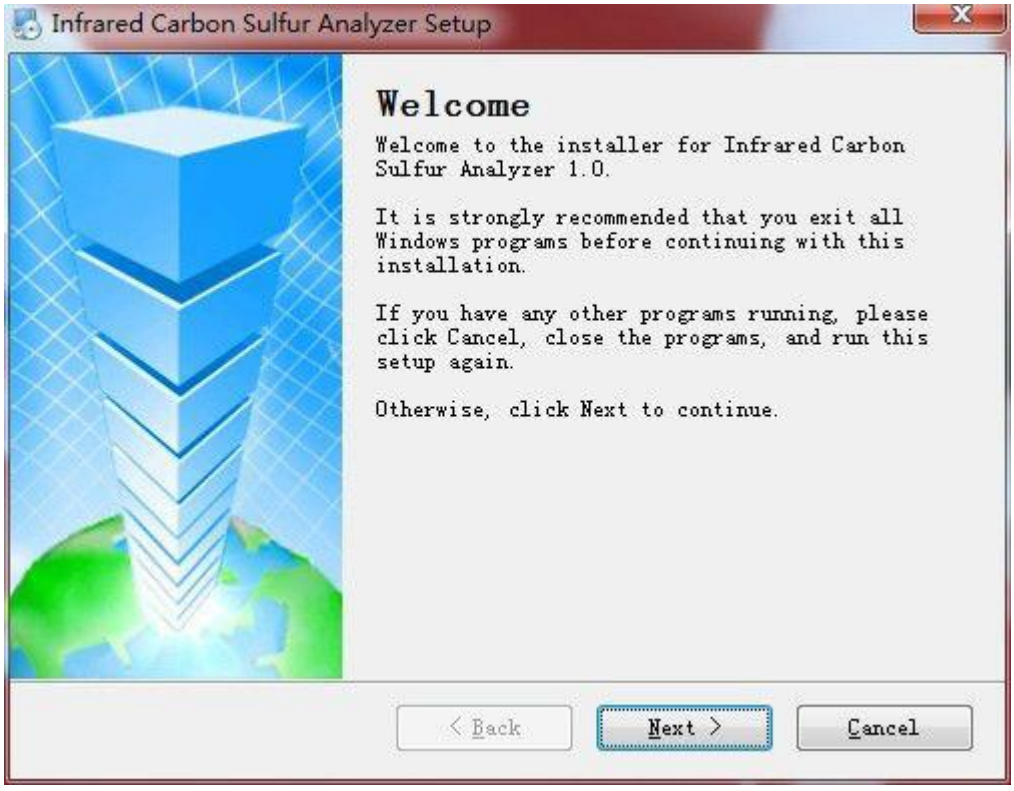
After installation the system prompts completion of installation, click Finish.

2.3.3 Connect with power source and all gas pipelines (referring to gas pipe diagram).

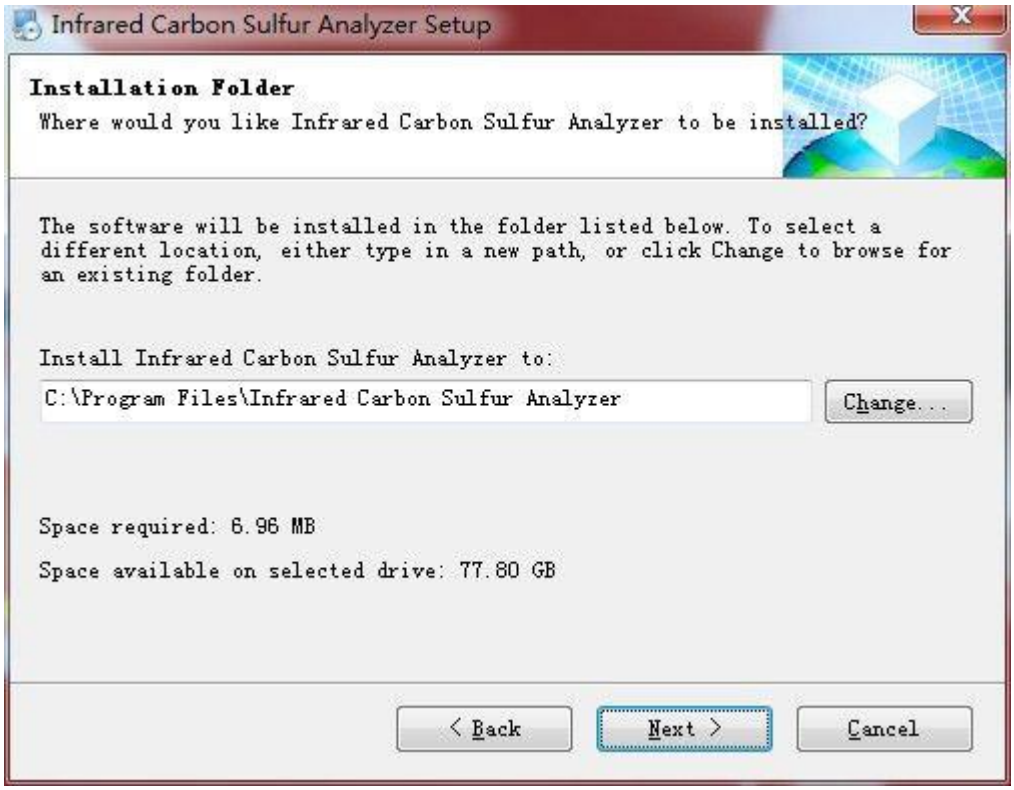
3. Installation and Registration of Operating Software

3.1 Installation of operating software

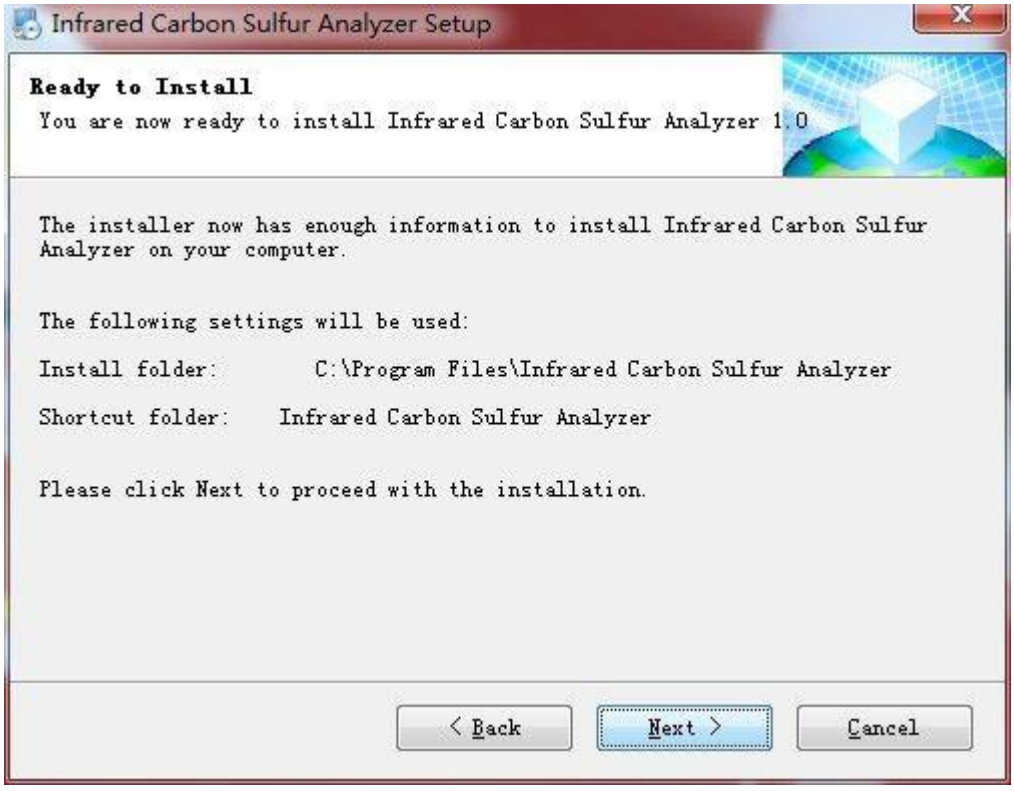
Open the auxiliary installation CD, and double click DW-CS-8820 SETUP file with mouse to enter the program installation process.

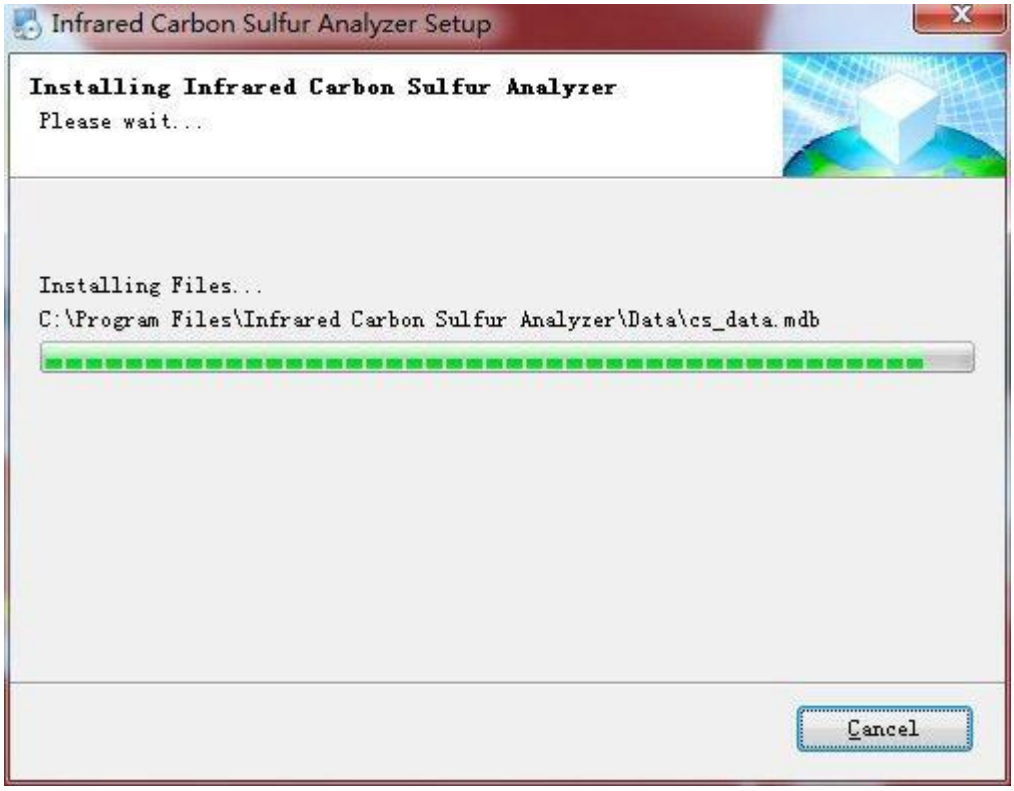


Upon the prompt click〖Next〗with the left mouse button into the next operation.



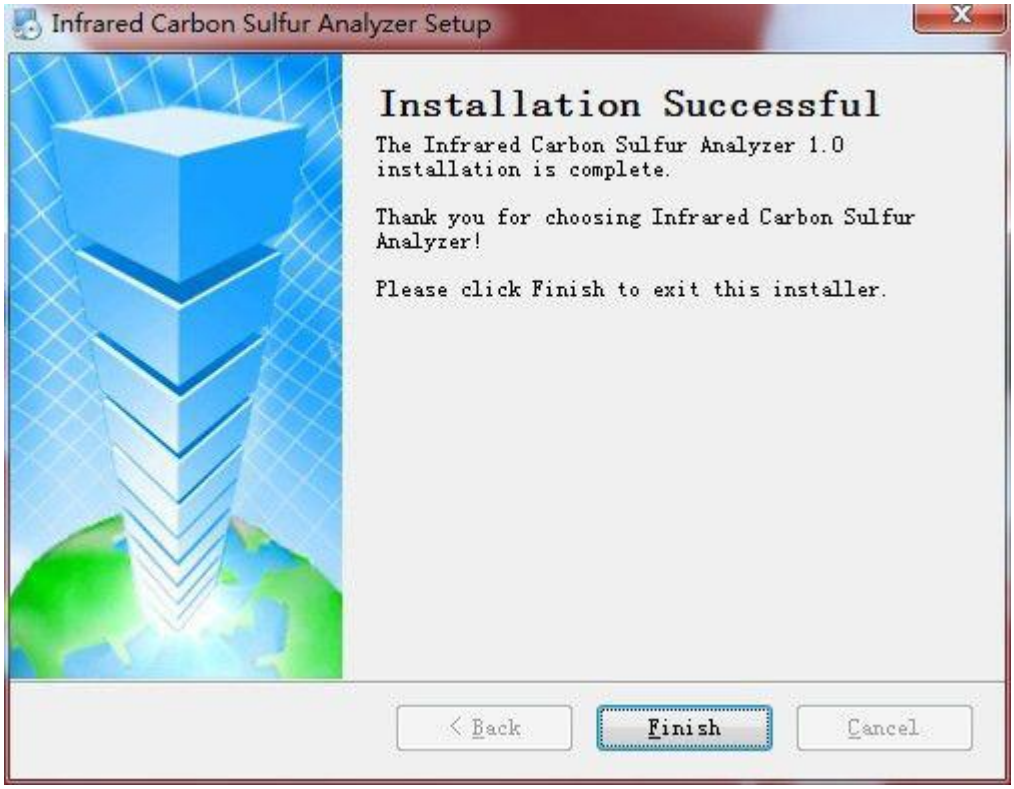
The installation program prompts to select the target directories to install, either defaulting the current directory, or clicking〖Browse〗to select other directories to install program. Click 〖Next〗with the left must button into the next operation.





Enter the start installation interface, and click〖Next〗with the left mouse button into the next operation.

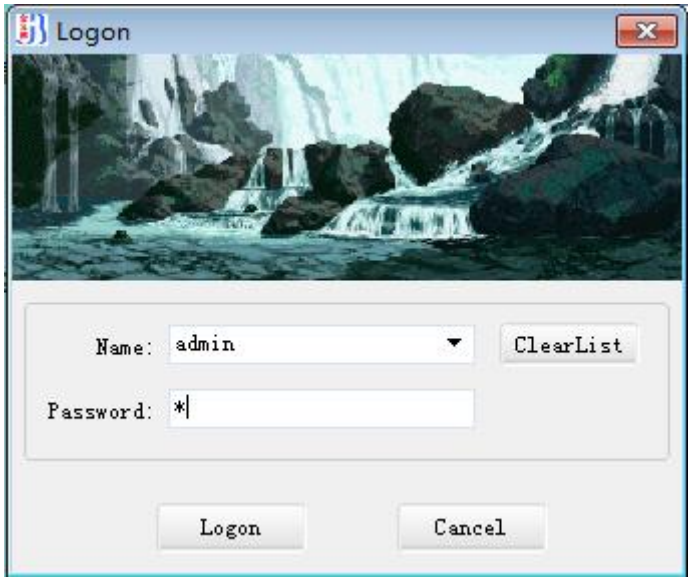
The installation program will prompt the time left for installation till the complete installation succeeds.



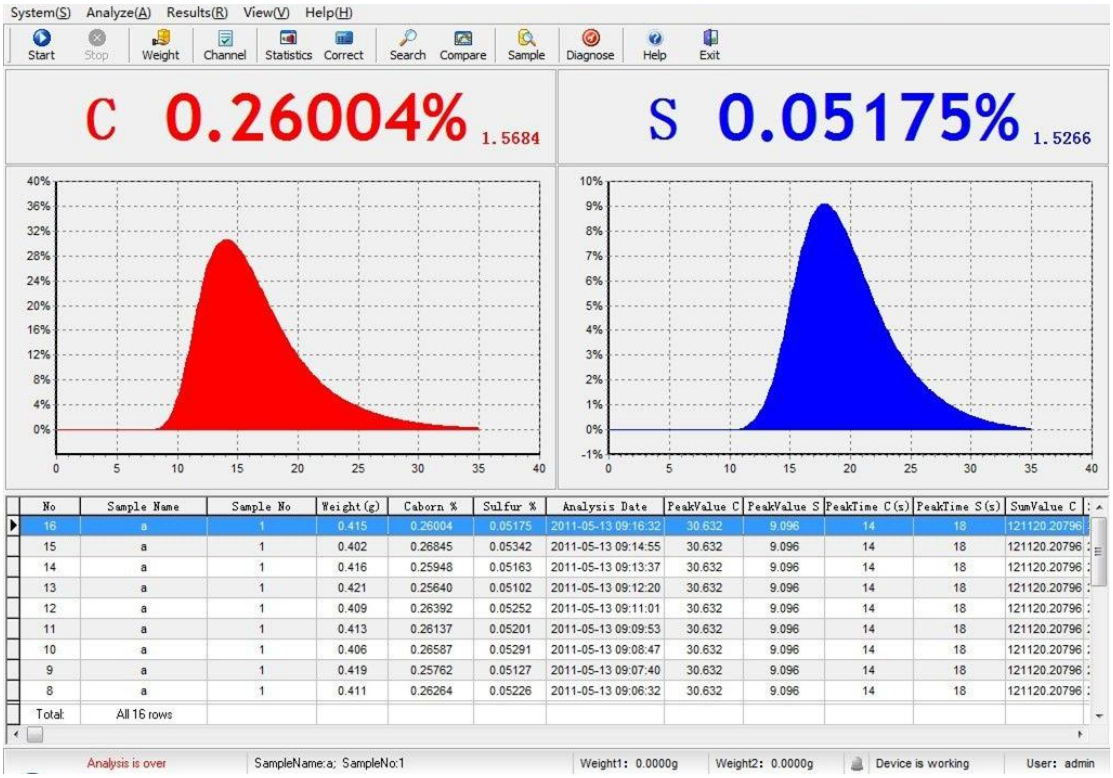
Upon completion of installation click〖Finish〗with the left mouse button.

3.2 Registration of software

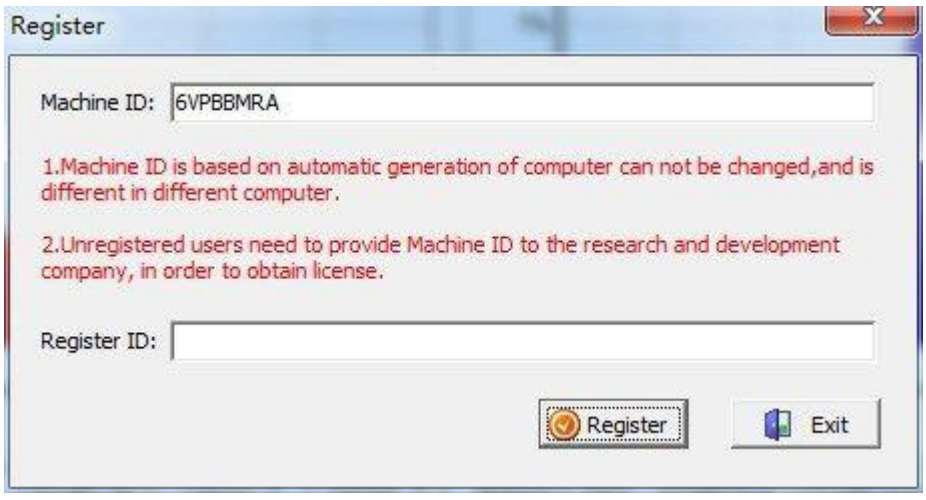
After successful installation of software, double click “DW-CS-8820” icon into the system login window with the initial user name being admin, input initial password “1” in the password field, and click login into the analysis interface.



This software can then be operated for demonstration, manually input weight, press〖Analyze〗to demonstrate the analysis process in automatic way and display the release curves and analysis results. However, the software should be on-line operated and cannot be normally used until being formally registered.



Select 〖Help 〗menu into 〖Register 〗to display registration contents, the system will automatically extract the machine code. Send the machine code to manufacturer to obtain the registration code, and input it correctly, the software is successfully registered.



Upon success of registration exit the program and enter once more, the normal working mode can be displayed accordingly.

Normal working mode:

(1) The cell voltage has stable pulsing signal (in general approximate 1.5000)

(2) The equipment in normal operation is displayed on the lower right corner of screen

4. Analysis

4.1 Preparations

4.1.1 Put the ceramic crucible into the muffle furnace and process for 4h after temperature rises up to 1000℃ and cool, after that put the ceramic crucible into dryer for standby.

4.1.2 Standard sample, fluxing agent

4.1.3 Crucible tongs, sample spoon

4.1.4 Oxygen and power gas for analysis (pressure all regulated to 0.18MPa)

4.1.5 Pre-heat the infrared detection cell for 1h and the high-frequency furnace for 30min.

4.2 Analysis operations

DW-CS-8820 is designed for analysis of steel and other materials such as cement, coal, rubber and soil, etc. The weighed quantity of samples, types of added fluxing agents and sensitivity of analyzers are different with the material properties of samples in combustion.

Describe as follows with steel for example:

Put the firing processed porcelain crucible in the electronic balance, reduce the tare, put the weighed sample of about 400-500 mg, push the button to file up sample weight in the computer, put 1.5 grams of fusing agent and then place the crucible which contains sample inside the burning room of the H-F furnace by forceps. Start “Furnace-Rise Switch” to seal the gas path, Click “Analysis” button on the screen with mouse move to make the instrument start analysis.

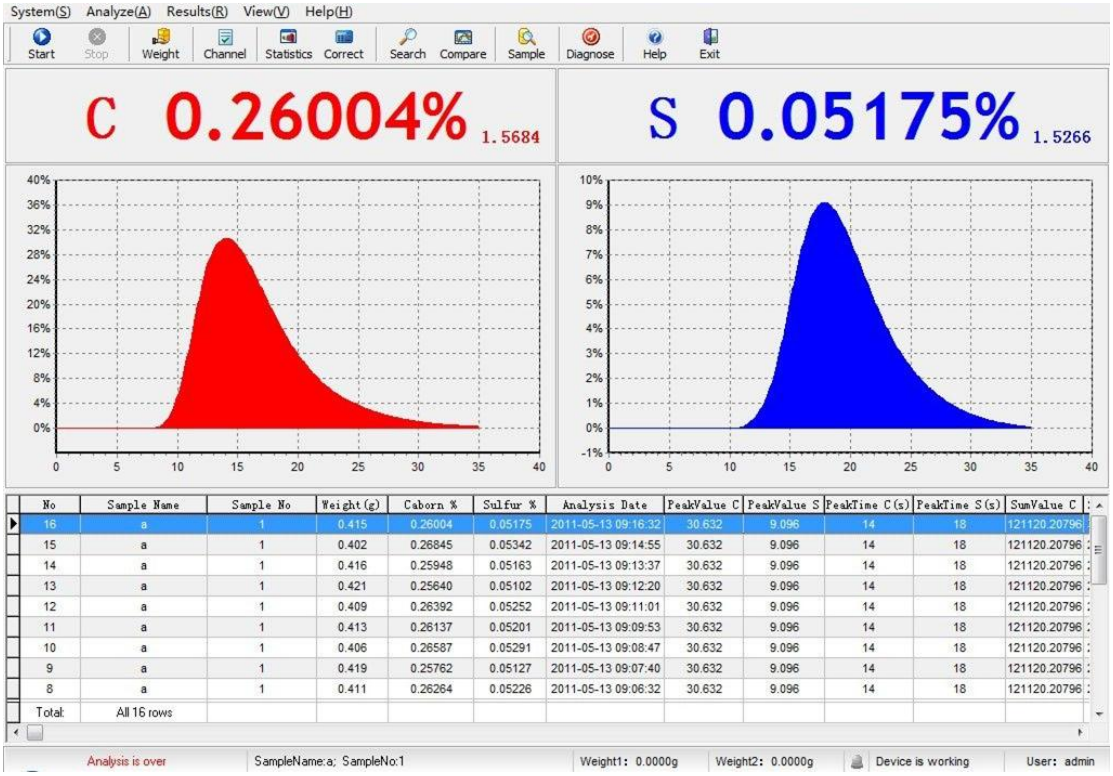
Notices:

(1) The ceramic crucible must be clamped with clean crucible tongs without touch by hand

(2) Only the mass of samples is read out by analyzer without including the mass of fluxing agents

5. Application of Analysis Software

5.1 Introduction of primary analysis interface



1 Main menu column **2 Shortcut menu column**

3 Analysis results column **4 Cell voltage display column**

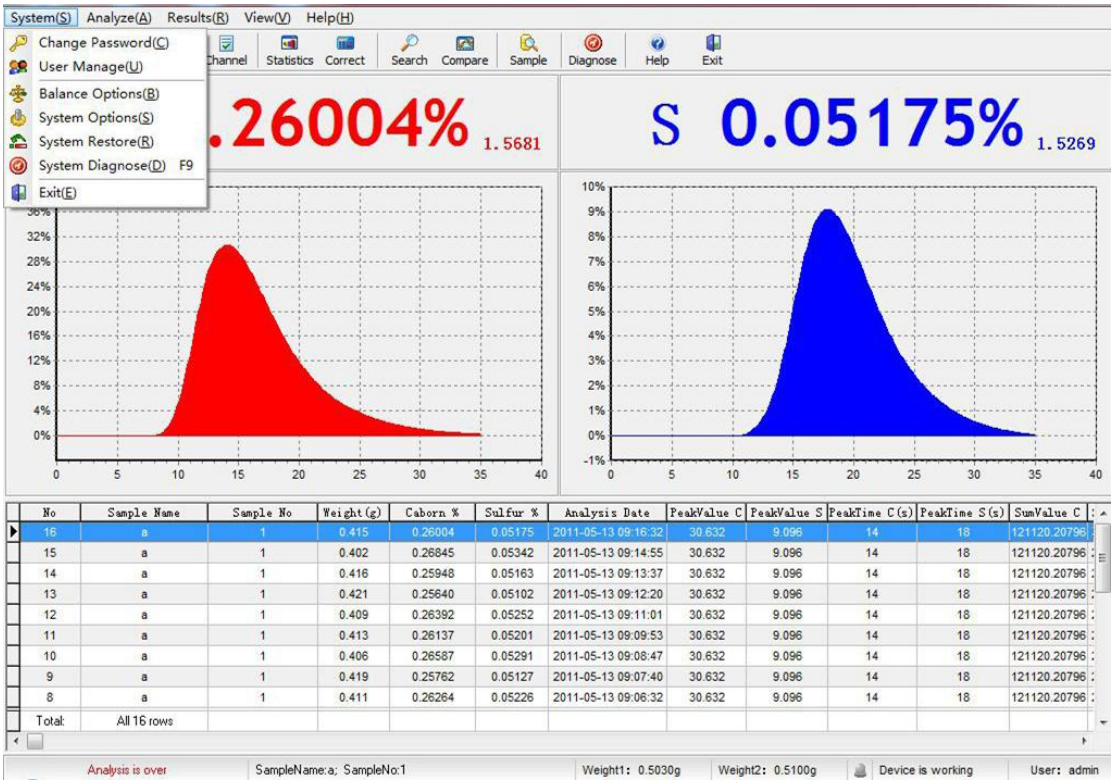
5 Real-time analysis curves display column **6 Rapid view column for analysis results**

7 Analysis status column

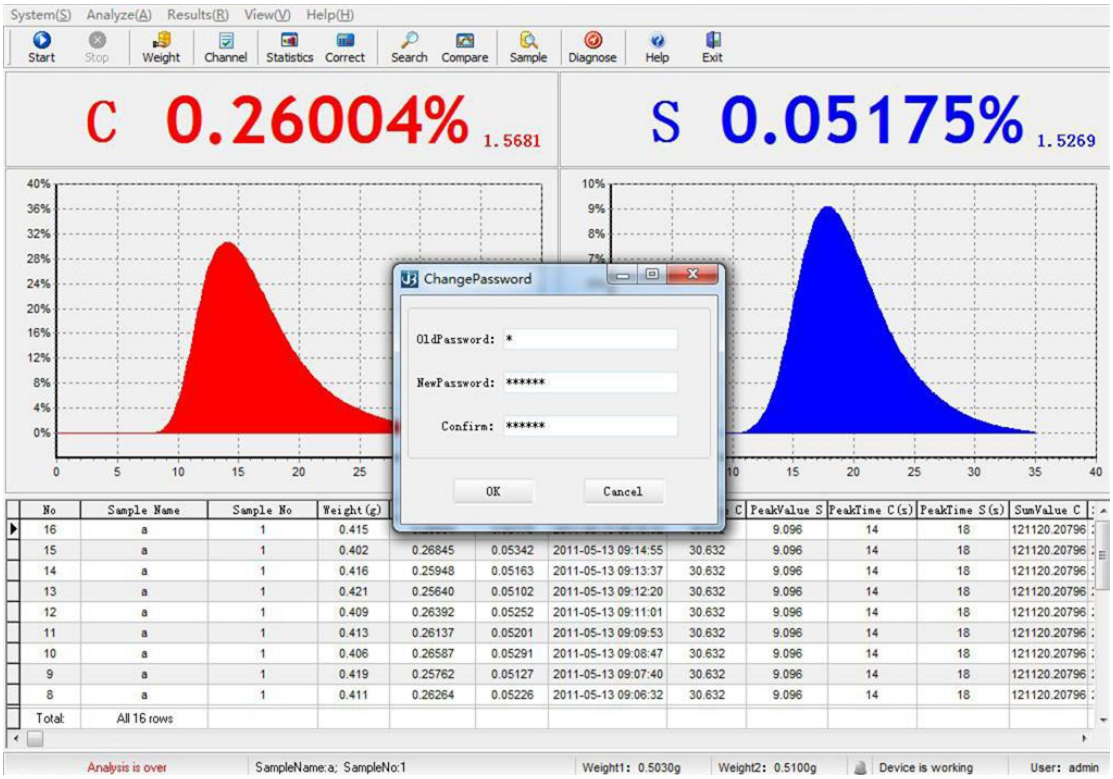
5.2 Introduction of main menu functions

System	Analyze	Results	View	Help
Change Password	Start	Statistics	Tools	Help
Balance Options	Stop	Search	Status	About
System Options	Input Weight	Coefficient Correct		Register
System Diagnose	Channel Options	Curve Compare		
Exit	Sample Options	Curve Correct		
	Linearization	Print		
	Input Sample			

5.3 System functions



5.3.1Modify password

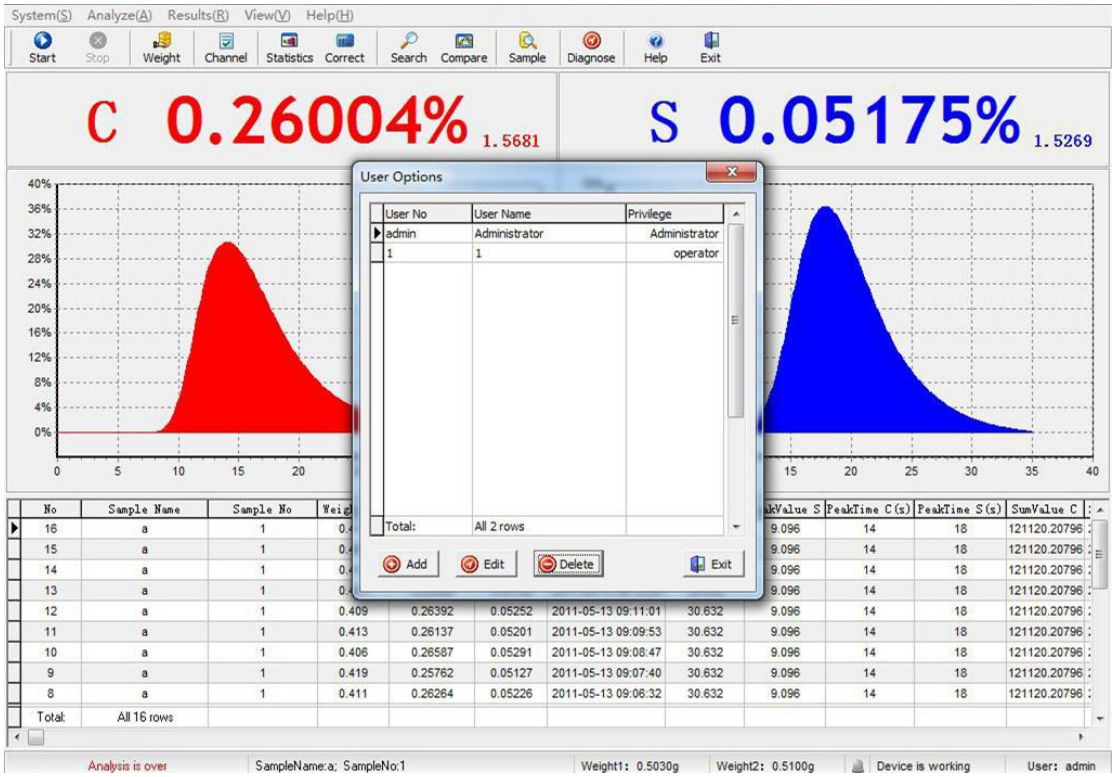


Select〖Modify password〗into〖Modify login password〗, input the current password

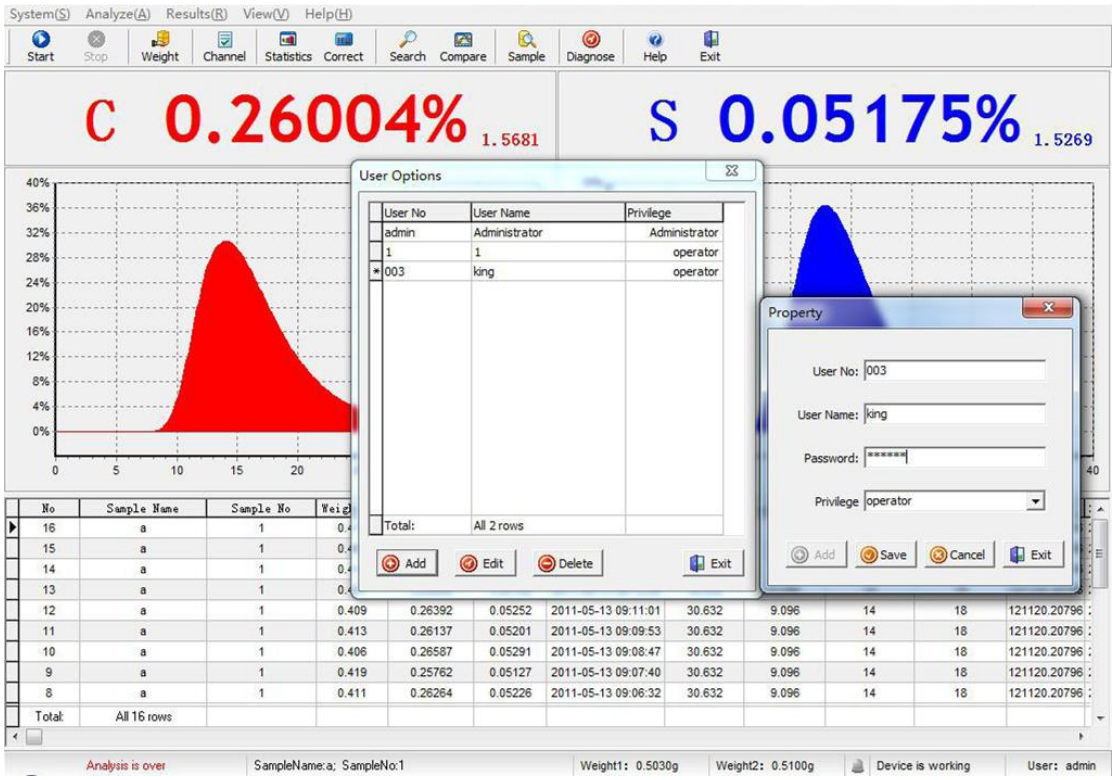
in

〖Original password〗, input the modified password in 〖New password〗 and 〖Confirm password〗 fields, and press 〖Ok 〗, the modification of password succeeds and new password becomes effective.

5.3.2 User management

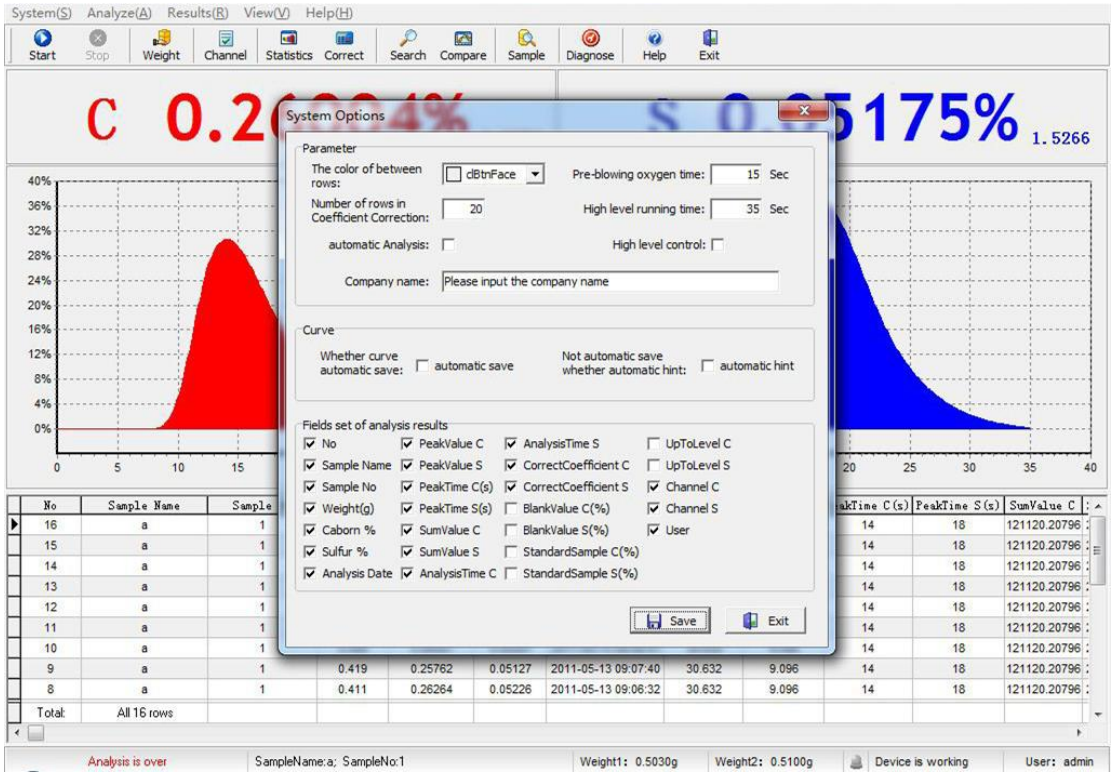


Select 〖User management〗, the system pops out 〖user management〗 menu to display all administrators and operators to operate this analyzer currently. As the supervisors of departments, the administrators can add or delete operators and modify the data and passwords of operators. As the analysts and the specific operatives for analyzer, the operators can operate the most menus of this software.



The administrators can add new operators by inputting user No., name and password and then pressing 〖Save〗. After selecting one operator with mouse and selecting 〖Modify〗, the basic information of the operator can be modified and edited, if 〖Delete〗is selected, the system prompts confirmation or not, the operator can be deleted by pressing〖Enter〗.

5.3.3 System setup



〖System setup 〗includes three functions, i.e. parameters setup, curves setup and listed fields display setup for analysis results.

〖Parameters〗mainly set up

(1) Interline colors of analysis result data

(2) Oxygen pre-blowing time

(3) Quantity of return records for coefficients correction

(4) Automatic analysis or not

(5) High-frequency operating time

(6) User name

〖Curves〗mainly set up

(1) Automatic saving of release curves or not after each analysis

(2) The system automatically prompts or not after each analysis without automatic saving 〖Listed fields display setup for analysis results 〗mainly sets up which parameters are displayed in rapid review column of analysis results, definitely listed as follows:

〖Listed fields display setup for analysis results 〗mainly sets up which parameters are displayed in rapid review column of analysis results, definitely listed as follows:

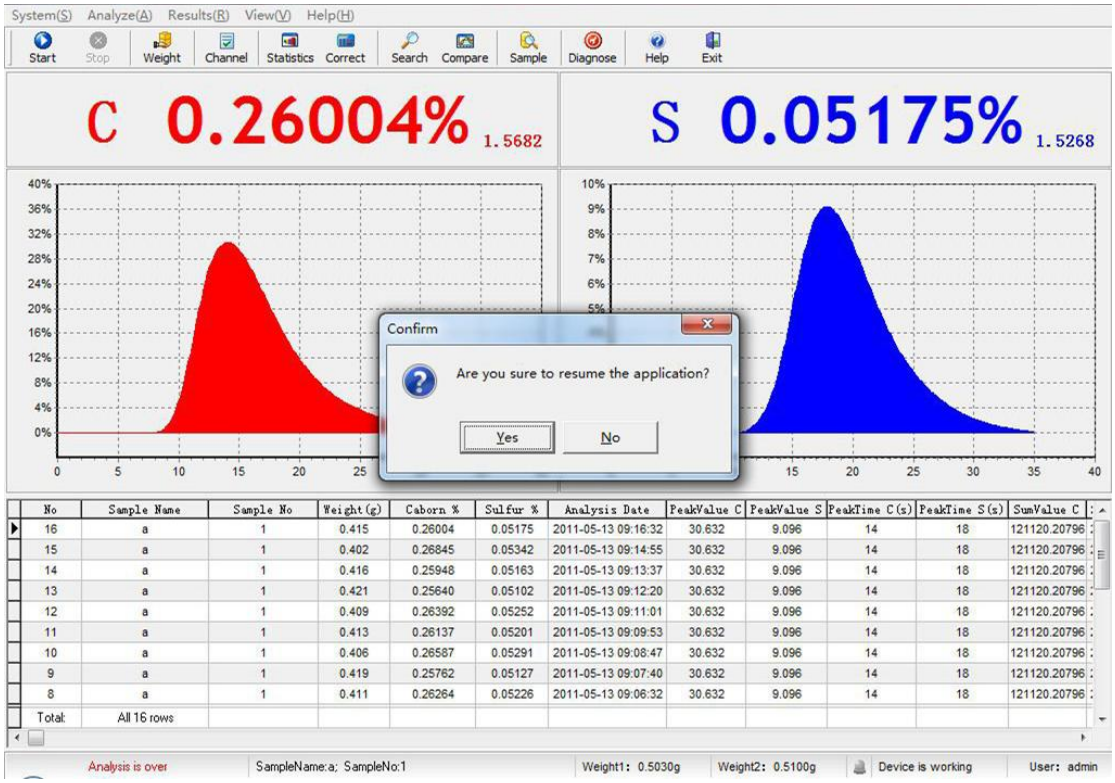
Serial No. Weight (g) Peak time of
sulphur (s)
Carbon
calibration
coefficient
Standard value of
carbon sample (%)

Sample
description
Analysis start
time
Carbon
accumulation
value
Sulphur
calibration
coefficient
Standard value of
sulphur sample (%)
Sample No. Peak value of
carbon
Sulphur
accumulation
value
Carbon blank

value (%)
Carbon cutoff level
Carbon
content (%)
Peak value of
sulphur
Carbon analysis
time
Sulphur blank
value (%)
Sulphur cutoff level
Sulphur
content (%)
Peak time of
carbon (s)
Sulphur analysis
time
Operators

There is one ☐ before every item, tick √ in ☐ to select the item, which will be displayed in result column, and the items not selected will be hidden, however, all items are displayed in results inquiry.

5.3.4 System restore

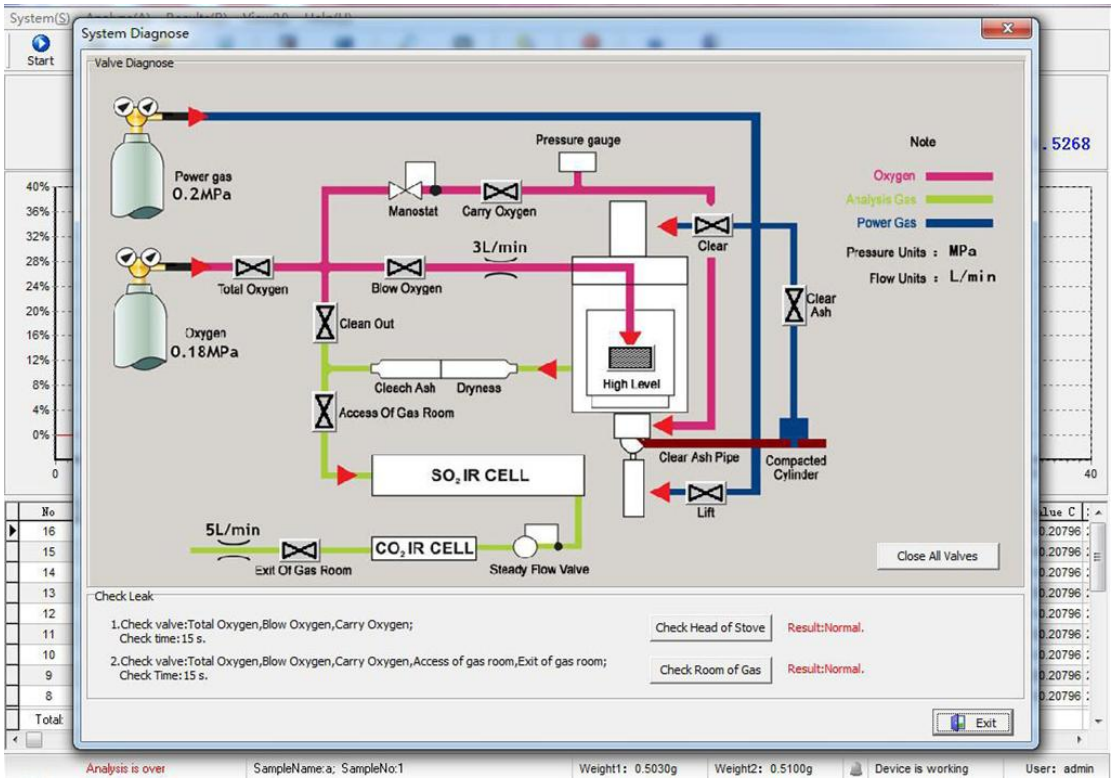


No	Sample Name	Sample No	Weight(g)	Caborn %	Sulfur %	Analysis Date	PeakValue C	PeakValue S	PeakTime C(s)	PeakTime S(s)	SumValue C
16	a	1	0.415	0.26004	0.05175	2011-05-13 09:16:32	30.632	9.096	14	18	121120.20796
15	a	1	0.402	0.26845	0.05342	2011-05-13 09:14:55	30.632	9.096	14	18	121120.20796
14	a	1	0.416	0.25948	0.05163	2011-05-13 09:13:37	30.632	9.096	14	18	121120.20796
13	a	1	0.421	0.25640	0.05102	2011-05-13 09:12:20	30.632	9.096	14	18	121120.20796
12	a	1	0.409	0.26392	0.05252	2011-05-13 09:11:01	30.632	9.096	14	18	121120.20796
11	a	1	0.413	0.26137	0.05201	2011-05-13 09:09:53	30.632	9.096	14	18	121120.20796
10	a	1	0.406	0.26587	0.05291	2011-05-13 09:08:47	30.632	9.096	14	18	121120.20796
9	a	1	0.419	0.25762	0.05127	2011-05-13 09:07:40	30.632	9.096	14	18	121120.20796
8	a	1	0.411	0.26264	0.05226	2011-05-13 09:06:32	30.632	9.096	14	18	121120.20796
Total:	All 16 rows										

Select〖System restore〗, the system pops out a prompt box, “Really restore the system?”, if〖Yes (Y)〗is selected, all data will be lost and the system returns to the initially installed status.

Notice: once〖System restores〗, all data of the whole system will be lost, so this option is not recommended.

5.3.5 System diagnosis



〖System diagnosis〗plots the analysis gas pipe diagram of the analyzer， users can click each value with mouse to diagnose whether every pneumatic valve operates normally or not, clicking the〖High frequency〗with mouse can check whether high frequency operates normally or not. All valves and high frequency can also be opened/closed by pressing numeric buttons directly.

Numeric buttons corresponding to switches/valves

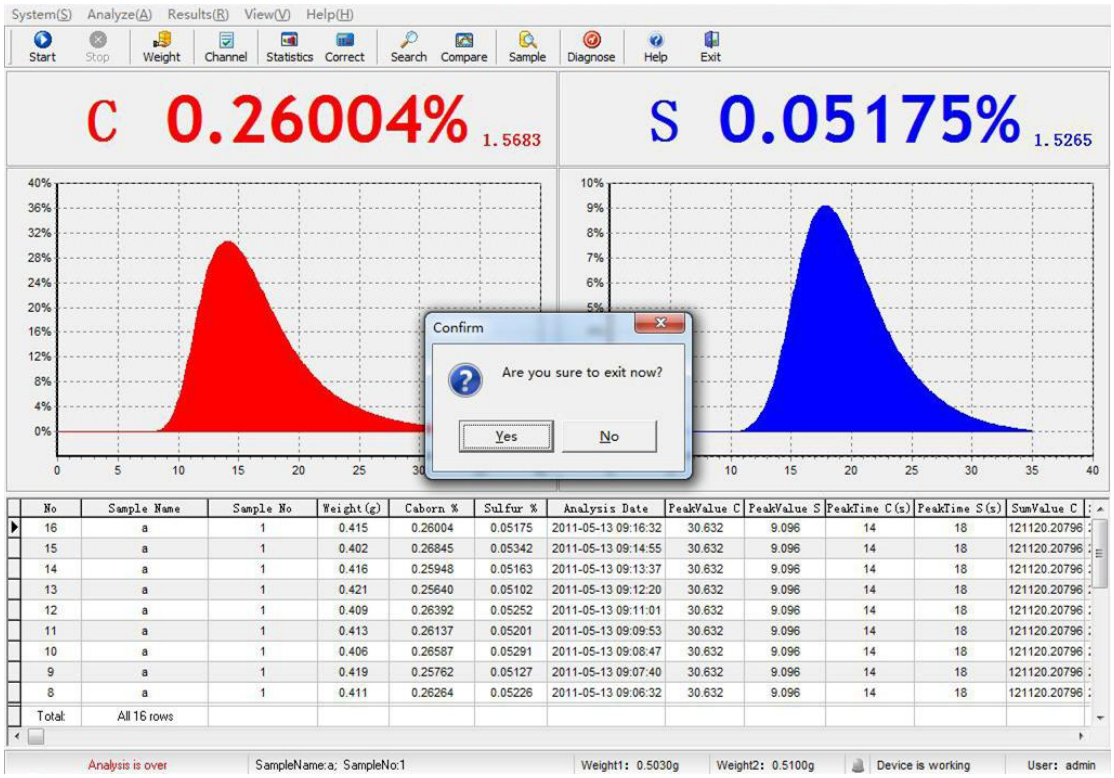
1 Total oxygen　　2 Oxygen-blowing　　3 Oxygen-carry in　　4 Clean

5 Inlet of gas cell　　6 Outlet of gas cell　　7 Discharge ash　　8 High frequency

The gas leakage check is below the〖system diagnosis〗menu, click〖Check furnace end〗or〖Check gas cell〗with mouse, the system will automatically open valves of corresponding gas pipes and then close valves to determine leakage or not by detecting changes of pressure.

Notice: the pressure gages and analyzing gas flow displayed in diagram are optional items, which can not be realized until users purchase the corresponding optional parts from our company.

5.3.6 Log out



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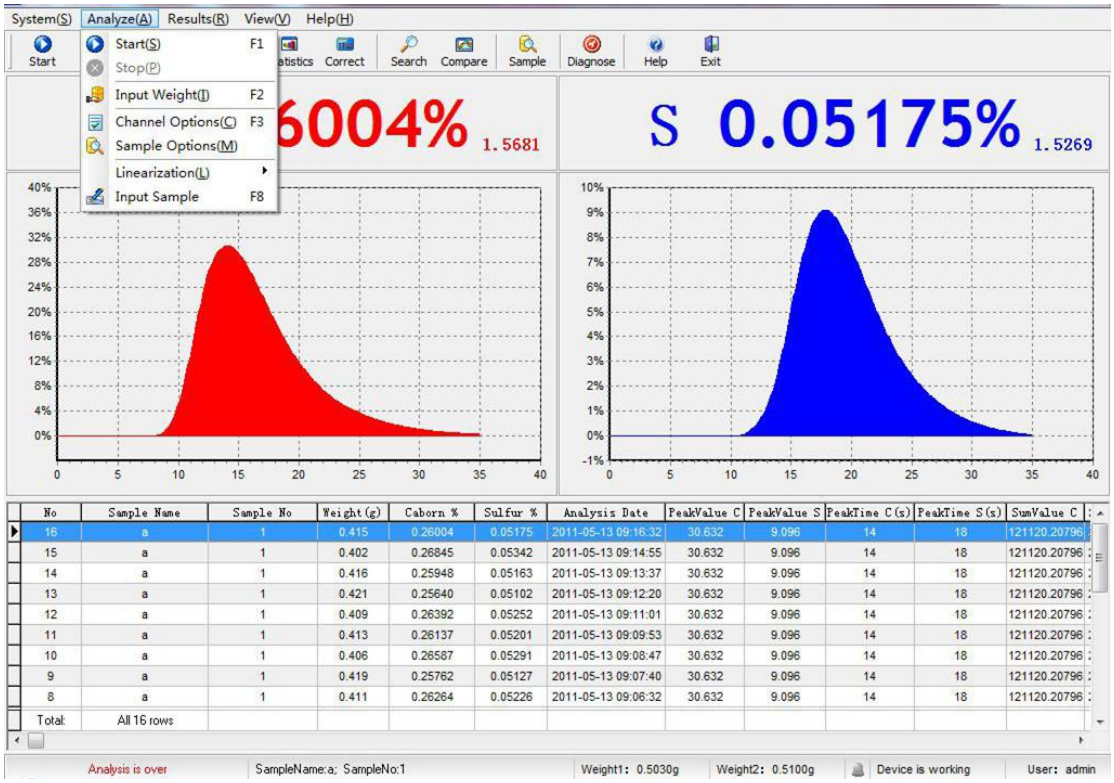
14	a	1	0.416	0.25948	0.05163	2011-05-13 09:13:37	30.632	9.096	14	18	121120.20796
13	a	1	0.421	0.25640	0.05102	2011-05-13 09:12:20	30.632	9.096	14	18	121120.20796
12	a	1	0.409	0.26392	0.05252	2011-05-13 09:11:01	30.632	9.096	14	18	121120.20796
11	a	1	0.413	0.26137	0.05201	2011-05-13 09:09:53	30.632	9.096	14	18	121120.20796
10	a	1	0.406	0.26587	0.05291	2011-05-13 09:08:47	30.632	9.096	14	18	121120.20796
9	a	1	0.419	0.25762	0.05127	2011-05-13 09:07:40	30.632	9.096	14	18	121120.20796
8	a	1	0.411	0.26264	0.05226	2011-05-13 09:06:32	30.632	9.096	14	18	121120.20796
Total:	All 16 rows										

Select〖Log out〗, the system pops out dialogue box “Really log out?”, if〖Yes (Y)〗is selected, the system will exit from the program.

5.4 Analysis control



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13	a	1	0.421	0.25640	0.05102	2011-05-13 09:12:20	30.632	9.096	14	18	121120.20796
12	a	1	0.409	0.26392	0.05252	2011-05-13 09:11:01	30.632	9.096	14	18	121120.20796
11	a	1	0.413	0.26137	0.05201	2011-05-13 09:09:53	30.632	9.096	14	18	121120.20796
10	a	1	0.406	0.26587	0.05291	2011-05-13 09:08:47	30.632	9.096	14	18	121120.20796
9	a	1	0.419	0.25762	0.05127	2011-05-13 09:07:40	30.632	9.096	14	18	121120.20796
8	a	1	0.411	0.26264	0.05226	2011-05-13 09:06:32	30.632	9.096	14	18	121120.20796
Total:	All 16 rows										

5.4.1 Start analysis

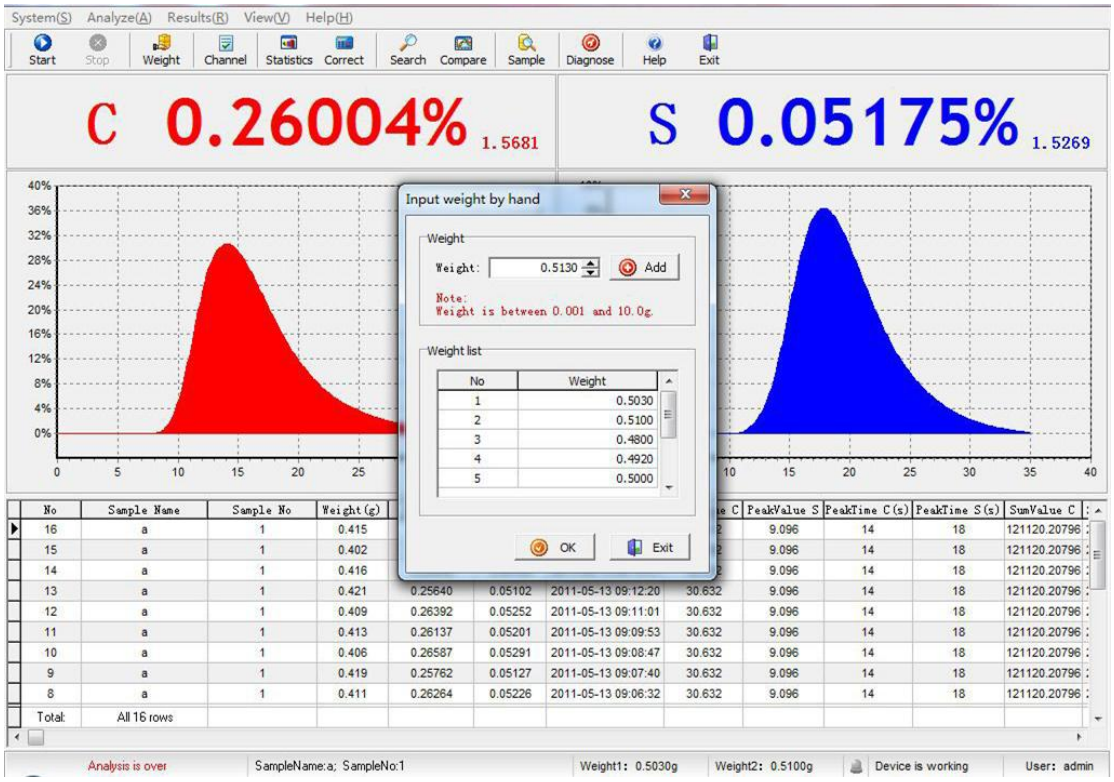
To make analysis, first of all two conditions must be satisfied: (1) There is weight in weight pool, (2) The lift cylinder goes up and down once. Select〖Start analysis〗, the analyzer enters analysis status, including the oxygen blowing process at first, and then the combustion process. Upon completion of analysis, the analyzer automatically closes all valves and the analysis this time is over.
The shortcut button for〖Start analysis〗: F1

5.4.2 Terminate analysis

If the analysis in process is to be terminated or finished ahead of time, select 〖Terminate analysis〗, the analyzer will finish the analysis.
Notice: (1) If the analysis is terminated in oxygen blowing process, the weight this time is valid and the samples don't combust, the analysis can be continued.
(3) If the analysis is terminated in combustion process, the samples have combusted, the weight this time will be included in the analysis results.

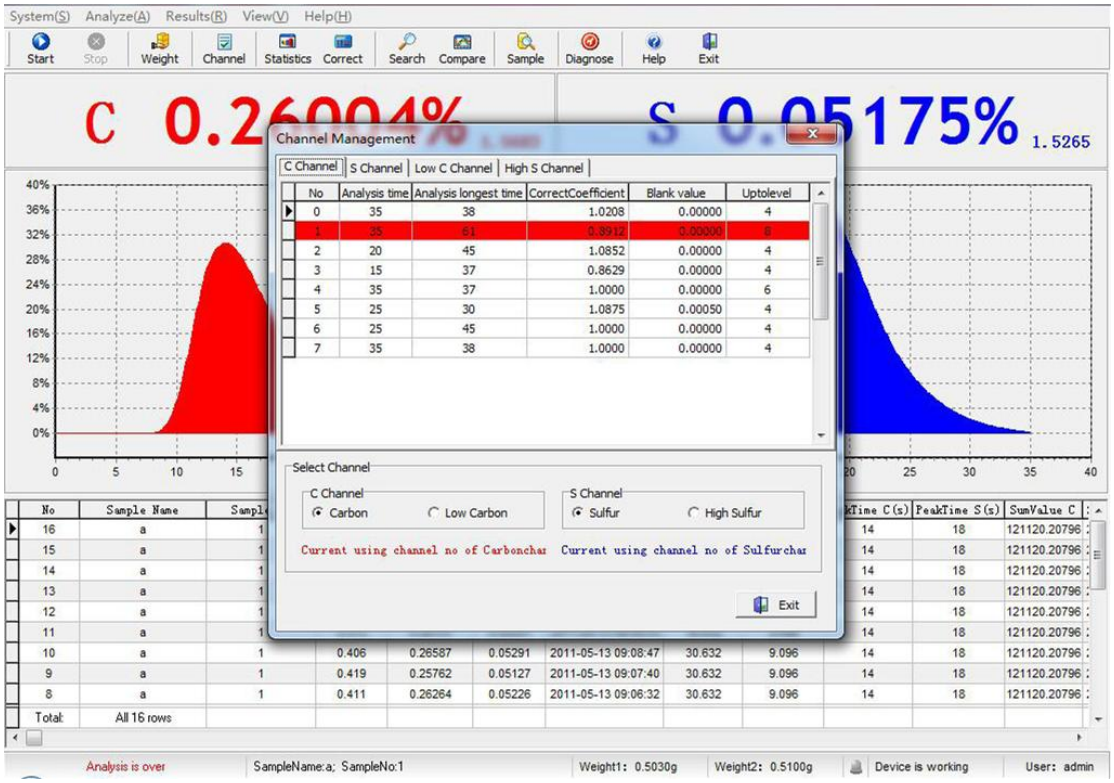
5.4.3 Weight input

For this analyzer, there are two ways of weight input: (1) automatic input by electronic balance; (2) manual input. The function adopted here refers to manual weight input.
Automatic weight input: weigh the weight by means of electronic balance, and press 〖PRINT〗on the lower right corner of the balance, the weight enters program.
Manual weight input: select〖Weight input〗 to pop out weight box, input weights and press 〖Add〗button, the input weights will be arranged as per the serial No. in weight list.
If some weight needs to be deleted, select that weight with mouse and double click the left mouse button.



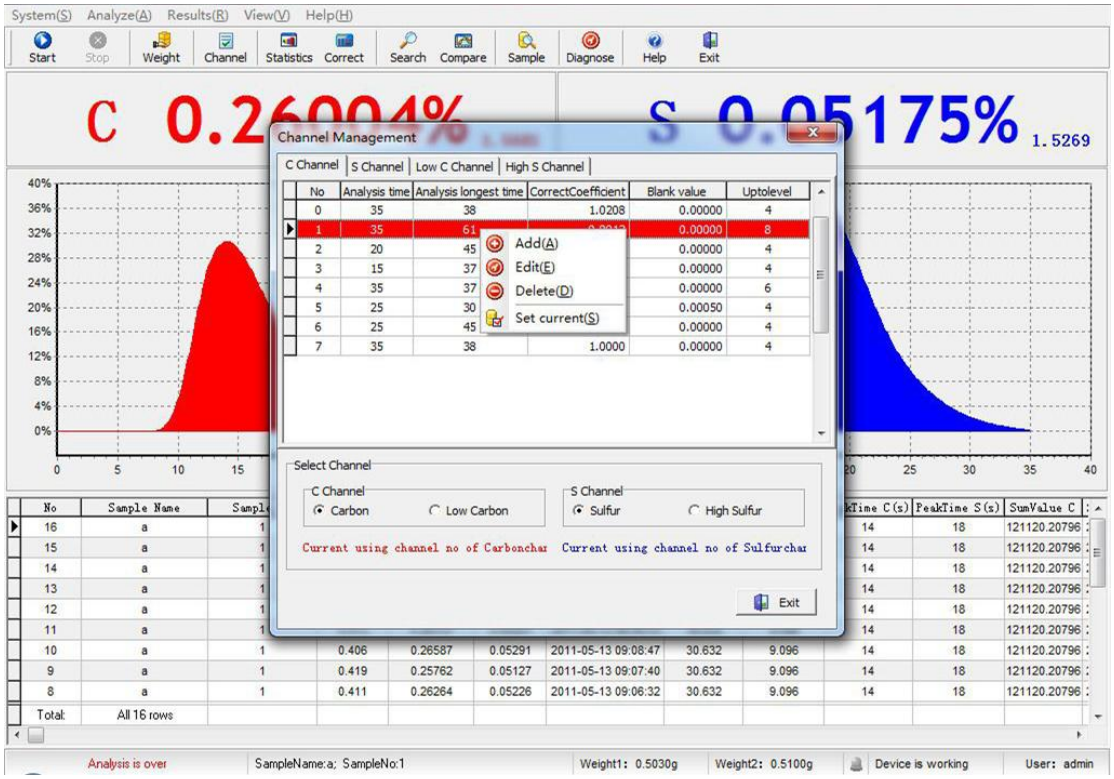
5.4.4 Channels management

Select〖Channels management〗, the system enters the channels management menu, each channel pool includes 8 groups of original channels, which record the data such as analysis time, calibration coefficient, blank value and cutoff level, etc.



The channels designed in this software can be freely deleted and added: select some

channel with mouse, and click the right button to pop out the option menu, the channel can be edited, deleted or set up as current channel, and new channels can be added, too.



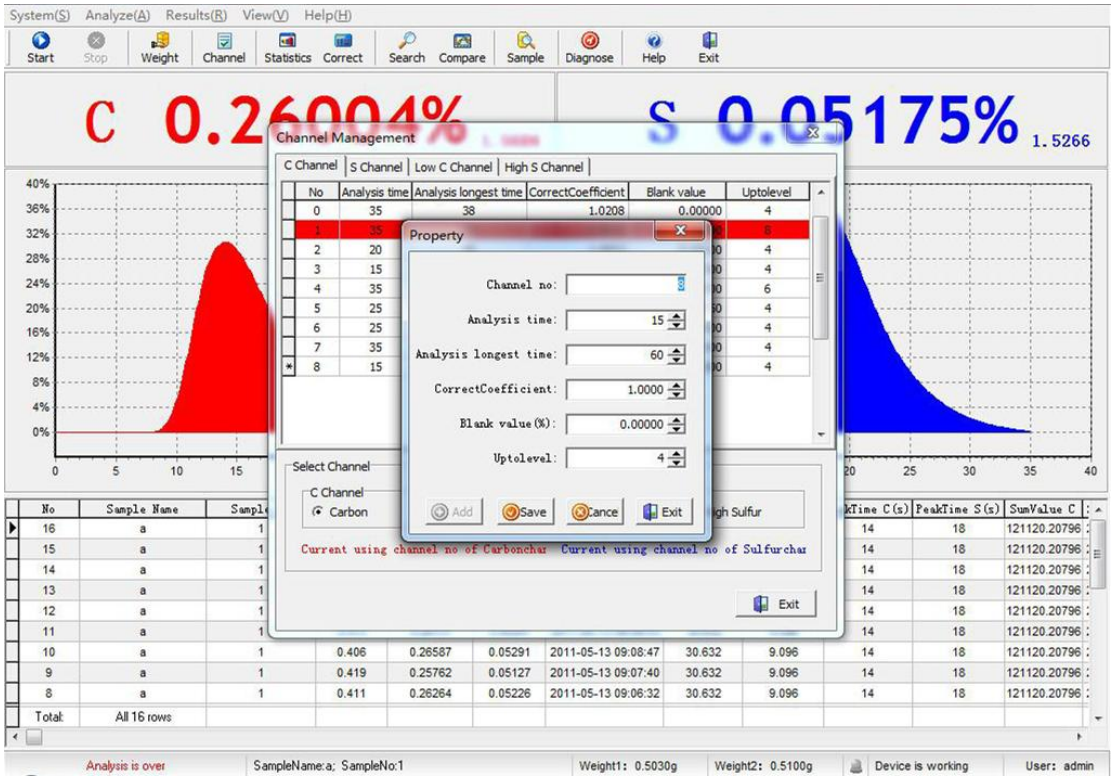
Add

Edit

Delete

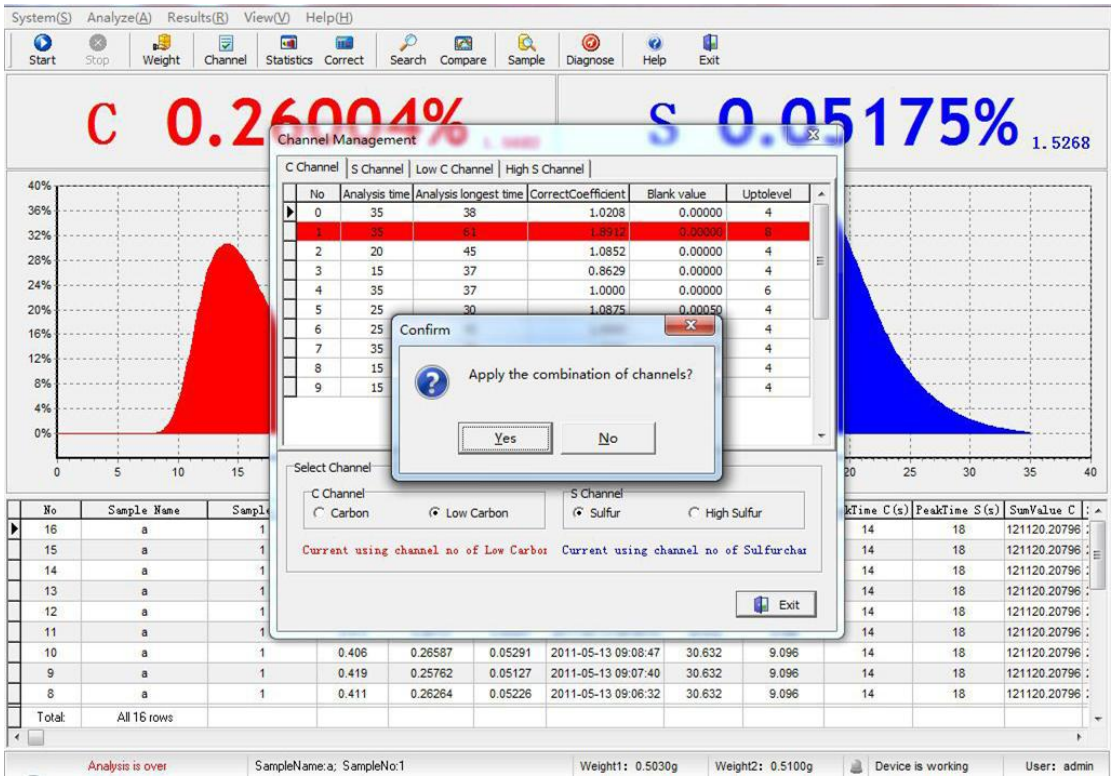
Set as current channel

Select 〖Edit〗, the system enters the attribute menu of the channel, all other properties except channel No. can be freely modified in specified range. After modifications press〖Save〗button, the edited contents are saved.



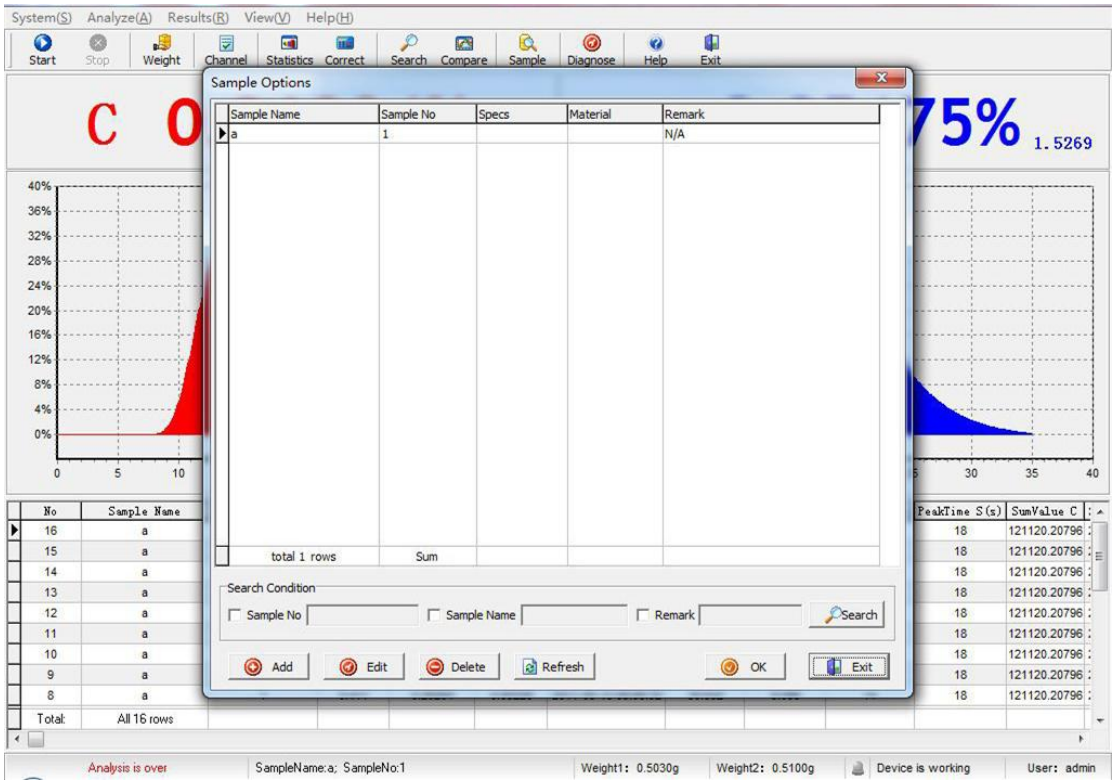
For different users, the possibility of extremely high or low difference of carbon and sulphur contents in materials under analysis exists, so our normal infrared detection cell faces the situations not applicable to the contents. This software designs to select any one group of carbon and sulphur channel pool from four channel pools of carbon, low carbon, sulphur and high sulphur. After some carbon channel and sulphur channel are selected, if the selected channel combination is selected for application from prompts, the system automatically calls the working curves of that channel pool, at the same time the cell voltage display selects the cell voltage of the corresponding infrared detection cell, too, the analysis results are the actual results of the corresponding detection.

Notice: this function must have corresponding auxiliary hardware and cannot be used normally until the carbon cell or sulphur cell is added.

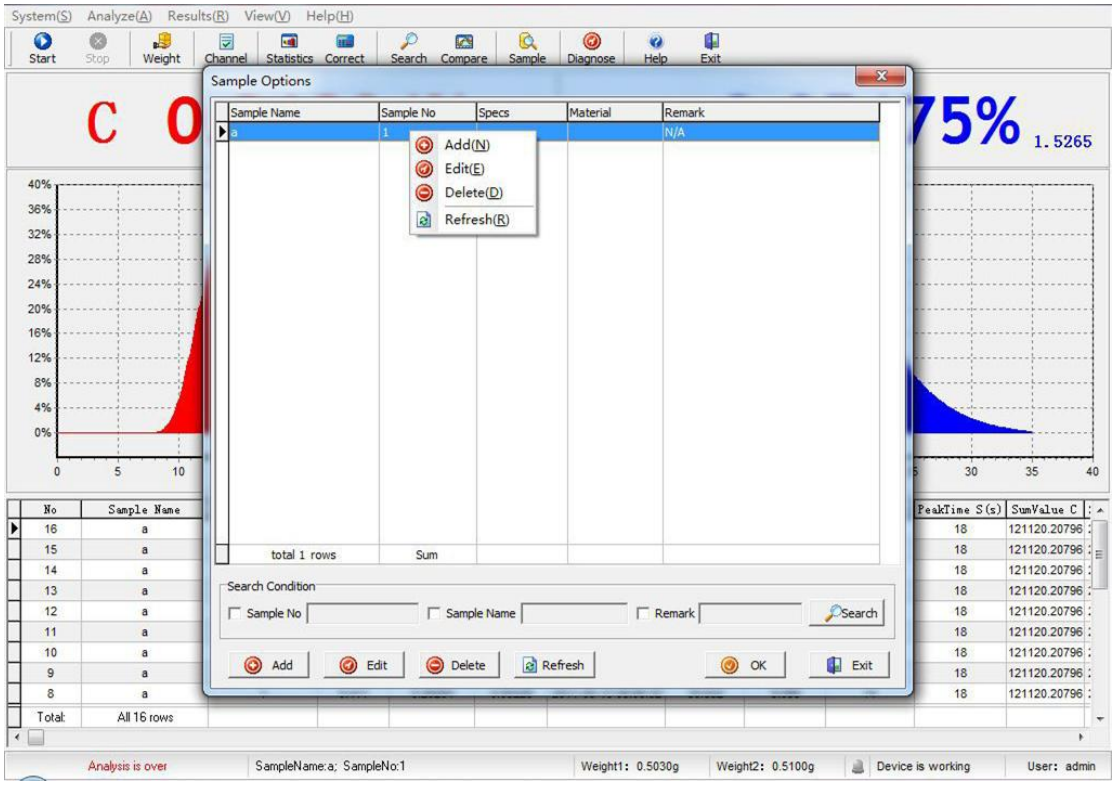


5.4.5 Samples management

Select 〖Samples management 〗, the system enters the attribute menu of samples management, which displays all sample identifications and names in the current sample database. One line of buttons at the bottom can modify and delete the already existing sample identifications and names, etc. in sample database, and can also add new sample identifications and names.

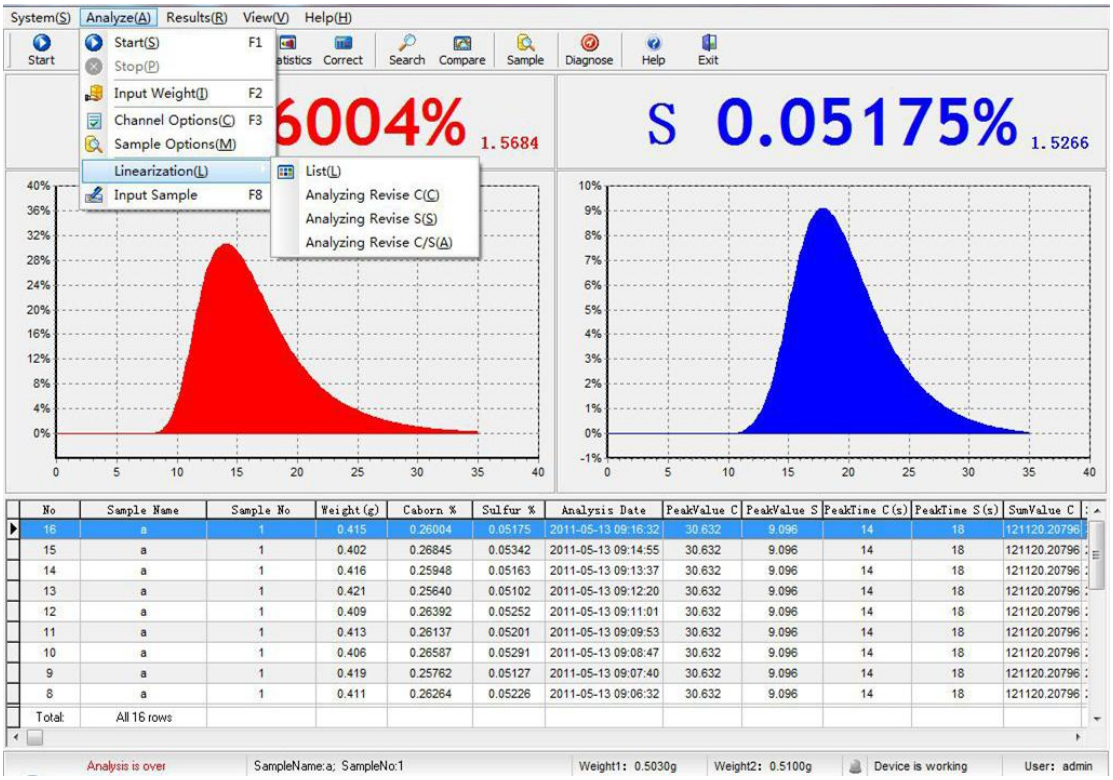


The already existing sample identifications and names, etc. in sample database can be modified and deleted, and new sample identifications and names can be added, too by selecting some sample name from the sample database at random and clicking the right mouse button.



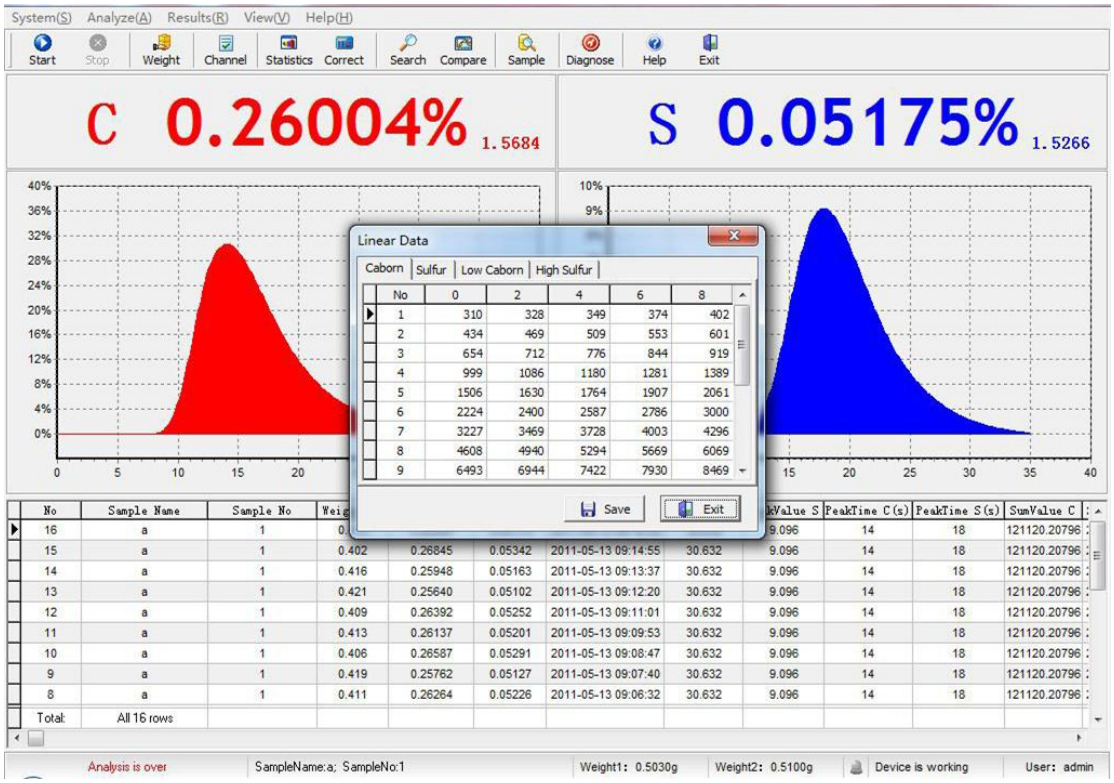
5.4.6 Linear data

In〖Linear data〗there are four sub-menus, i.e. 〖List of linear database〗, 〖Correct carbon in analysis〗, 〖Correct sulphur in analysis〗and〖Correct carbon and sulphur in analysis〗.



5.4.6.1 List of linear database

Select〖List of linear database〗in〖Linear data〗, the system lists the data of carbon and sulphur linear database, users can modify and save the data in interface, or click the right mouse button to derive the database and save as the files of linear database.



5.4.6.2 Correct carbon in analysis

The software of DW-CS-8820 infrared carbon and sulphur analyzer sets up the function of

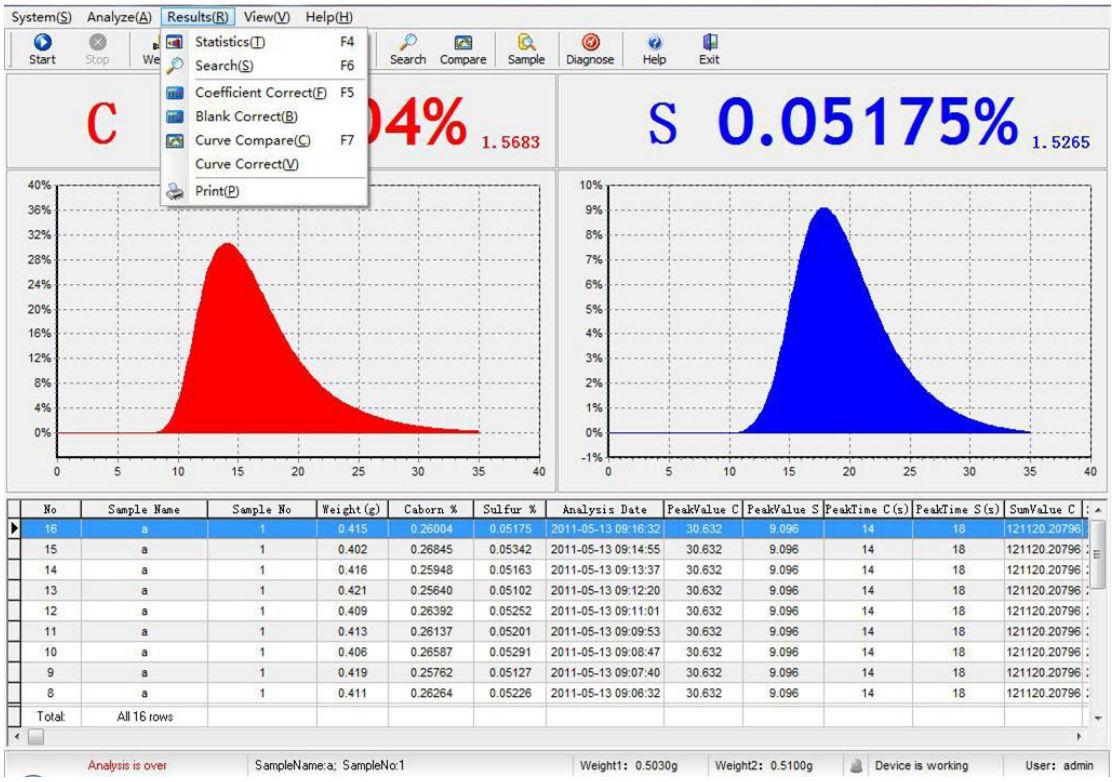
establishing the working curves, users can establish the working curves of carbon and sulphur for analyzer in accordance with carbon and sulphur contents in samples to be analyzed. This function establishes the original database of the working curves of carbon in analysis.

Definite method: analyze the standard samples in order as per the sequence from low contents to high contents, after the analysis finishes every time, the system will prompt to input standard contents, and then the next analysis is performed. After all analyses finish, the data are automatically saved in the program, and fitted in〖Curves fitting〗, thus the working curves are established (refer to 5.5.6 〖Curves fitting〗 in detail).

5.4.6.3 Correct sulphur in analysis Ditto

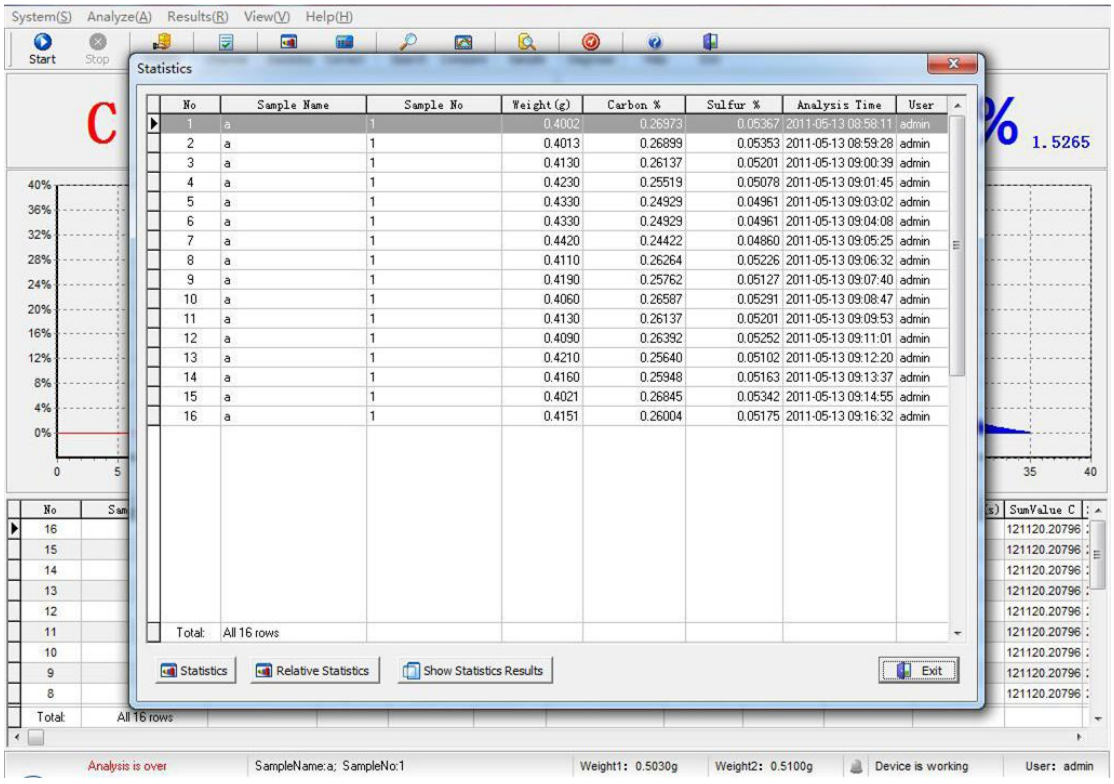
5.4.6.4 Correct carbon and sulphur in analysis Ditto

5.5 Results processing



5.5.1 Results statistics

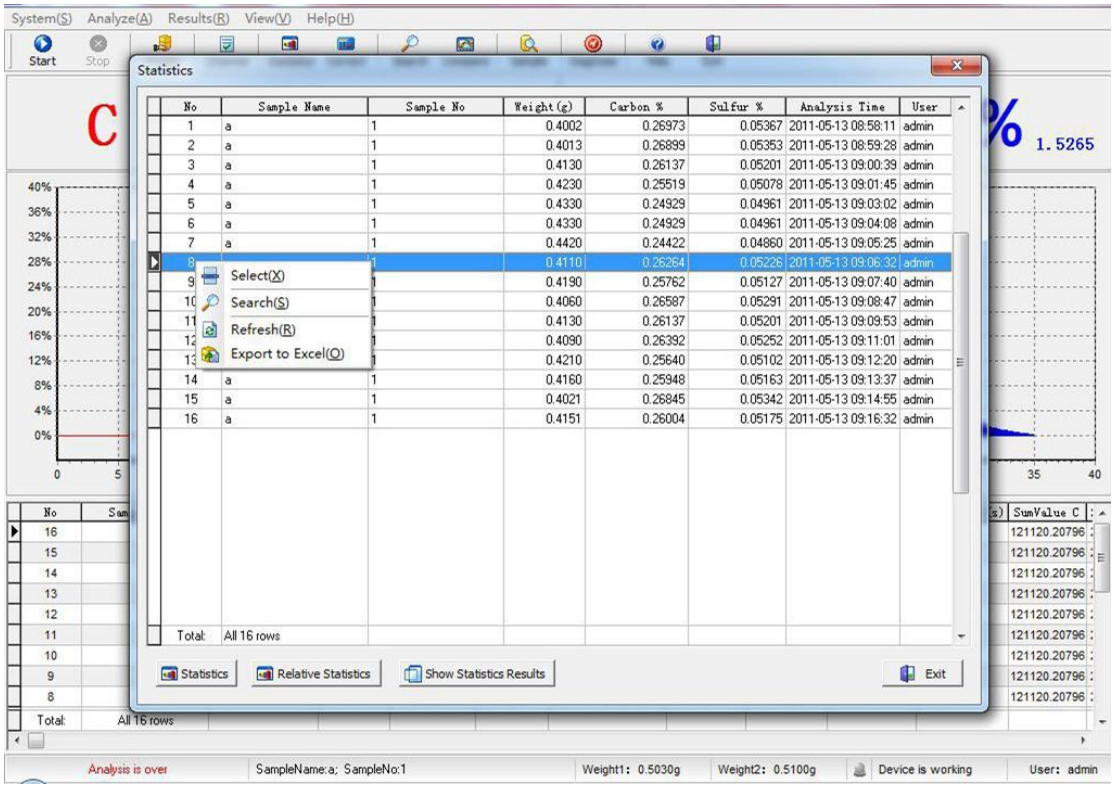
Select 〖Results statistics〗, the system enters the attribute menu of samples management.



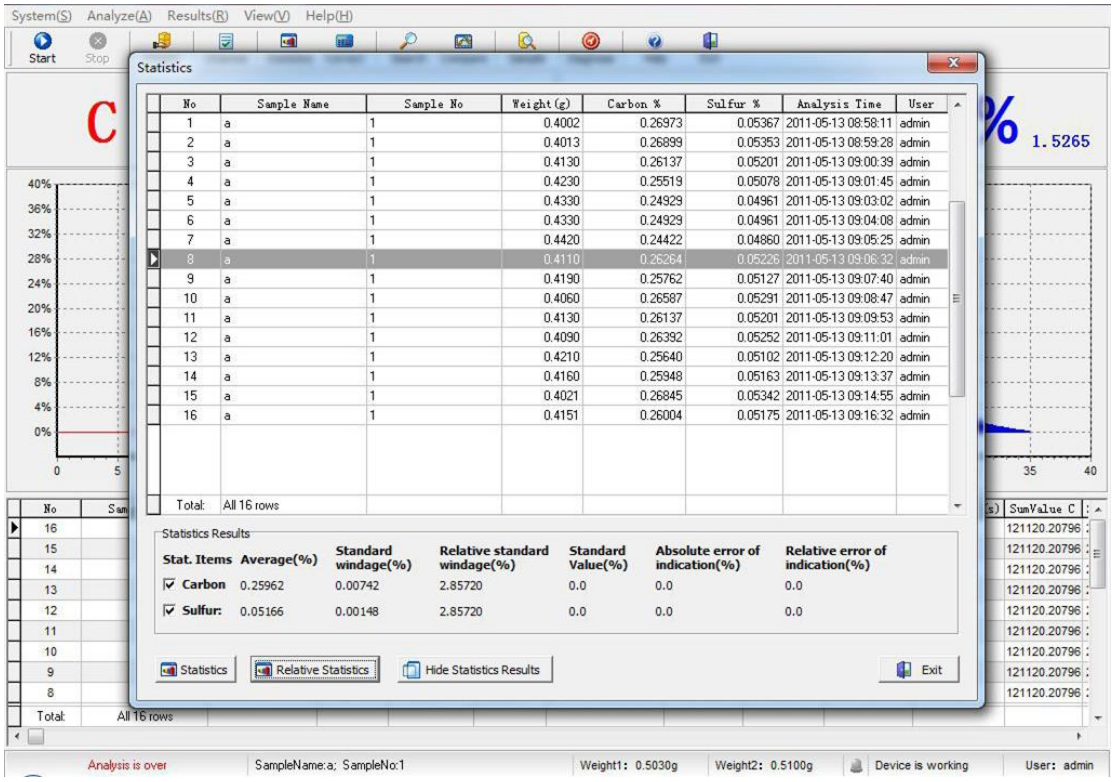
Select the analysis results for statistics with the left mouse button, press the left mouse button and pull down for consecutive data, and press “Ctrl” button for

inconsecutive data, and then select data with mouse, press the right mouse button to pop out the selection box.

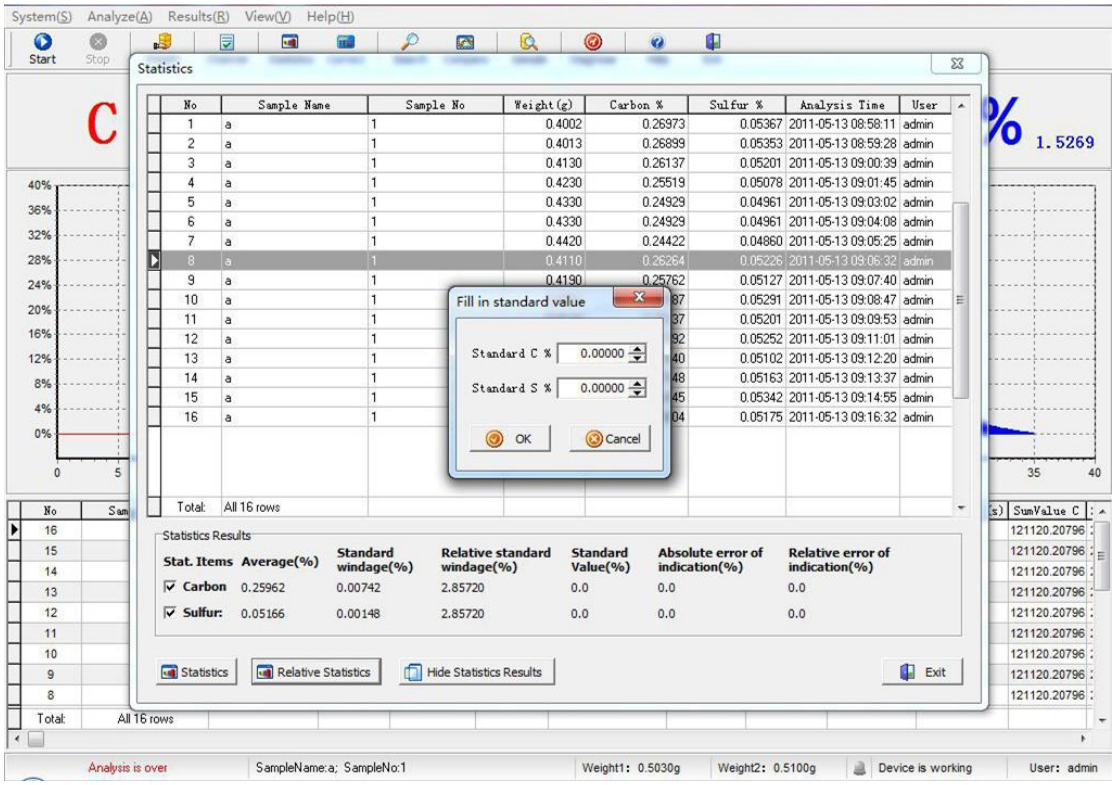
Select〖Derive from Excel〗in the box, all current data can be derived from Excel.



Press 〖Select 〗in popup menu, the selected data are listed, but the other data are not displayed. Select〖Statistics〗button on the last line, the system automatically obtains the mean value and standard deviation.

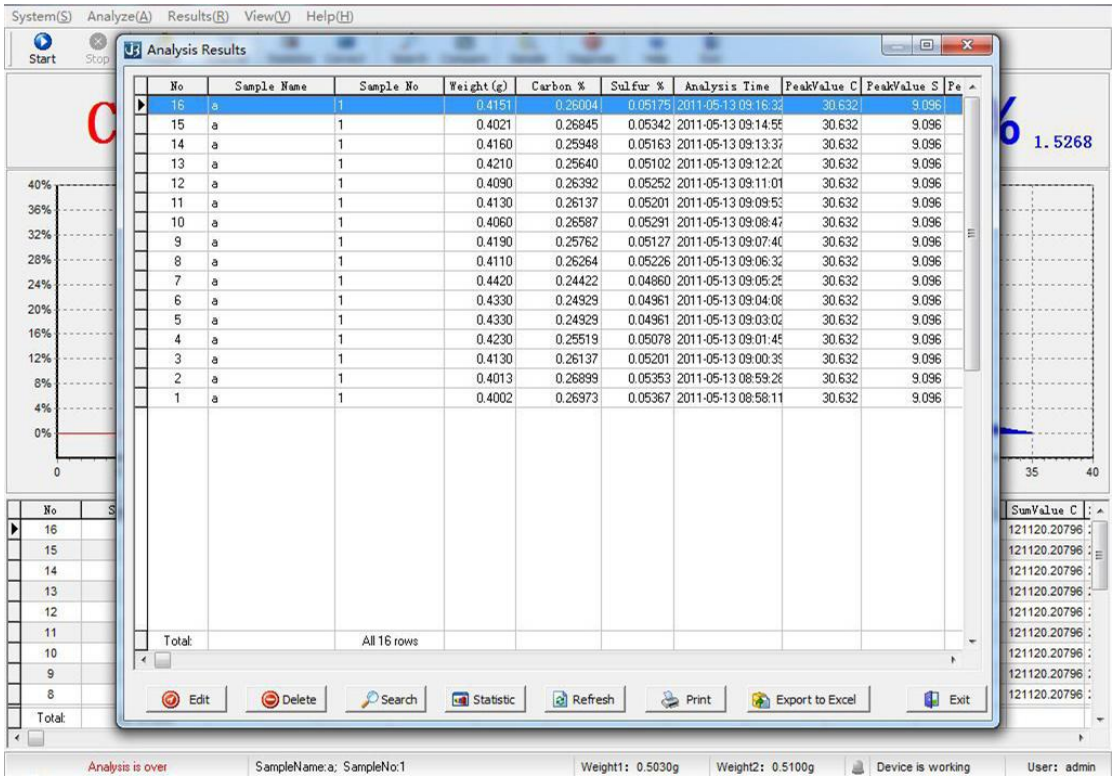


Press〖Relative statistics〗, the system prompts to input the standard values of carbon and sulphur, and press Enter after input, the relative standard deviation, absolute indication value and relative indication error are then calculated.

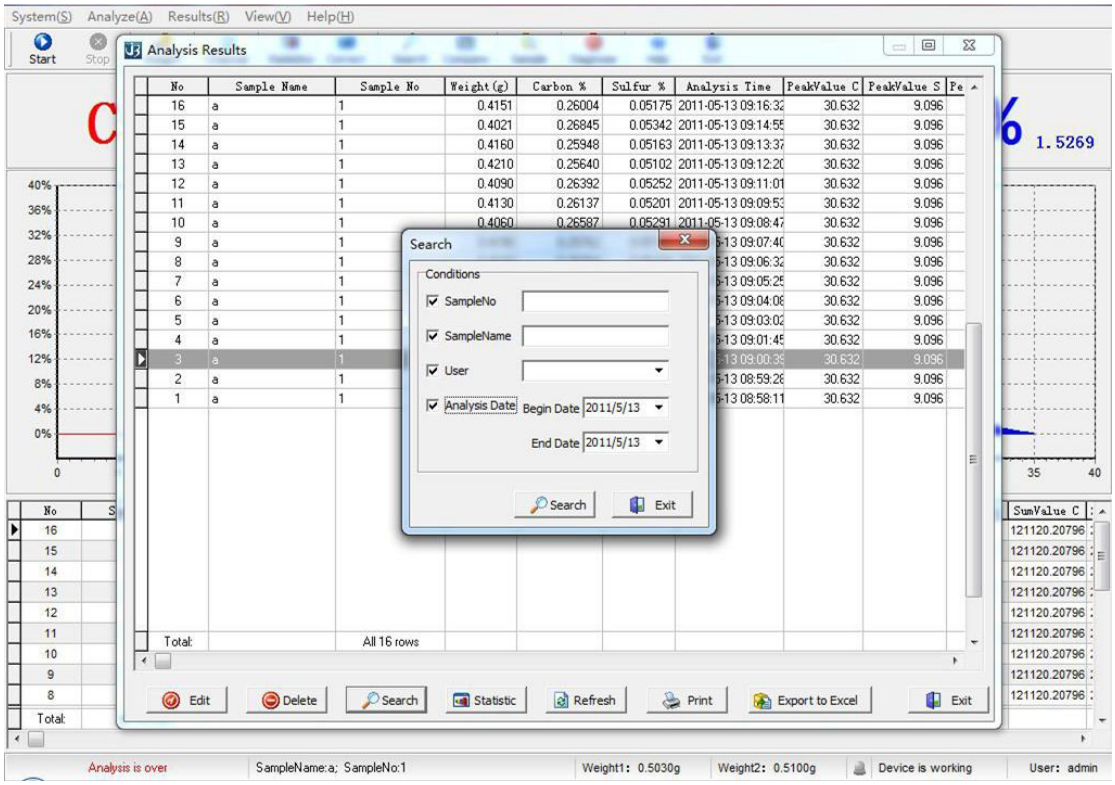


5.5.2 Results inquiry

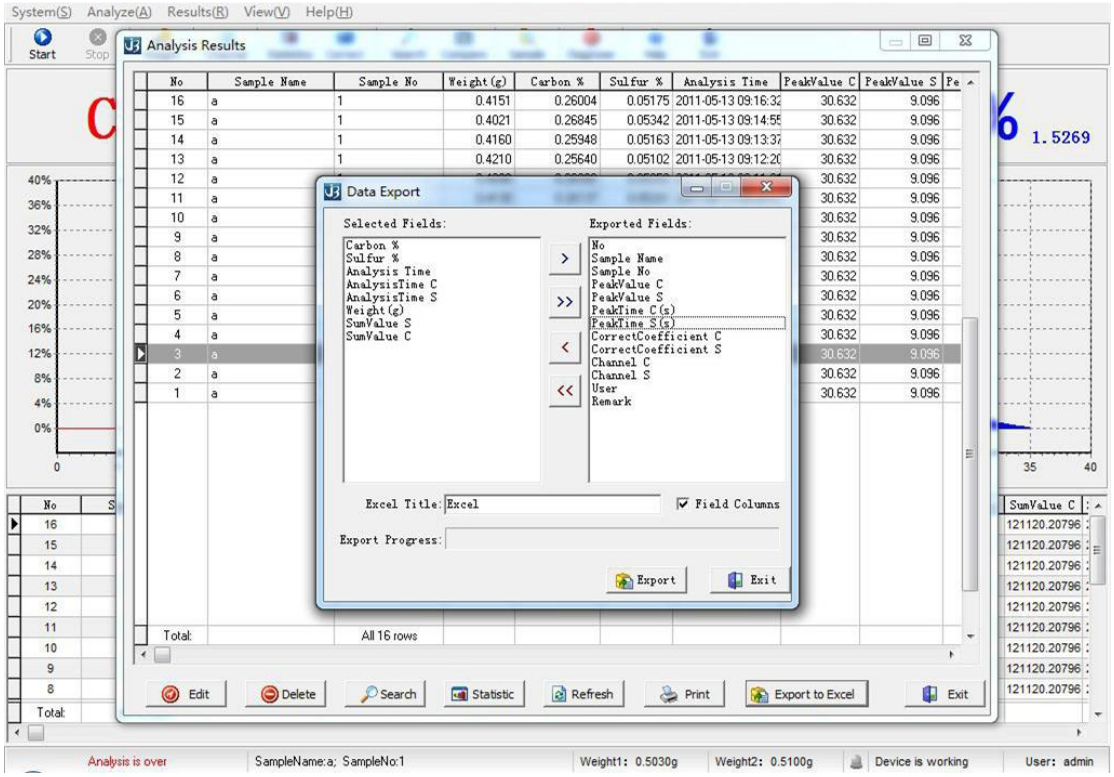
Select〖Results inquiry〗in menu, the system pops out the results display box.



Select〖Inquiry〗button on the lower part to pop out the inquiry conditions box, users can freely select inquiry conditions in accordance with sample identifications, sample names, operators, starting time and ending time of analysis.

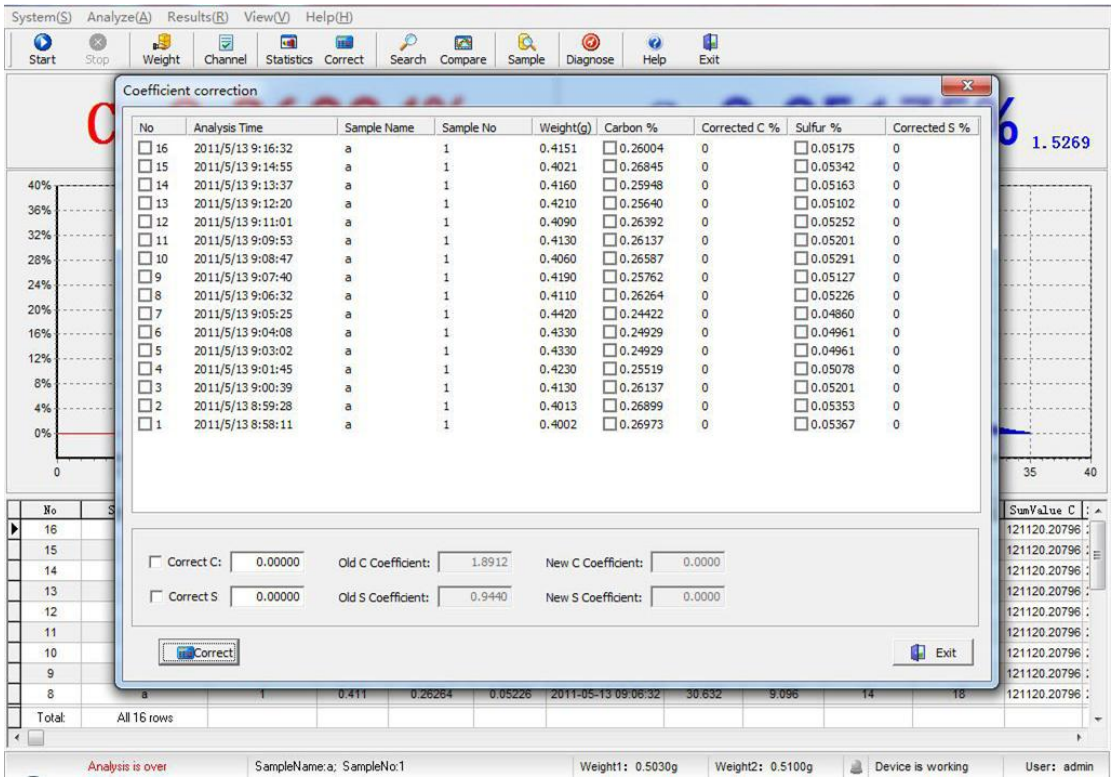


Select 〖Derive from Excel〗 button on the lower part, users can derive the data in accordance with the required fields to generate files in the form of Excel and save in disk.

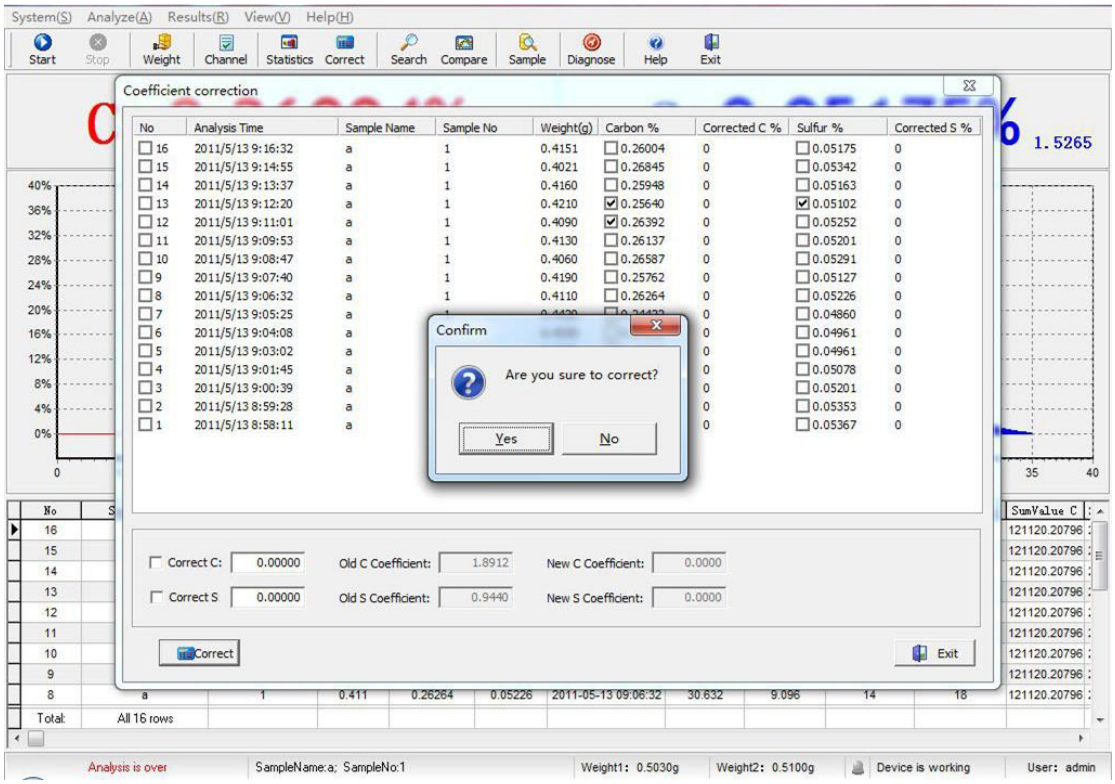


5.5.3 Coefficients correction

Select 〖Coefficients correction〗 in menu, the system pops out the coefficients correction box.



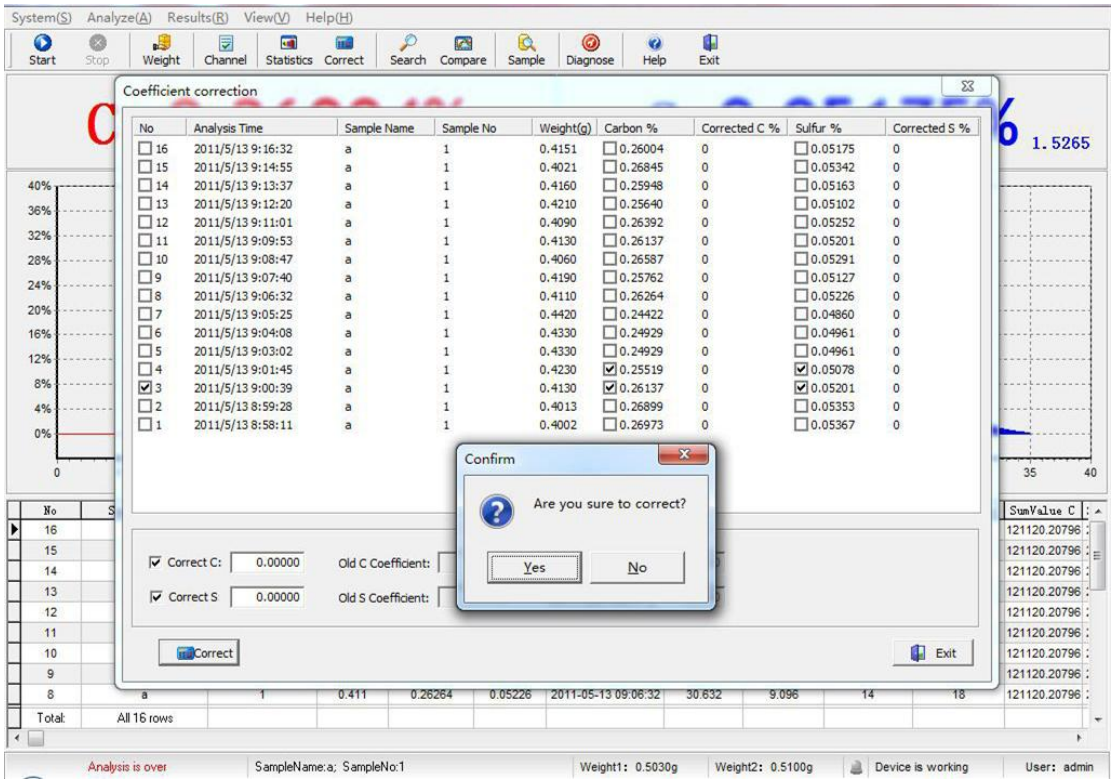
In analysis results select those results with known contents of carbon and sulphur, and tick √ in ☐ before the results. Users can independently correct carbon or sulphur or both at the same time. Tick √ in ☐ before correct carbon/correct sulphur on the lower part and input standard contents, and then press 〖Correct〗 button.



The system prompts “Be sure to correct?”, if 〖Yes (Y)〗 is selected, the original correction coefficients are changed, and from the next analysis the system will calculate based on the new correction coefficients.

5.5.4 Blanks correction

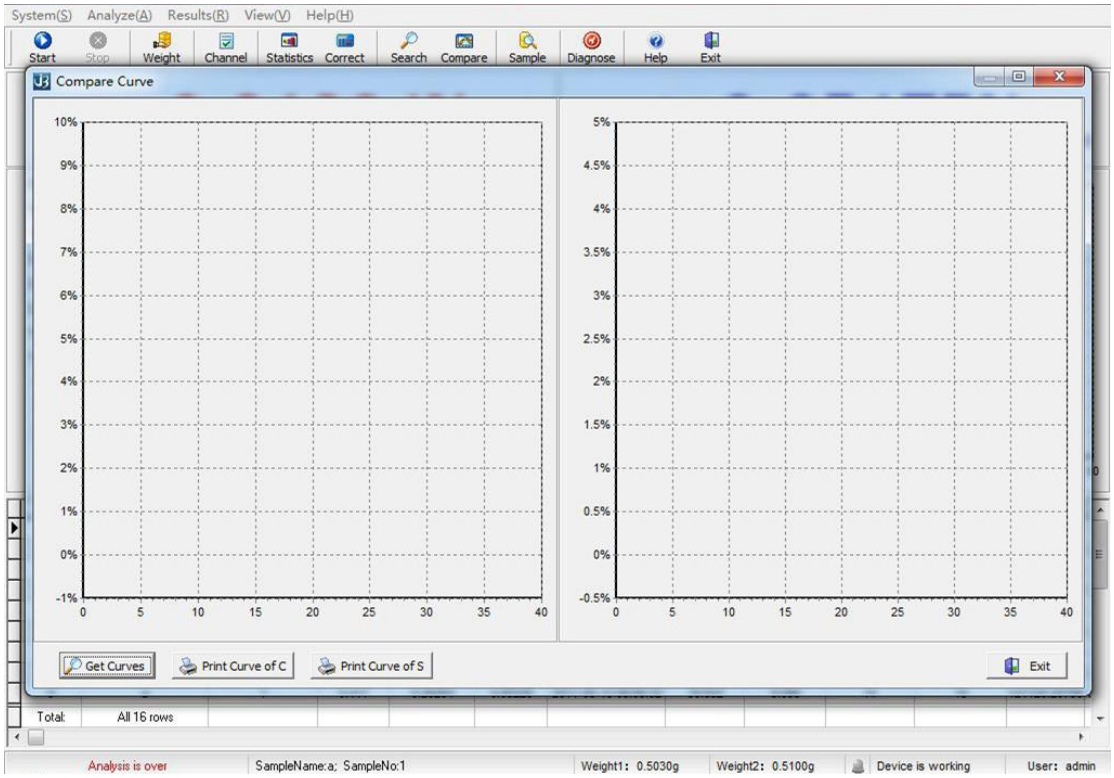
The blanks correction is to deduct the blank values in advance since the blanks in fluxing agent and crucible affect the analysis results during analysis of samples with ultra low contents. The definite method is the same as that for coefficients correction, but during correction the system automatically defaults the standard contents as 0 without input. After blanks correction, the analysis results in current carbon and sulphur channels will automatically deduct the blank values.



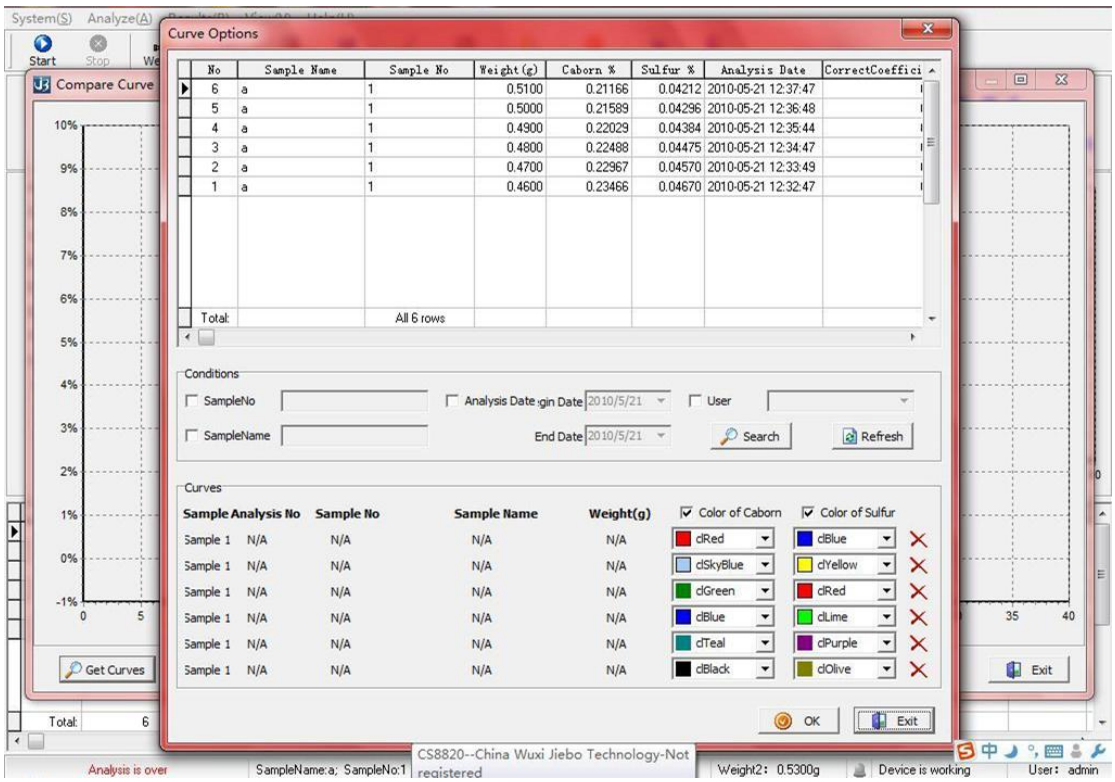
5.5.5 Curves comparison

As introduced in previous 5.3.3〖System setup〗,the system will remind saving the release curves or not after each analysis, or can set up saving curves automatically. The curves after saving automatically enter the result database, users can freely call curves and compare the release curves of the same sample.

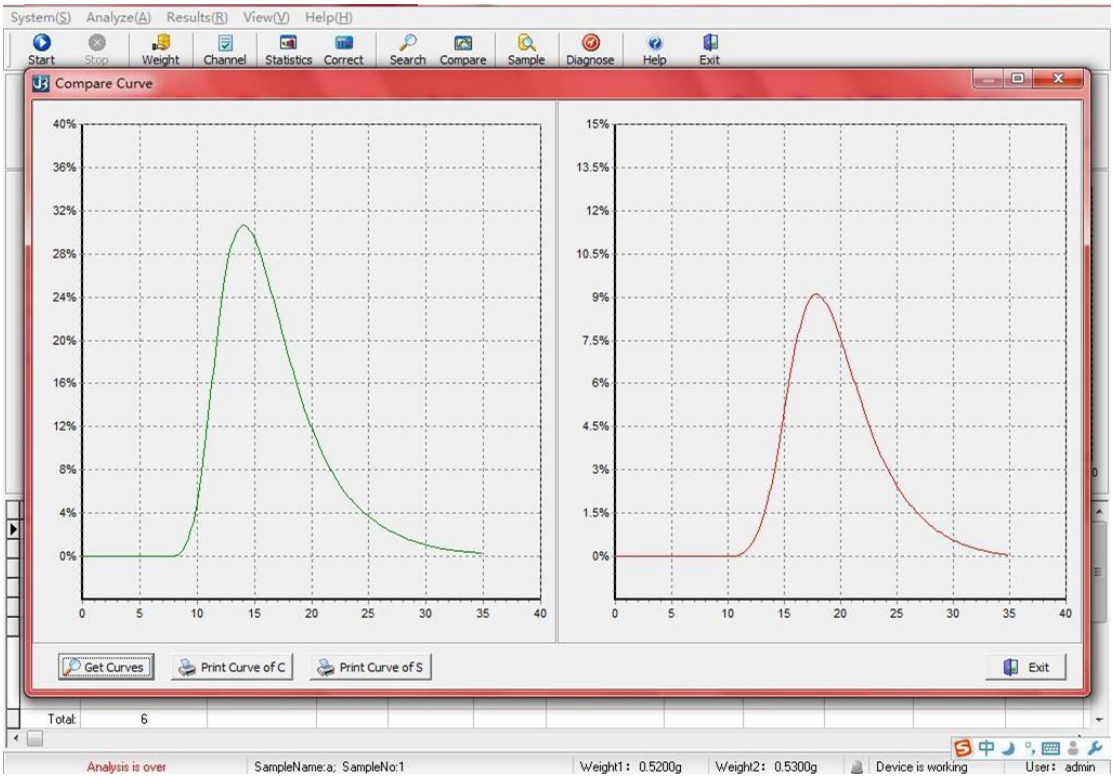
Select〖Curves comparison〗 in menu, the system pops out the curves comparison box.



Select〖Extract〗button in pop-up box, the system displays all current analysis results which have saved curves, the curves can be directly selected by clicking with the left mouse button or called in accordance with the relevant conditions in inquiry conditions, after selected samples enter 〖Selected curves〗, users can design colors to be displayed by themselves.



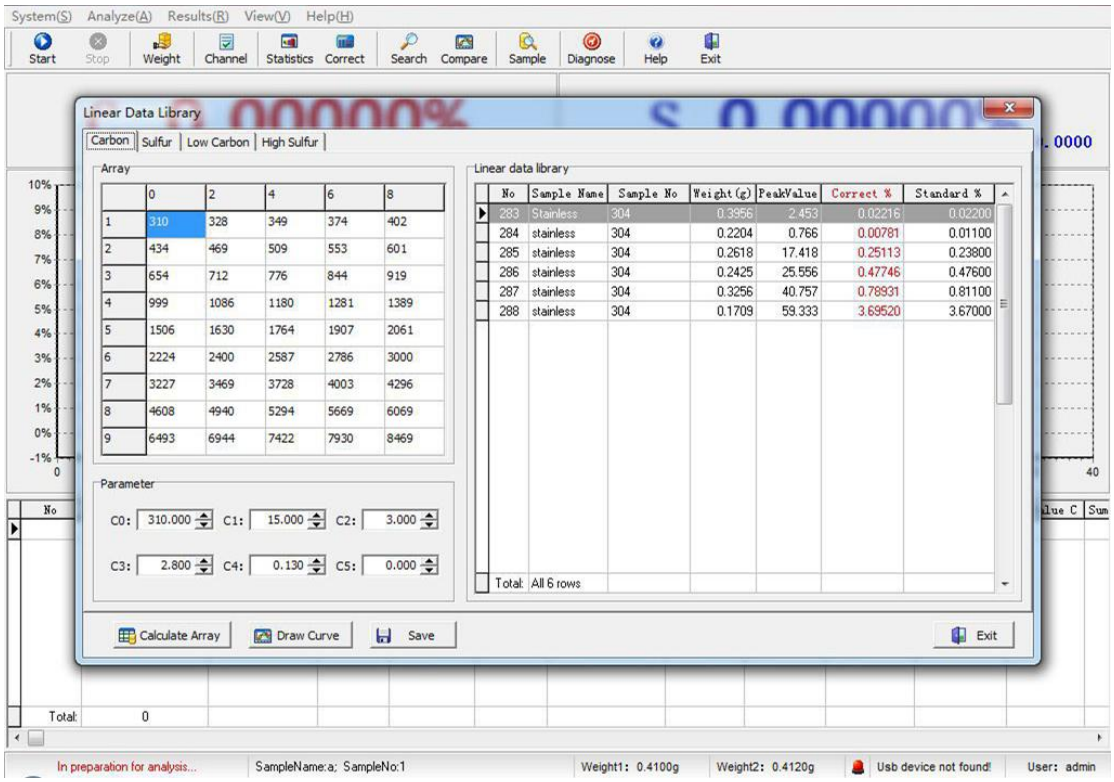
After selection press〖Enter〗, the selected curves are displayed in comparison box.


System(S) Analyze(A) Results(R) View(V) Help(H)
Start
Stop
Weight
Channel
Statistics
Correct
Search
Compare
Sample
Diagnose
Help
Exit
Compare Curve
40%
36%
32%
28%
24%
20%
16%
12%
8%
4%
0%
0 5 10 15 20 25 30 35 40
15%
13.5%
12%
10.5%
9%
7.5%
6%
4.5%
3%
1.5%
0%
0 5 10 15 20 25 30 35 40
Get Curves
Print Curve of C
Print Curve of S
Exit
Total: 6
Analysis is over
SampleName:a; SampleNo:1
Weight1： 0.5200g
Weight2： 0.5300g
Device is working
User： admin

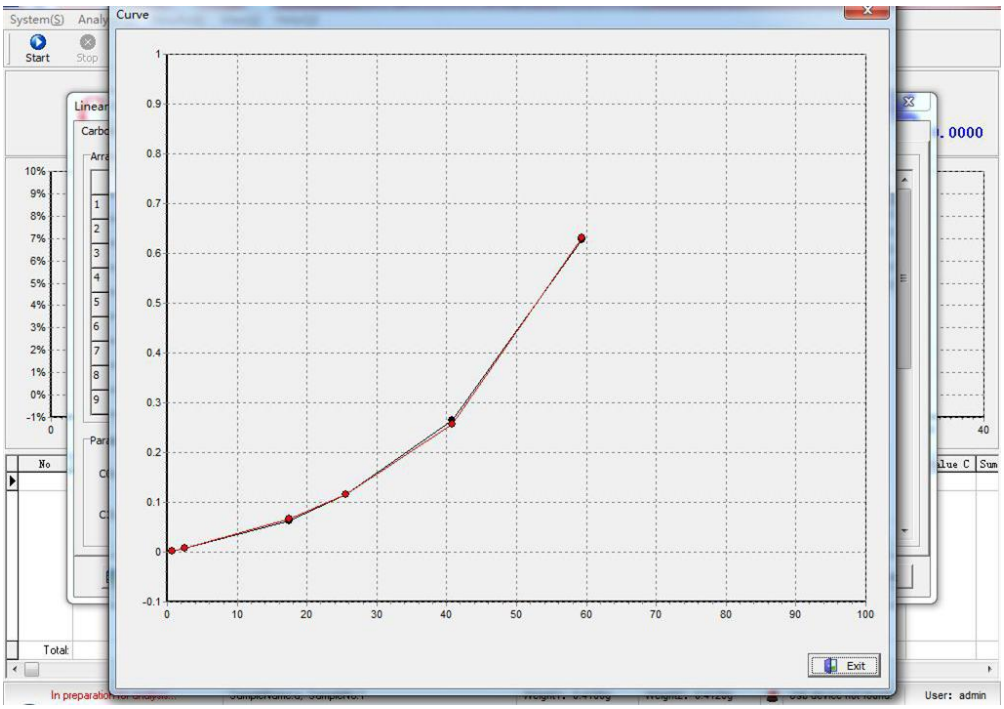
5.5.6 Curves fitting

The curves fitting is to fit the results of correcting carbon/sulphur of analysis in 5.4.6, enabling the analyzed results to coincide with the standard sample values by adjusting the values of parameters C0, C1…C5 so as to fit a standard curve.

Notice: this function is operated by administrators only, and the common operators do not have this right.



After the curve is fitted, select〖Plot curve〗button to check whether the fitted curve is close to the standard curve or not so as to determine the newly fitted curve is good or bad.

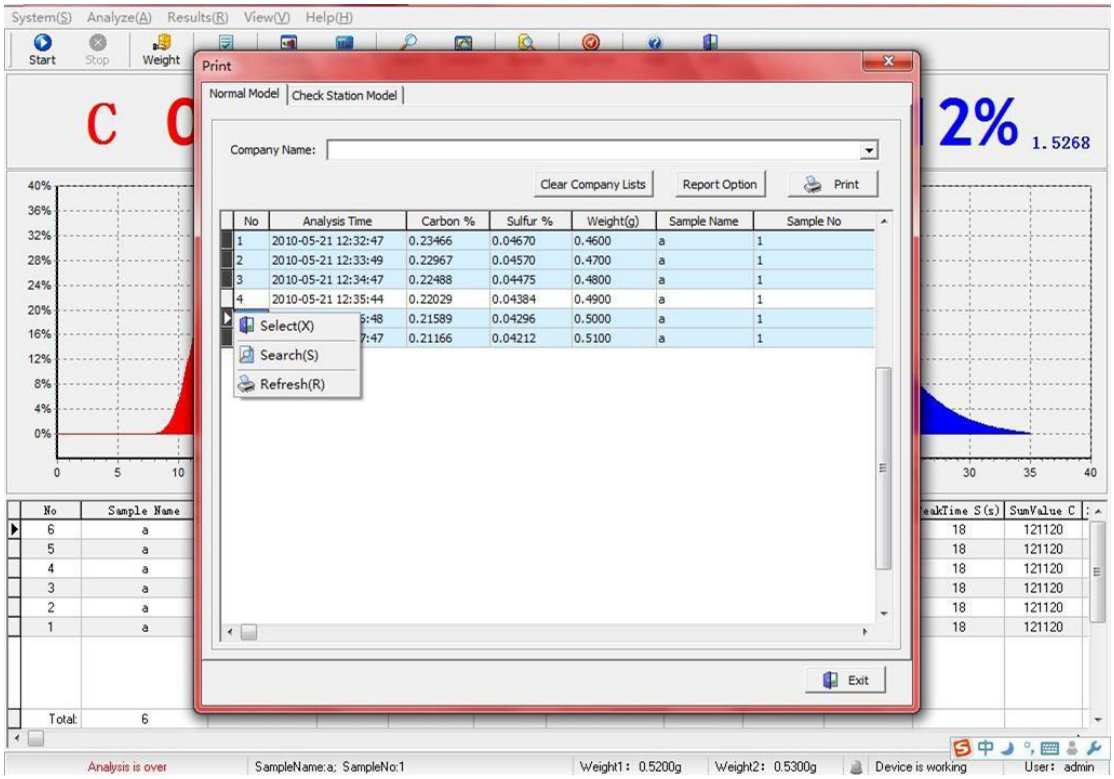


5.5.7 Results printing

This software sets up two results printing modes: report mode and detecting station mode.

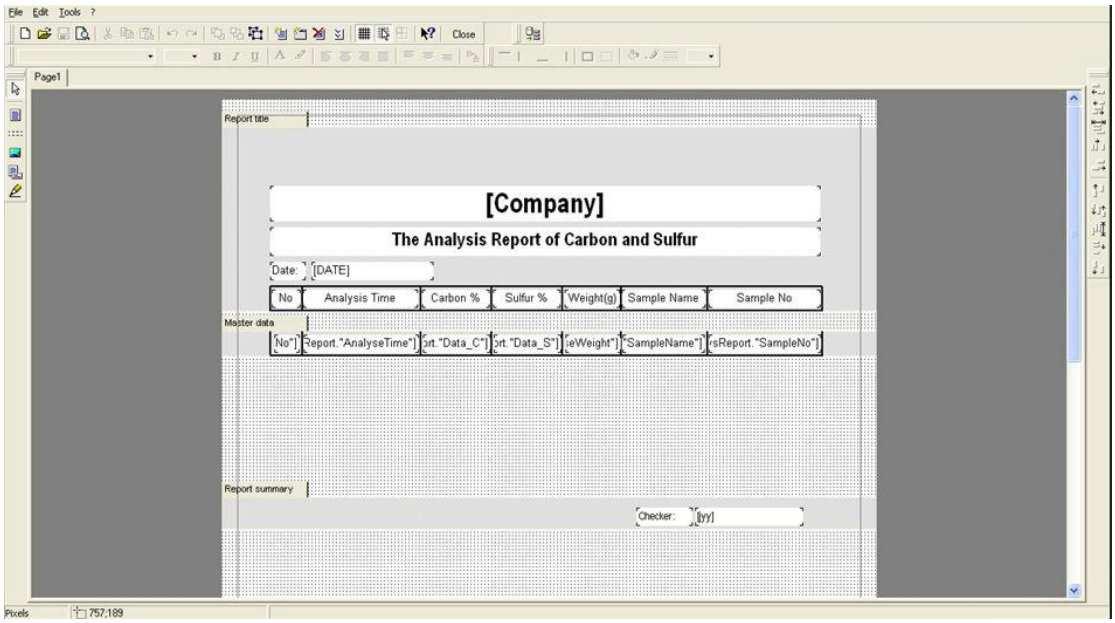
5.5.7.1 Report mode

The report mode is mainly used for general users to print and analyze results. Input the company name in “Company” field, and then select all data to be printed.

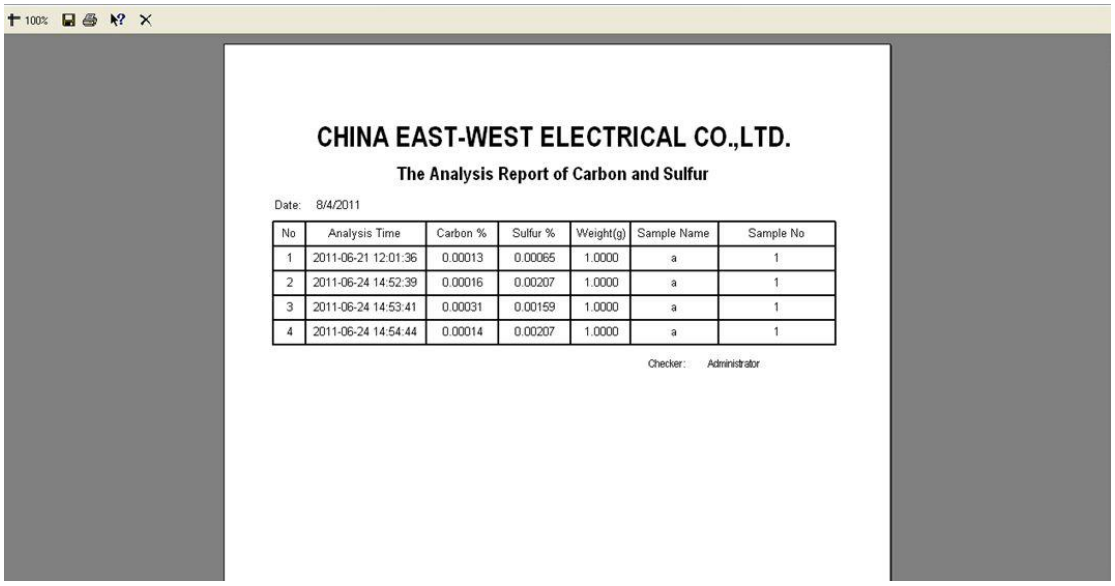


Select analysis results: put the cursor onto ☐ on the left of serial No., press Ctrl button and select the data to be printed with mouse, click the right mouse button (as shown in figure above) to select 〖Select〗 so as to complete selection for analysis results.

After selecting data press 〖Report setup〗, the form format, line spacing and column width, etc. being currently used can be adjusted.

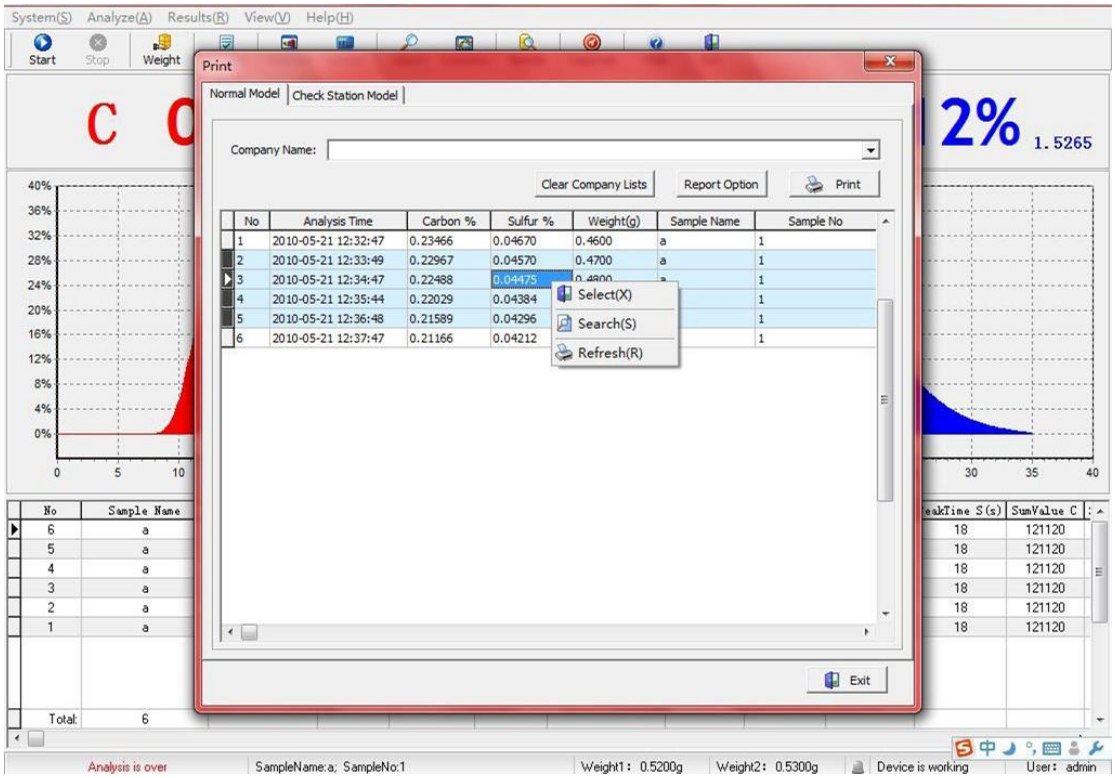


Adjust form format, and press 〖Print〗 button into print preview mode, press the icon of printer on upper left corner of the screen to start printing forms.

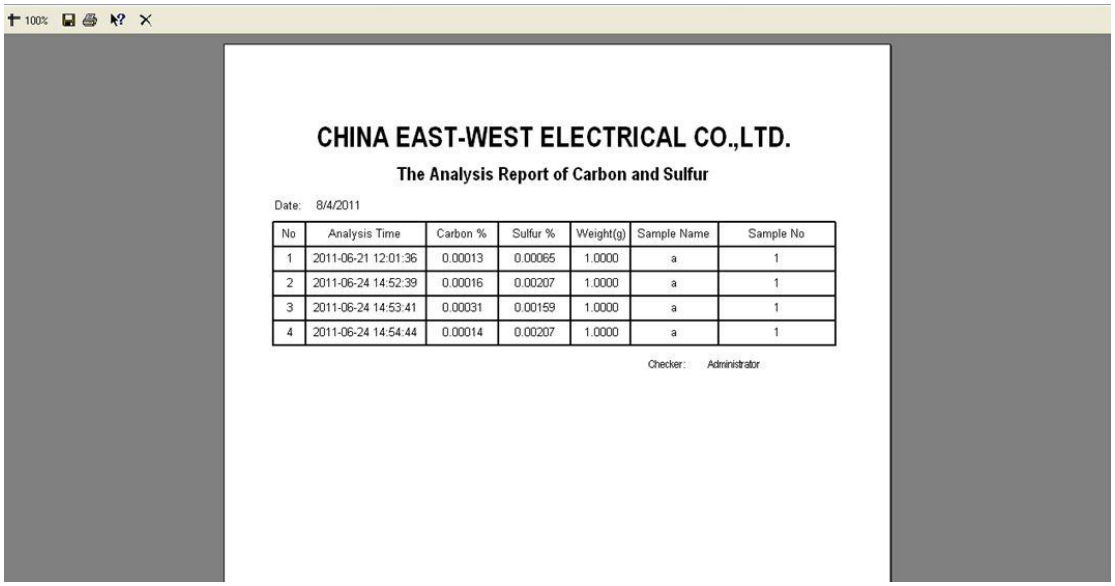


5.5.7.2 Detecting station mode

The detecting station mode mainly provides detection with supplied samples for customers, and to which the unit issuing detection reports should be furnished. In general the process is to continuously analyze some sample for a few times, make statistics for analysis results, and then print results.



As shown in figure above, input “Name of customer supplying sample”, select data to be printed, directly press〖Print〗button to display the mean value, standard deviation and RSD value of that sample.



CHINA EAST-WEST ELECTRICAL CO.,LTD.

The Analysis Report of Carbon and Sulfur

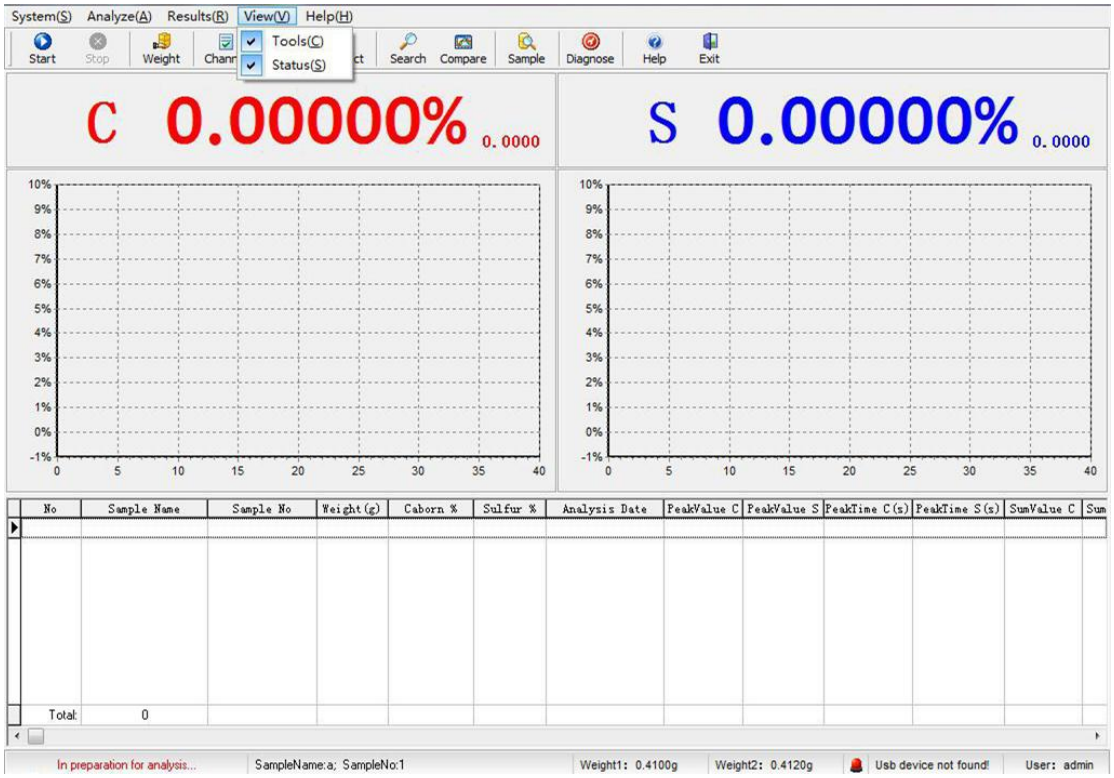
Date: 8/4/2011

No	Analysis Time	Carbon %	Sulfur %	Weight(g)	Sample Name	Sample No
1	2011-06-21 12:01:36	0.00013	0.00065	1.0000	a	1
2	2011-06-24 14:52:39	0.00016	0.00207	1.0000	a	1
3	2011-06-24 14:53:41	0.00031	0.00159	1.0000	a	1
4	2011-06-24 14:54:44	0.00014	0.00207	1.0000	a	1

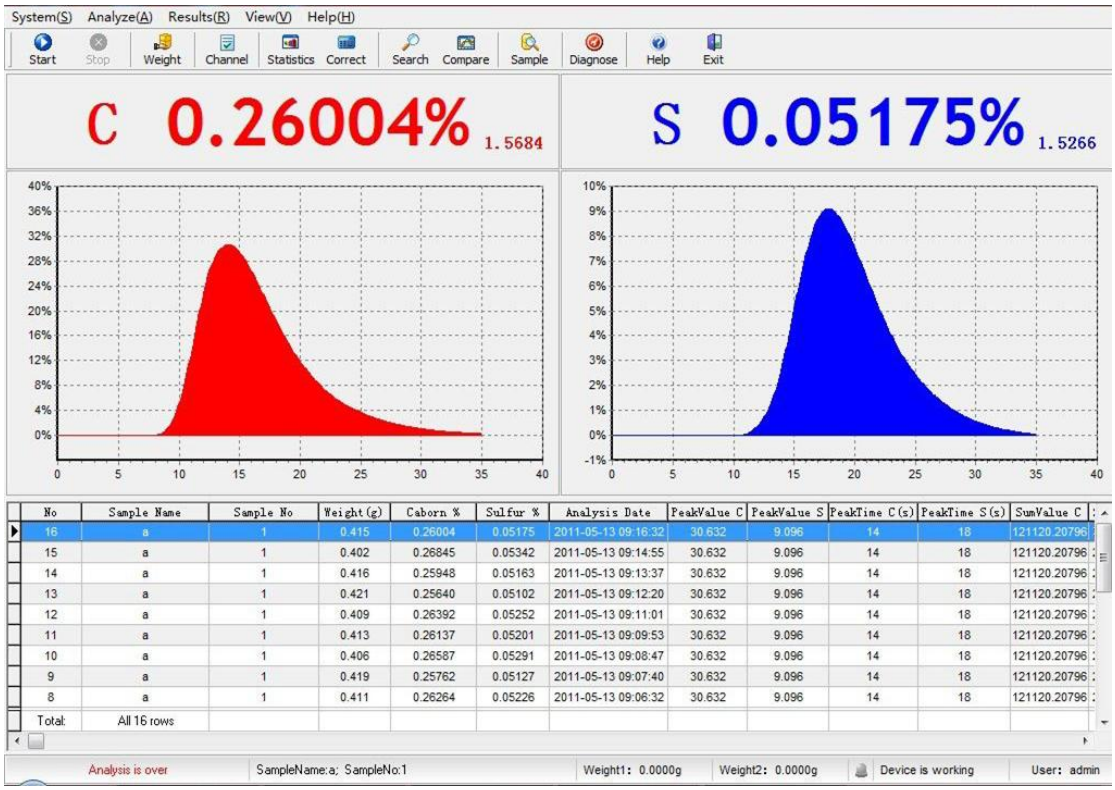
Checker: Administrator

5.6 Interface operation

The interface operation mainly controls whether the toolbar and taskbar are displayed in operating interface or not, which can be selected with mouse.



If the toolbar and taskbar are not selected, their contents are not displayed in operating interface (as shown in figure below).



6. Basic working principle

6.1 The Principle for infrared testing principle

The gaseous molecules of CO2 and SO2 placed in the infrared waveband have selective absorption spectra. When going through CO2 and/or SO2 gases, the infrared rays of certain wave length can have strong capacity of light absorption, of which the regularity can be obtained from Lambert-Beer's Law.

$IO(\lambda)=Ii(\lambda)(-\alpha(\lambda)CL)$……(1)

Since it is available for the detector to convert the light signal into the electric signal, Formula (1) could be expressed in another way as follows:

$VO(\lambda)=Vi(\lambda)(-\alpha(\lambda)CL)$……(1)

In which, Ii(λ) and Vi(λ) represent respectively the incoming light intensity of the specific wavelength λ and the electric signal value thereof.

Io (λ) and VoI(λ) represent respectively outgoing light intensity after the absorption cell and the electric signal value thereof.

α (λ) represents the absorptance index of the testing gas in the specific wave length λ.

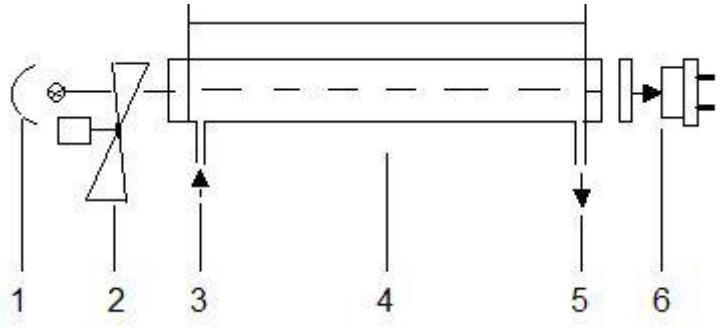


Fig. (4)---Route Chart of Analysis Cell

1	**light source**	**2**	**chopper**	**3**	**infrared window**
4	**absorption cell**	**5**	**light filter**	**6**	**detector**

It is comprehensible from the aforesaid formula that as one specific wave length is chosen and the analytical (absorption) cell length is determined, the concentration of the testing gas contained in the mixed gases can be converted from the light intensity measured. That is the basic principle for the quantitative determination of the gas concentration with the infrared absorption method. Selected for this type of measuring instrument, the wavelength of CO2 is μm 4.26m and that of SO2 is 7.4 μm.

6.2 High-Frequency Heating Principle

According to Farady law of electromagnetic induction, as being placed in the HF alternating field, the metal conduct will produce from inside the induction electromotive force and, as a result of its low resistance, will generate powerful induced current. It is known from Joule-Lenz's law that the alternating magnetic field shall cause the current in the conduct flow toward the metal surface so as to create the skin effect, the density of the instantaneous current is proportional to the frequency, i.e. the higher the frequency is, the more density of the induced current would concentrate on the surface, or in another word, the skin effect would be more intensive. The conduct will be heated rapidly as the valid conductive area is decreased but the resistance is increased.

6.3 Working Principle for HF Induction Circuit

After switching on the power on the panel, the 220V AC voltage will be divided into three routes by way of LB1 Power Wave Filter before supplying the whole system separately: the first one will be supplied to the axial fan F through LB2, the second will be supplied to the filament transformer T2 and the third will be supplied to the HV circuit through the control of the solid-state relay K2. After the switching the High-frequency, and the solid-state relay K2 is turned on, the 220V AC voltage will be input to the step-up transformer at its primary step and then the high voltage from the output of its secondary step will be rectified by V1~V4 HV rectistack into the DC high volt before supplying the anode of the oscillator when a tank circuit can be formed by C3, C4 & L2 so as to initiate the process of combustion and heating. By adjusting the grid potentiometer W can the grid current be changed so that alteration of the negative feedback would thus be possible. At the end of the set time limit of combustion, the power will be cut off automatically and the process of combustion will be ended. The schematic wiring diagram (5) can be reviewed for details.

In addition, the electric circuit is equipped with the protectors against over current and over time. The circuit will cut off the HV power and give the alarm automatically if anodic current exceeds 0.7 A or the time of combustion exceeds 1 minute. Push "Reset" button on the lower board to call off the alarm and restore the original condition of operation, the machine can continue to work after proper treatment.

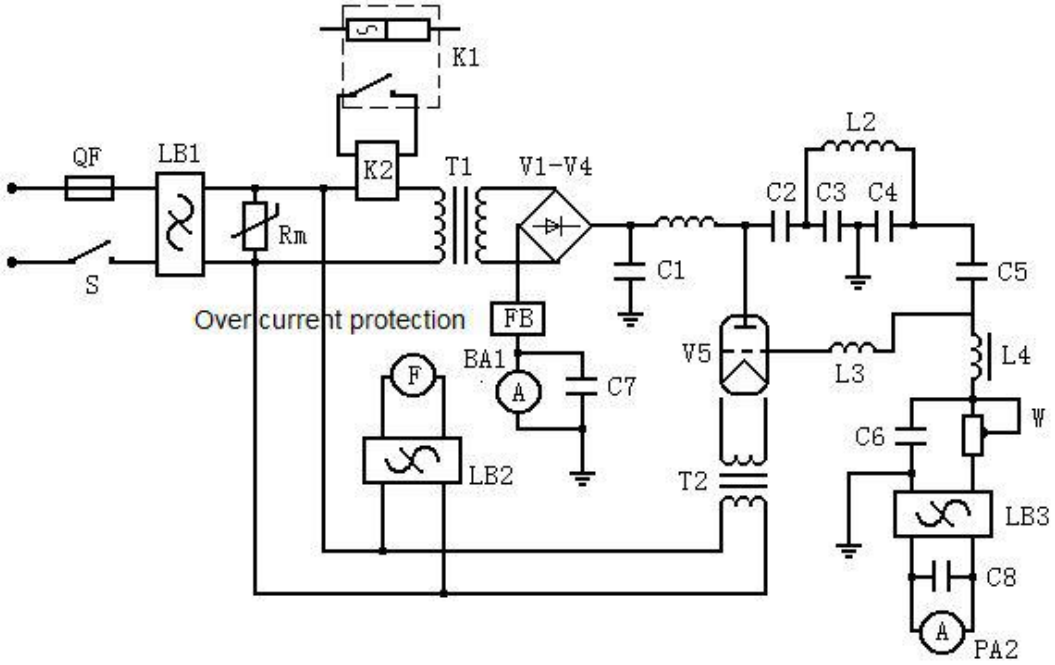


Fig. (5)--Schematic wiring diagram

6.4 Working Principle of Gas Path

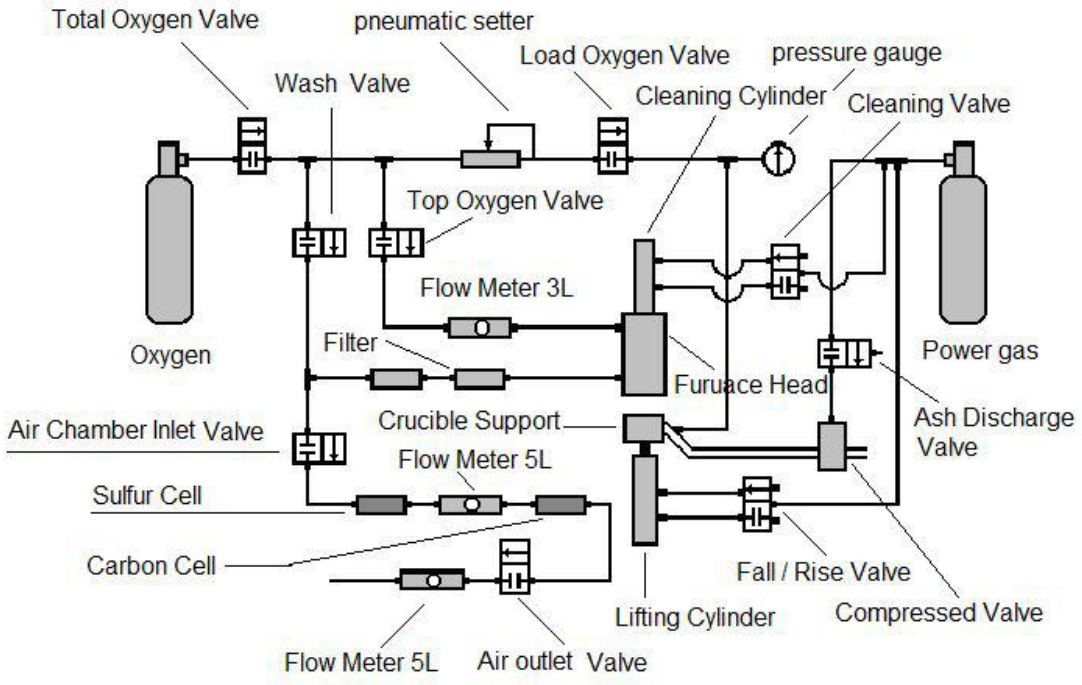


Fig.(6) Schematic diagram of gas path

Refer to Figure (6) for its working principle. The oxygen from the reduce valve of its cylinder with a regulated pressure at 0.18-0.2 MPa (1.8~2.0- kg/cm2) is supplied to the instrument for combustion while nitrogen or compressed air is used as the power gas.

One route of the power gas passes by the hold-down valve to compress the ash ejecting pipe. One route supplies auto cleaning equipment to clean quartz pipe by the way of auto cleaning valve, and is supplied as the force to uplift and descend the cylinder by the way of lifting valve.

Having passed the master valve for oxygen, the combustion-oriented gas is divided into two routes: one is to be regulated by 0~3 l/min flowmeter before supplying to the top blow of oxygen, in case of cleaning the filtration screen, the gas can be used by way of the purge valve for dedusting, the other is to be regulated by the value stabilizer. The purpose of using the value stabilizer is to keep fixed pressure inside the combustion chamber. After the sample is heated and combusted with oxygen, the mixed gas thereof will be dedusted with the absorbent cotton and dehydrated with the desiccant before being led into the sulfur cell by gas room inlet valve, then it will enter the carbon cell by the way of transform furnace, metal cotton, 0-5L/min flowmeter, and at last it will release through the gas room outlet valve after the 0-5L/min flowmeter defines the real rate of flow of it.

6.5 The Full-frame Working Principle

The block diagram is to be seen for the full-frame working principle. Figure 7 is divided as the upper, middle and bottom parts. The upper part is the gas path system where each arrow indicates the direction of the gas flow. The middle part is an outline with dotted line reflecting the whole process of transference from the light signal to the electric signal inside the gas analysis room indicated by arrows. The bottom is the circuit system.

7. Common Faults in Analyzer and Treatment

7.1 Cell voltage faults:

Fault 1: the pulsing of cell voltage is unstable, the fluctuation is more than 0.01V/min (normally less than 0.002 V/min)

Fault causes:

(1) If the signal in one of carbon and sulphur channels is unstable, the elements on amplifier plate of that channel may be damaged, the amplifier plate should be replaced.

(2) If the signals in both carbon and sulphur channels are unstable, the rotating speed of motor may be not stable, check the driving voltage of motor and then the drive plate of motor and motor. If problems are found, the drive plate of motor or motor should be replaced.

Fault 2: the cell voltage signal is lower, and the cell voltage is less than 1.0000V

Fault causes: the cell voltage is smaller, but pulses stably because the inner wall of gold-plated tube is dirty and the magnification times of signal are decreased. The manufacturer should be contacted to visit for cleaning or replacing gold-plated tube.

Fault 3: the cell voltage signal is extremely low and less than 0.1000V

Fault causes: (1) If the signal in one of carbon and sulphur channels is extremely low, the light source does not work, check whether there is voltage in that light source and the light source is damaged or not. Replace the light source.

(3) Check whether the modulating motor rotates or not, if not, the cell voltage displays zero signal. The drive plate of motor or motor should be replaced.

Fault 4: the cell voltage has no signal and displays 0.0000V

Fault causes: (1) No signal is input, showing that the signal of lower computer is not transmitted to upper computer, Check first whether the USB connection is normal or the USB drive is installed or not. The USB cable should be adjusted.

(3) If the USB connection is normal, the sampling chip of motherboard has faults. The motherboard should be replaced.

Fault 5: the cell voltage signal is more than 1.9 and has no change

Fault causes: the cell voltage signal is larger with over range display. Adjust the 50K potentiometer of amplifier plate and turn to smaller value anticlockwise till the signal stabilizes at approximate 1.5000.

7.2 Combustion faults:

Fault 1: no combustion in high-frequency furnace

Fault causes: (1) Check the control plate of high-frequency furnace: open software and activate “diagnosis” function, press numeric button “8”, check whether the LED on control plate corresponding to high frequency lights or not, if not, the signal is not transmitted, check whether the optical-fiber is connected normally or not or replaced. If LED lights, the signal has been transmitted, check whether there is DC12V on two wires on control plate connected with the solid-state relay or not, if not, the control plate is broken and should be replaced. If there is 12V, the control

circuit is in good condition, check the high-frequency circuit.
(2) Check the high-frequency circuit: the high-frequency circuit adopts the electron tube as its dominant component, so first check whether the electron tube works or not, visually examine whether the electron tube heater lights or not, which supplied by electron tube heater transformer of AC6.3V. If the electron tube is normal, check whether there is open circuit in the whole circuit or not, the multimeter can be used to check the resistance of wire-wound resister, which should be 5K, if the resistance is infinite, the wire-wound resister is in open circuit.
Fault 2: analysis does not start
Fault causes: if the analyzer cannot start analysis normally, the instructions issued by upper computer is not received by lower computer, the communication is in error, check whether the connection of optical-fiber is normal or not, if not, replace optical-fiber. If optical-fiber is perfect, the hardware in communication part of motherboard is erroneous, the motherboard can be replaced.

Fault 3: the fuse is burnt when combustion begins
Fault causes: the wiring connection in high-frequency circuit part becomes loose or the fuse is burnt because of high-voltage striking due to imperfect insulation of high-voltage part. The connecting parts in high-frequency circuit can be tightened and the high-voltage bushing can be added in high-voltage part to ensure insulation.
Fault 4: bad leak tightness in gas pipes
Fault causes: (1) The joints and electromagnetic valve part of gas pipes will not have gas leakage, the leak tightness of gas pipes should be checked after replacement of drying agent or cleaning of furnace end. If the gas leakage happens, the vacuum silicon grease can be evenly coated on all sealing rings so as to ensure leak tightness.
(3) If quick drop of oxygen carrying pressure is found, the ash discharging pipe is broken and should be replaced.
7.2 Common faults during analysis
Fault 1: plate flow out of normal range (normally 200-600mA)
Fault causes: (1) Plate flow <200mA shows that the weighed sample is underweight, combustion power is low and the sample is not ferromagnetic one. The weight of sample or fluxing agent can be increased.
(2) Plate flow > 600mA shows that the sample or fluxing agent is overweight. The weight of sample or fluxing agent can be decreased.
Fault 2: release curves abnormal
Fault causes:
(1) Appearance of tailed peak curves shows that the weighed sample is overweight and contents are too high and cannot be released and the power is low.
(2) Release of double peaks shows that the weighed high-content sample is overweight.

(3) Peak flowing-out time > 20” shows the sample is difficult to melt and the oxygen blowing is insufficient.
(4) Release time >50” shows high contents and tailed peak; the crucible blank is large;

and the gas in analysis flow is small.
Note: effect of a few accelerators: strengthen the induction effect of analysis system (Cu, Sn), reduce the melting point of sample materials for complete melting (Fe), the solubility of carbon and sulphur is large beneficial for release of carbon and sulphur (W, Fe), and plays a role of dilution so as to increase the melting point of sample materials facilitating complete release.
Fault 3: bubbles in melt Fault causes: the melt temperature is lower (improper choice of fluxing agent), the power is lower.
The proper fluxing agent can be selected or the weighed sample can be decreased.
Fault 4: bad repetitiveness of analysis results.
Fault causes:
(1) The contents are too high and over the linear range. The weight of samples can be decreased.
(2) The contents are low and the blanks are not stable, the crucible should be processed in oxygen enriched atmosphere, use high-purity oxygen, prolong oxygen blowing time as appropriate, select high-purity fluxing agent.
(3) The processing for samples is not good, clean samples, sample once more, bake; sample as per standard.
(4) The samples are not even, take bigger mean value, make more parallel analyses or require the inspection applying unit to sample again.
(5) The quality of fluxing agent is inferior and the blanks are not stable, the stable blanks should be selected.
(6) The lying idle of analyzer for long time will cause the detector and electronic components are affected with damp or other causes, make experimental check by means of standard samples with the assistance of maintainers, who or conduct maintenance and repair.