Labnics

IR Carbon and Sulphur Analyzer

NCSA-104

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1. Introduction

IR Carbon and Sulphur Analyzer NCSA-104 is a high frequency unit with a high precision TSC infrared detector with platinum IR light. It provides continuous heat and high spectral efficiency. Simultaneous analysis of both, high and low carbon and sulphur concentrations in one measurement is achieved which is ideal for measuring the mass fraction of Carbon and Sulphur in various specimens.

2. Features

- ✓ 0.4 µm metal filter for separation of gas from dust
- ✓ High precision flow controller ensures stable gas flow
- ✓ Ceramic vacuum tubes and capacitors
- ✓ Automatic high frequency inductive combustion furnace
- ✓ Low carbon and high carbon pool
- ✓ TSC infrared detector
- ✓ Automatic overtime / overflow alarming system
- ✓ Highly integrated electronic circuit
- ✓ Power block ensures stable output
- ✓ Self-cleaning device and ash removing system

3. Specifications

Model No	NCSA-104
Measurement range	Carbon: 0.0005 % ~ 99.9999 %
	Sulphur: 0.0005 % ~ 99.9999 %
Analysis time (adjustable)	25 ~ 60 seconds
Burning power	2.2 kVA
Oscillation frequency	20 MHz
Analysis precision	Carbon: RSD ≤ 1.0 %
	Sulphur: RSD ≤ 1.5 %
Sensitivity	0.1 ppm
Reading Precision	0.0001 grams
Indoor temperature	10 ℃ ~ 30 ℃
Relative humidity	< 75 %
Carbon analysis pool	1
Sulphur analysis pool	1
Sample weight	0.5 grams

4. Applications

Used for measuring carbon and sulphur in steel, alloy, cement and various other non-ferrous materials in new energy, metallurgy, mines, nuclear industry, automobile industry, aviation, food industry, research institutes, geology, petrochemical industry, etc.

5. Instrument Introduction

The instrument is divided into five parts: Infrared detection part, high-frequency induction heating part, microcomputer, laser printer, and electronic balance. The following section focuses on the internal structure of the high-frequency induction heating section and the infrared detection section.

The high-frequency induction combustion furnace internal frame structure is divided into the upper, middle, and lower three-layer arrangement, the upper layer installs a high-frequency induction circuit, out of date, an overcurrent protection circuit, and solenoid valve control circuit, the middle layer installs power supply, gas circuit on/off switch, filtering and drying of analytical gases and other devices, the lower layer of the installation of high-voltage transformer, dust collection box, compression valve and so on. From the front, the upper left side is the plate flow indication ammeter, the grid flow indication ammeter, the oxygen-carrying pressure gauge and the oxygen-carrying adjustment knob, the top oxygen flow adjustment, the analysis gas flow adjustment, and the lower part is the raise/lower the furnace button, the outdated/overcurrent reset button, the automatic cleaning button, the power supply switch, and the dryer device. On the right side is the combustion zone of the combustion furnace, above which is the filtration and cleaning system for the gas released after combustion, and below which is the cylinder, which is used for feeding the specimen into the combustion zone when analyzing the sample and removing the specimen after the combustion is finished.

The infrared detection unit contains a modular power supply and mainframe control circuit boards; in addition, there are gas analysis cells, with carbon and sulphur analysis cells in the chamber.

6. Installation

6.1 Preparation Before Installation

Instrument analysis room: Keep away from corrosive gases such as acid and alkali, dust, vibration, and places that interfere with the measurement.
Area of analysis room: Required to be greater than 3 x 3m.
Working environment: Indoor temperature: 10-30°C, relative humidity: <75%.
Power supply: Requires good grounding, voltage AC220V±5%, frequency 50Hz±2%, no harmonic interference.
Regulated power supply: Rower 5kW, voltage regulation accuracy <2%.
Working gas: Oxygen, purity >99.5%.
Power gas: Nitrogen or compressed air (to remove water, oil, and dirt)
Tools: Unpacking and general use tools.

6.2 High-frequency Furnace Installation

- Unpack the box, take out the high-frequency furnace, remove the rear cover of the instrument, lift off the upper cover, and then remove the right side of the board, in the right side of the instrument with a screwdriver to unscrew the stainless steel cover of the inner cover, check the movement inside the various parts of the connection of the screws have no signs of loosening and tighten promptly. (Shaking during transport may cause a few screws to loosen.
- Remove the gas line skin tube in the head area, remove the head unit by unscrewing the fasteners by hand, place the quartz tube into the grate from above, and pass it through the induction ring in the middle of the grate. The upper end of the quartz tube installs the removed furnace chamber as it was. The lower end of the quartz tube is fitted with a red silicone washer coated with vacuum silicone grease.
- Check the internal screws for looseness and the chassis for other extraneous debris.
- Fix the movement, the fixing screws, and the screws of the stainless-steel cover of the inner cover and install the right-side panel and the rear cover.

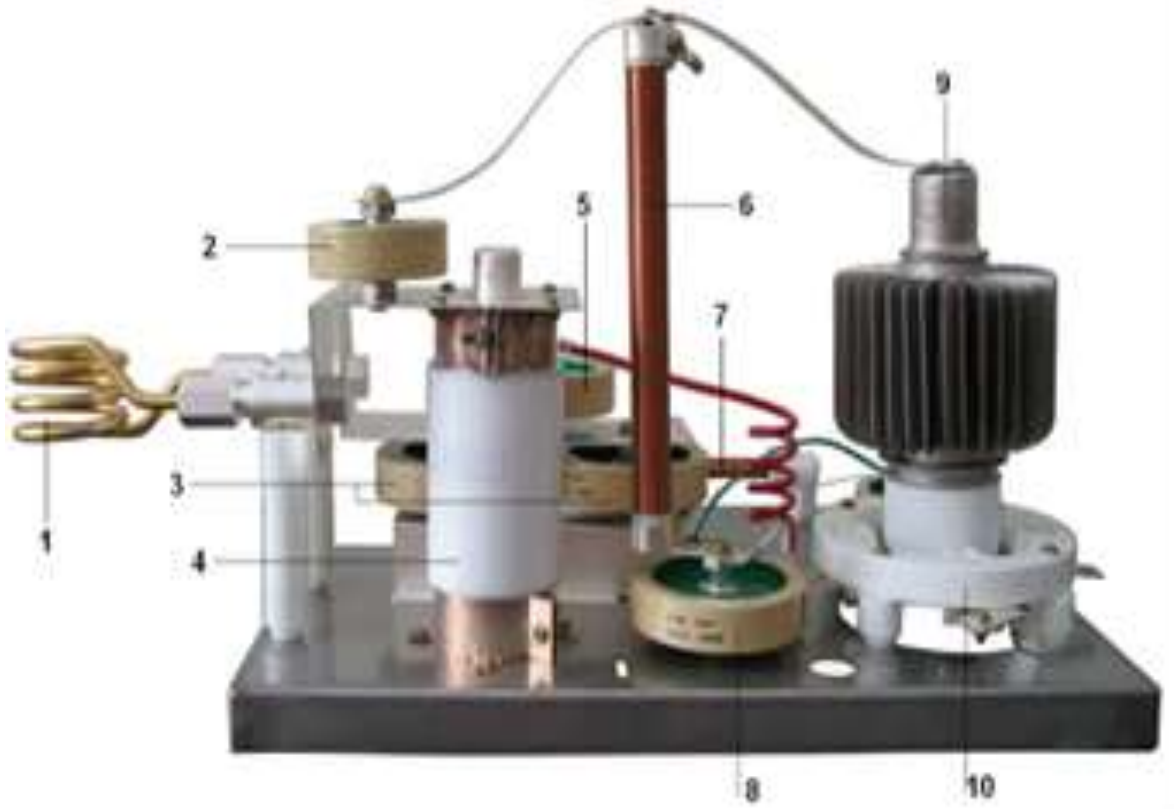

Figure-1

1) High-Frequency Heat Coil
2) Coupling Capacitor
3) Main oscillation circuit capacitor bank
4) Vacuum Capacitor
5) Gate feedback voltage coupling capacitance
6) plate pole choke
7) Grid Plate High-Frequency Chokes
8) filter capacitor
9) High-Frequency Oscillator
10) valve seat

6.3 Installation for Infrared Detection Section

- After unpacking the box and removing all parts of the instrument, place it according to its shape and structure.
- Open the back door of the infrared detection section, check the upper printed circuit board components and each connector for looseness, and plug in the balance interface cable, USB cable, and optical fiber in order respectively.

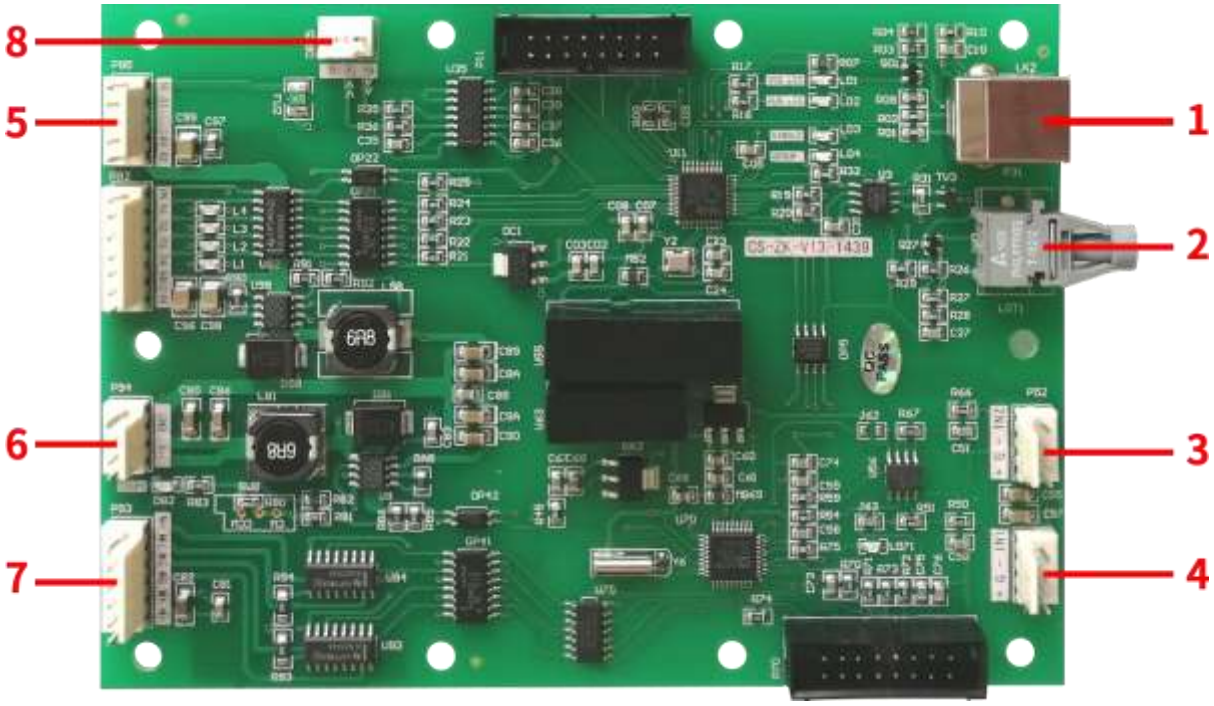

Figure-2 Control Circuit Boards

1) USB communication cable
2) High-speed communication fibre
3) Connecting Sulphur Amplifier Plates
4) Connecting Carbon Amplified Plates
5) DC power input
6) Light source input
7) Stepper motor cable
8) Balance Connection Cables

6.4 Gas Line Connection between HF Furnace and Analyzer

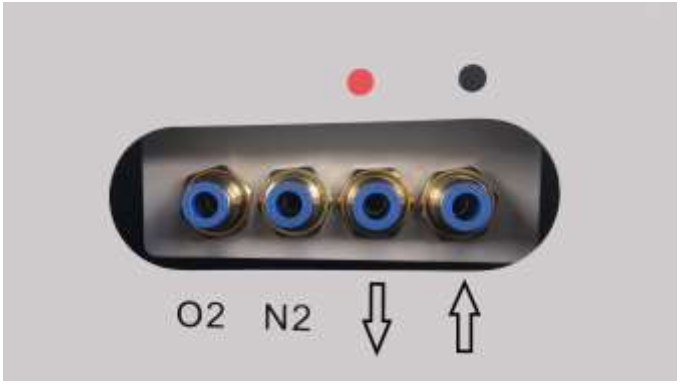

Figure-3 High Frequency Furnace

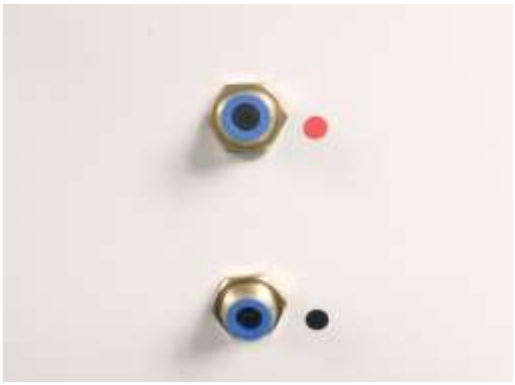

Figure-4 Analysis Unit

- Oxygen pressure-reducing valve connector at the oxygen cylinder at the O2 connection of the high-frequency furnace.
- High-frequency furnace N2 connected to compressed air or nitrogen
- HF Furnace ⇩ connect with analysis unit
- HF Furnace ⇧ connect with analysis unit

7. Working Principle

7.1 Infrared detection principle

CO2, SO2, and other gas molecules in the infrared wavelength have a selective absorption spectrum, when a specific wavelength of infrared light through the CO2 or SO2 gas, can produce strong light absorption, this absorption law can be derived from the Lambert-Beer law.

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

Since the detector converts the optical signal into an electrical signal, when the detector operates in the linear region, then (1) can be rewritten as:

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

Where: Ii(λ), and Vi(λ) are the incident light intensity and the corresponding electrical signal value at a specific wavelength λ, respectively.

IO(λ), and VO(λ) are the incident light intensity and the corresponding electrical signal value after passing through the absorption cell, respectively.

α(λ) is the absorption coefficient of the measured gas at a specific wavelength λ.

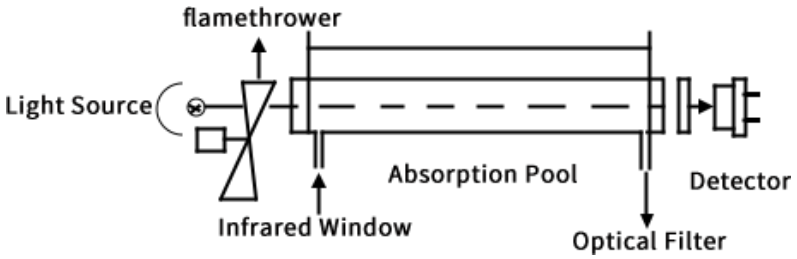

Figure-5 Analyser cell optical circuit Diagram

As can be seen from the above formula, when a specific wavelength is selected and the length of the analysis cell (absorption cell) is determined, the measured light intensity IO can be converted to the concentration of the gas to be measured in the gas mixture, which is the basic principle that the infrared absorption method can quantitatively measure the concentration of gases. The measurement wavelengths selected for this instrument are 4.26 um for CO2 and 7.4 um for SO2.

7.2 Principle of high-frequency heating

When the metal conductor is in a high frequency alternating electric field, according to Faraday's law of electromagnetic induction, will produce an induced electromotive force within the metal conductor, due to the conductor's resistance being very small, thus generating a strong induced current. Joule-corrugated law can be seen, the alternating magnetic field will make the conductor in the current tend to the surface of the conductor circulation, caused by the skin effect, the instantaneous density of the current is directly proportional to the frequency, the higher the frequency, the density of induced currents concentrated in the surface of the conductor, that is, the more serious the skin effect, the effective conductive area is reduced, the resistance increases, so that the conductor is rapidly warmed.

7.3 High Frequency, so that the conductor is rapidly warmed

Open the power switch on the panel, 220V AC voltage through the power supply filter LB1 after the three-way respectively for the work of the whole machine, all the way through the filter LB2 for the axial fan F work, all the way for the filament transformer T2 work, all the way through the solid-state relay K2 control for the high-voltage circuit work. When the high-frequency switch is opened, the solid state relay K2 is opened, the primary of the step-up transformer T1 to join the 220V AC voltage, and the secondary output high voltage, rectified by the high-voltage rectifier V1-V4 rectifier to produce DC high voltage for the oscillation of the control of the anode, at this time, C3, C4, L2 composed of LC oscillating circuit, the combustion of heating begins. By adjusting the gate potentiometer W, you can change the gate flow, thus changing the negative feedback in the circuit. When the combustion time arrives, the high-voltage power supply is automatically turned off, and the combustion heating process ends.

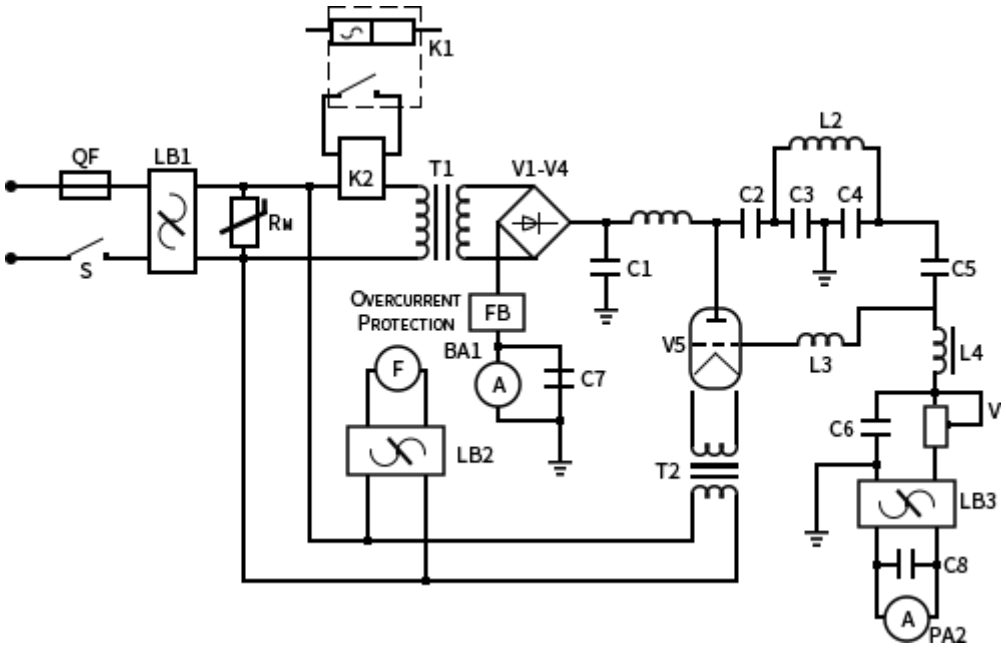

Figure-6 Electrical Schematic Diagram

In addition, there is an obsolete overcurrent protection device in the circuit, once the anode current exceeds 0.7A, or the burning time exceeds 1 minute, the circuit automatically cuts off the high-voltage power supply and alarms. After hearing the alarm sound, press the [Reset] switch on the panel, the alarm sound will be eliminated, and the machine will return to the original working state, and it can continue to work after being processed.

7.4 Principle of Operation of the Air Circuit

The principle of the gas circuit of the instrument: oxygen is sent into the instrument through the pressure-reducing valve at the upper end of the oxygen cylinder and the pressure is adjusted to 0.2-0.25MPa for combustion, and the power gas generally adopts nitrogen or compressed air for power.

Power gas is usually nitrogen or compressed air for power. The power gas is pressed through the compression valve to press the ash discharge pipe. Through the automatic cleaning valve for the automatic cleaning device to clean the quartz tube, all the way through the lifting valve for the cylinder lift.

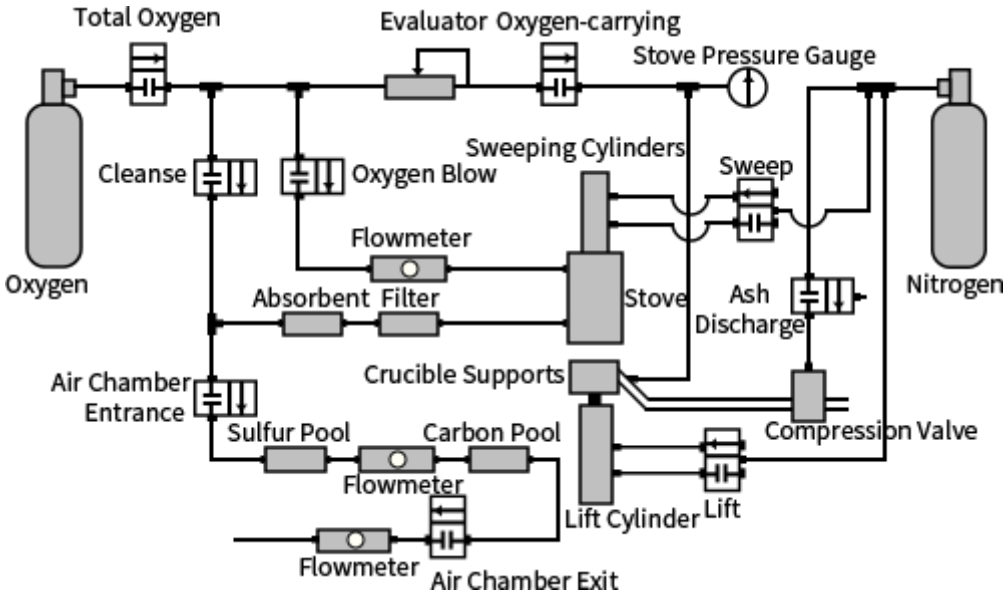

Figure-7 Schematic diagram of Air Circuit

The combustion gas is purified and dried by the purification furnace through the total oxygen valve and then supplied to the instrument in two ways: One way is supplied to the top blowing oxygen after adjusting a regular flow rate through the 0-3 L/min flowmeter. One way is adjusted by 0-3 Lmin flow meter and then supplied to the top blowing oxygen. Through the fixed value of the regulator, for the carrier gas, the use of the fixed value of purpose is to make the combustion chamber maintain a constant pressure. Sample through the heating through the oxygen combustion gas mixture generated by the degreasing cotton to remove dust, desiccant to remove water, through the gas chamber inlet valve into the sulphur pool, and then through the 0-5 L/min flowmeter into the carbon pool, and finally through the 0-5 L/min flowmeter to determine the actual flow rate by the gas chamber outlet valve to empty.

7.5 Working Principle of the Whole Machine

The working principle of the whole machine: it is divided into three main parts: the upper part is the gas circuit system, and each arrow indicates the direction of gas flow; the middle part is a dotted line box, which reacts to the whole process of converting the light signal into electric signal in the whole gas analysis room linked by the arrows; the lower part is the circuit control system.

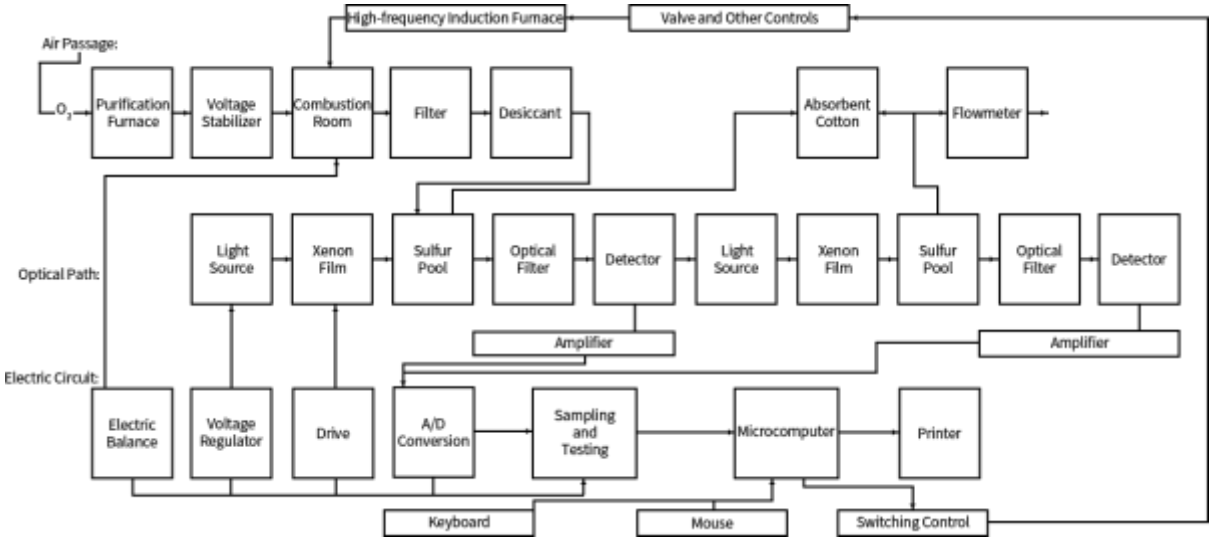
High-frequency Induction Furnace
Valve and Other Controls
Air Passage:
O_2
Purification Furnace
Voltage Stabilizer
Combustion Room
Filter
Desiccant
Absorbent Cotton
Flowmeter
Optical Path:
Light Source
Xenon Film
Sulfur Pool
Optical Filter
Detector
Light Source
Xenon Film
Sulfur Pool
Optical Filter
Detector
Amplifier
Amplifier
Electric Circuit:
Electric Balance
Voltage Regulator
Drive
A/D Conversion
Sampling and Testing
Microcomputer
Printer
Keyboard
Mouse
Switching Control

Figure-8

8. Software Operation

Double-click the "CS Analyzer" icon to enter the system login window, the initial username is admin, enter the initial password "1" in the password field, and click login to enter the analysis interface.

Figure-9

8.1 Software Interface

Figure-10

1) Menus & Toolbars
2) Analysis results column
3) Pool voltage display column
4) Real-time analysis curve display bar
5) Quick reference column for analyses
6) Analysing the progress bar
7) Currently analysed sample name
8) Currently analysed sample weight
9) Equipment operating status
10) Name of the person who logged on to the software

- The pool voltage has a jumpy but stable signal (usually around 1.5000, with a signal fluctuation of less than 0.001 in one minute being optimal).
- The lower right corner of the screen indicates that the device is operating normally.
- **Menu and Toolbars:** Located at the top of the software, they provide the entry point to all the functions of the software, as shown in the figure below.

Main menu bar	Sub-menu bar	Menu functions
System function	Change your password	Change the password of the current login user.
	User management	Manage all administrators and operators who operate the instrument.
	System settings	Setting up parameter, curve and analysis result list field displays.
	System recovery	Fixing system failures.
	System diagnosis	Diagnose whether each pneumatic valve is working properly.
	Log out of the system	Exit the current system.
Analysis control	Start analysing	Analyse.
	Termination analysis	Early termination or closure of the analysis.
	Key weight	Input sample weight.
	Channel Management	Select to modify the carbon and sulphur channels.
	Sample Management	Add a note to the sample name.
	linear data	Detection of correction curves.
Results processing	Results statistics	Data averages
	Results Enquiry	Query Modified Data.
	Coefficient correction	Tuning coefficients for accurate results.
	Gap correction	Reduction of external interference errors.
	Curve comparison	Compare the effect of different data curves.
	Curve fitting	Draw curve.
	Print results	Printing paper reports.
Interface operation	Toolbar (in computer software)	Function Shortcuts
	Taskbar	
Help	Help	Help Document
	About	Display software copyright and version information.

8.2 System Function

Under System Functions, there are six functions, as shown below

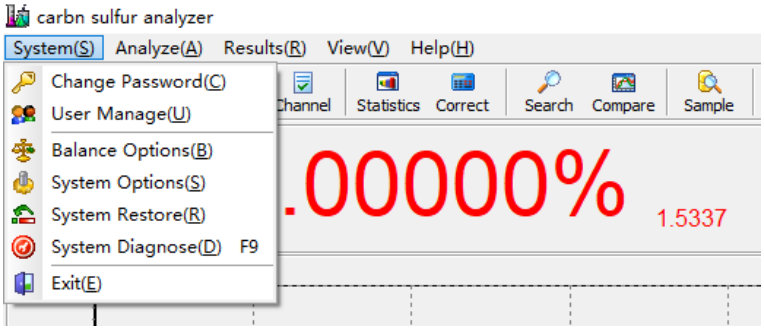

Figure-11

8.2.1 Change Password

Select [Change Password], enter Change [Login Password], enter the current password in [Original Password], enter the modified password in [New Password] and [Confirm Password] columns, press [OK], the password will be modified successfully, and the new password will take effect.

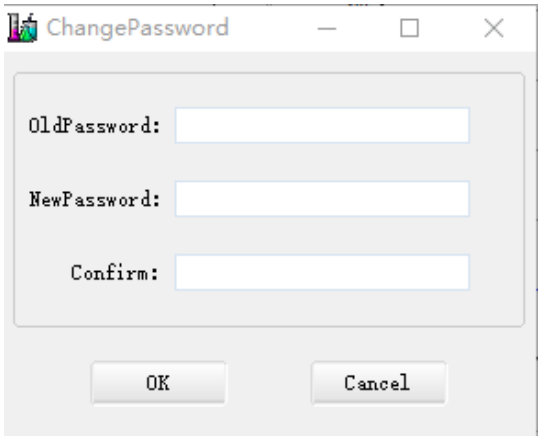

Figure-12

8.2.2 User Management

Select [User Management], the system pops up the [User Management] menu, displaying all the administrators and operators who are currently operating this instrument. The administrator is the department manager, can add and delete operators, and can modify the information and password of operators. The operator is both the lab technician and the specific operator of the instrument, who can operate most of the menus of this software. Administrators can add a new operator, input user number, username, and password, and then press [Save], you add a new operator. Select an operator with the mouse and choose [Modify] to modify and edit the basic information of the operator, if you choose [Delete], the system prompts you whether to confirm or press [Confirm]to delete the operator.

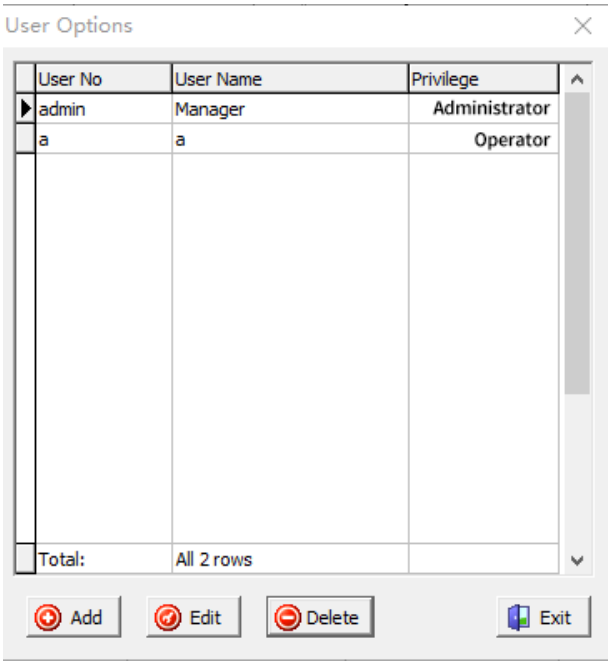

Figure-13

8.2.3 System Setting

There are three groups of functions in [System Settings], which are Parameter Settings, Curve Settings and Analytical Result List Field Display Settings.

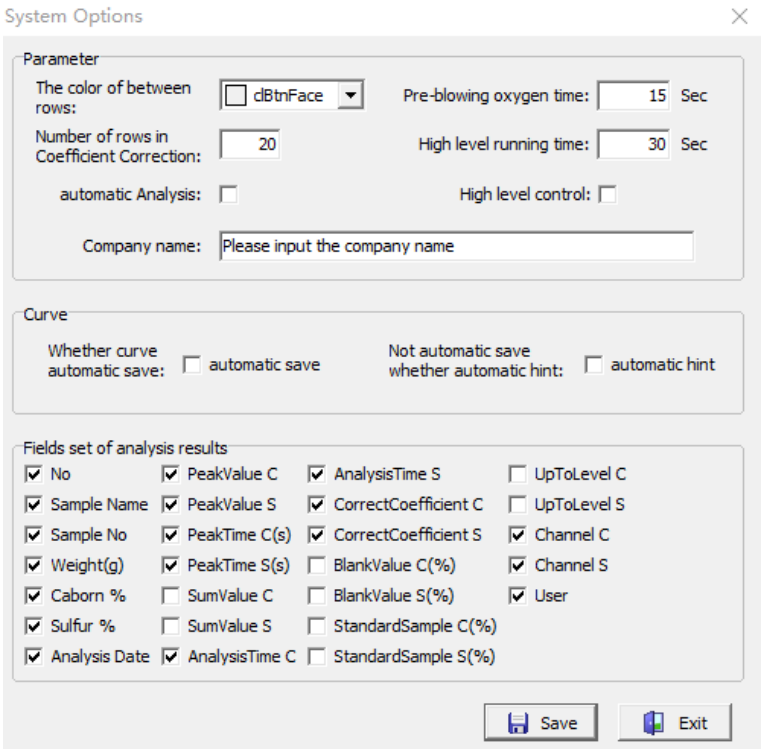

Figure-14

- [Parameter] Mainly, it is to set
  1) The colour between the lines of the analysis result data.
  2) The time of pre-blowing oxygen.
  3) The number of records returned by coefficient correction.
  4) Whether to analyze automatically or not.
  5) The running time of high frequency.
  6) The name of the user.
- [Curve]The main settings are
  1) Whether to save the release curve automatically at the end of each analysis.
  2) Whether to prompt the system automatically at the end of each analysis if it is not saved automatically.
- [Display Settings for Analyzed Result List Fields] The main setting is to set which parameters are displayed in the analyzed result quick check field; the specific list is as follows.

No	Weight	Sulphur peak time (Seconds)	Carbon Calibration factor	Carbon Standard (%)
Sample name	Start of analysis	carbon footprint	Sulphur calibration factor	Sulphur standard (%)
Sample number	peak carbon value	sulphur cumulative value	Carbon blank value (%)	Carbon cut-off level
Carbon content (%)	peak sulphur	Carbon analysis time	Sulphur blank value (%)	Sulphur cut-off level
Sulphur Content (%)	Carbon peak time (seconds	Sulphur analysis time	operator	

There is a in front of each item, ticking on it means that the item is selected, the selected item will be shown in the result display column, the unselected item is hidden, but all items are shown in the result query.

8.2.4 System Repair

Used to repair the system in case of Failure.

8.2.5 System Diagnosis

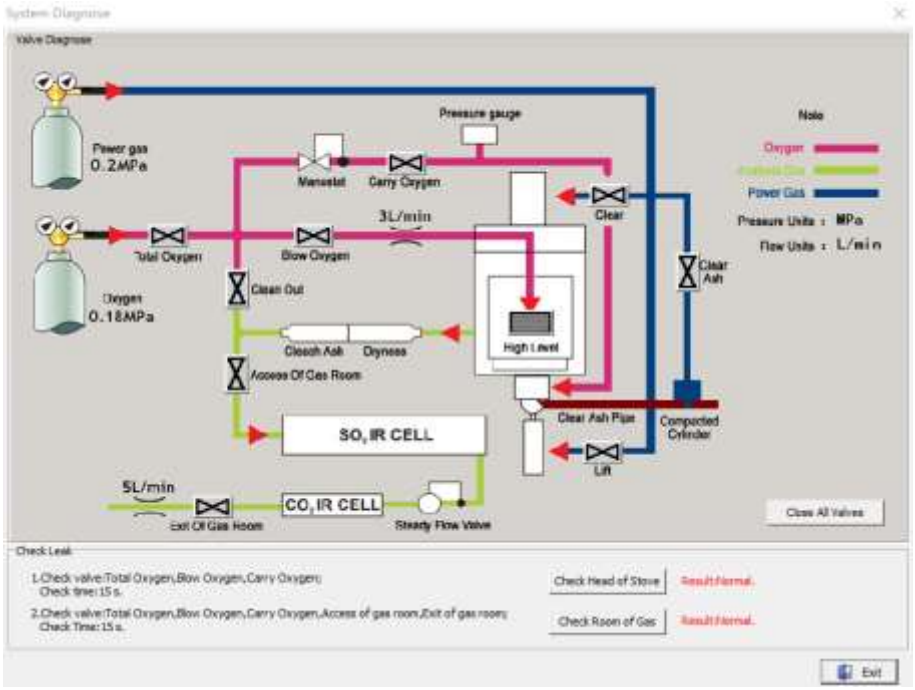

Figure-15

[System Diagnosis] draws the analytical gas circuit diagram of the instrument, users can click on each valve with the mouse to diagnose whether each pneumatic valve is working normally or not; in the illustration of [High Frequency], clicking on it with the mouse can check whether the high frequency is working normally or not.

At the bottom of the [System Diagnosis] menu is gas leakage checking, clicking [Checking Head] or [Checking Gas] Chamber with a mouse, and the system will automatically open the valve of the corresponding gas line, and then close the valve, and then conclude whether there is gas leakage or not by checking whether there is any change in pressure.

8.2.6 Log Out of the System

Select [Exit System], and the system pops up a dialogue box, whether you want to exit the system, select [Yes], and the system exits the program.

8.2.7 Balance Settings

This setting is used for real-time transfer of weight between the balance and the main board of the IR Carbon Sulphur Meter and is pre-set at the factory.

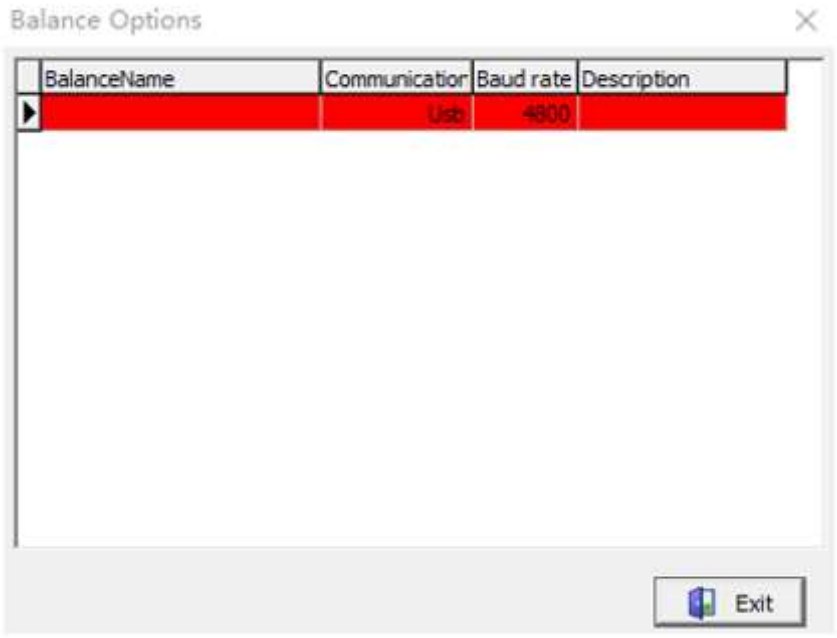

Figure-16

8.3 Analysis Control

8.3.1 Start Analysis

To carry out the analysis, two conditions must be satisfied first.

1) There is weight in the weight library.
2) The lifting cylinder is lifted once. Select [Start Analysis], the instrument enters the analysis state, the first is the oxygen-blowing process, then the combustion process, when the analysis is finished, the instrument automatically closes all the valves, and the analysis is completed. Corresponding shortcut key to [Start Analysis]: F1

8.3.2 Termination Analysis

If you want to terminate or end the analysis early, select [Terminate Analysis]."
The instrument will then end the analysis.

Note:

1) If the termination of analysis is during the oxygen-blowing process, this weight is valid and the sample has not been burnt, the analysis can be continued.
2) If the termination of analysis is in the process of combustion and the sample has been burned, the weight will be counted as the result of this analysis.

8.3.3 Input Weight

There are two ways to input the weight of this instrument:

1) Automatically by the electronic balance.
2) Manually. This function is for manual weight input.

- Automatic weight loss: weigh with electronic balance, press the lower right corner of the balance printer, and the weight will enter the programme.
- Manual Weight Input: Select [Key Weight], and the weight box will pop up, input the weight in the weight input box, press the [Add] button, and the input weight will be listed in the weight list according to the serial number.

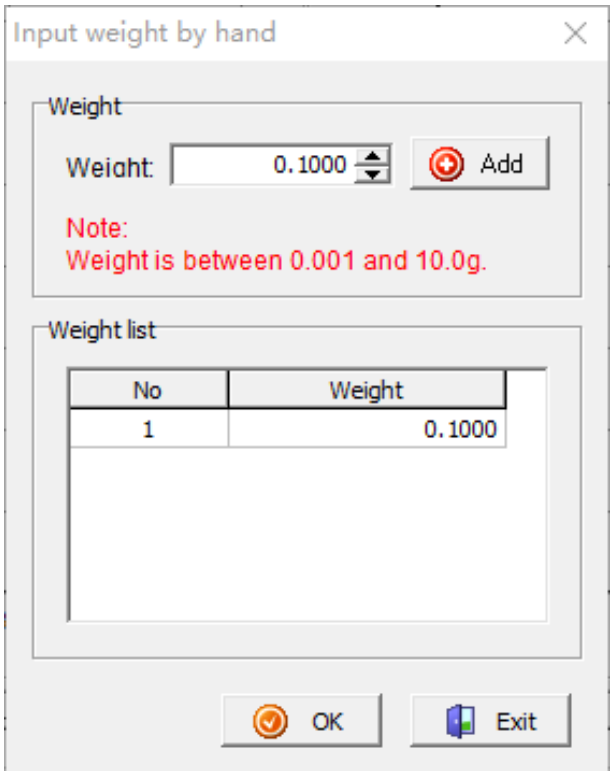

Figure-17

To delete a weight, select the weight with the mouse and double-click the left mouse button to delete the subweight.

8.3.4 Channel Management

Select [Channel Management], the system enters the channel management menu, each channel library has 8 groups of original channels, recording the analysis time, analysis time, calibration coefficients, blanking value, and cut-off level data of the channel.

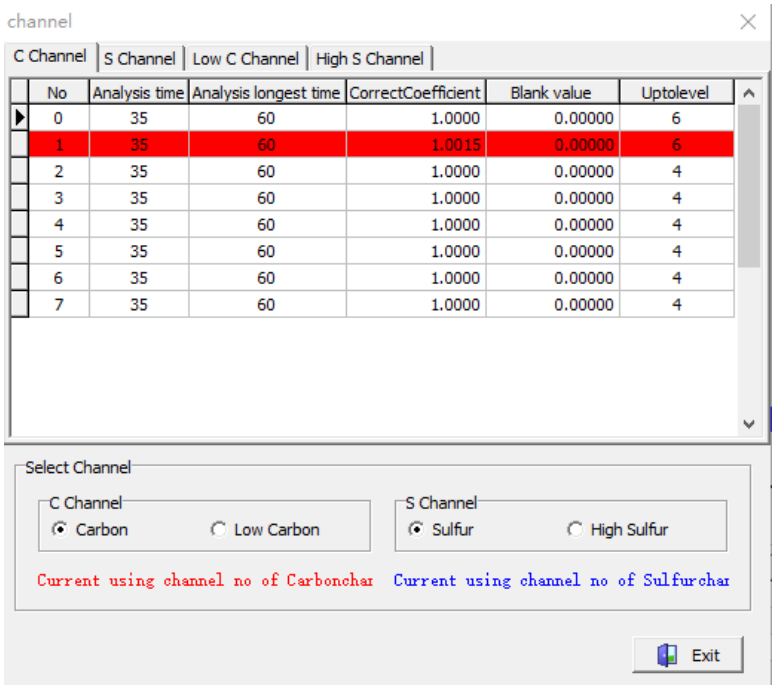

Figure-18

The channels designed in this software can be freely deleted and added: select a channel with the mouse and press the right button to bring up the selection menu, the channel can be edited, deleted, or set as the current channel, but also new channels can be added.

Select [Edit], the system enters the attribute menu of the channel, except the channel number cannot be changed, and the other properties can be modified within the specified range. When the modification is finished, press the [Save] button, the edited content will be saved.

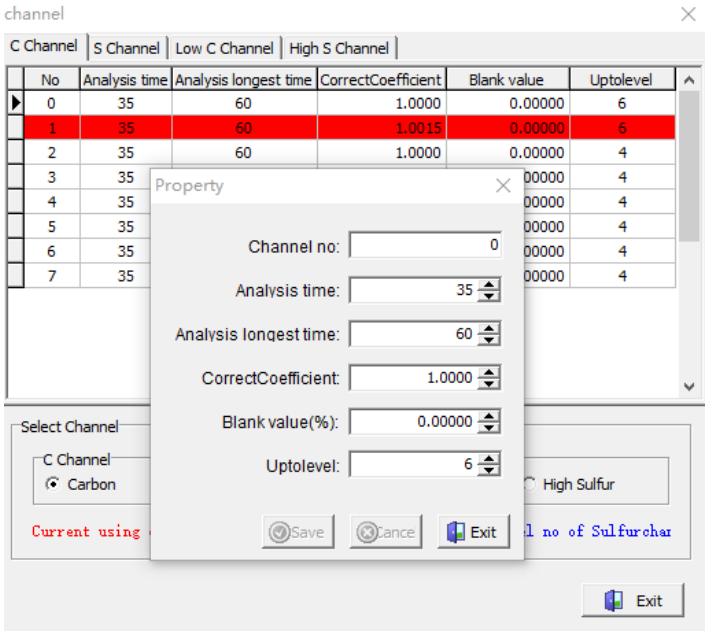

Figure-19

For different users, the analyzed materials in carbon and Sulphur there is a very high or very low difference in the possibility of our normal infrared detection cell faced with the inability to adapt to the content of the band. This software is designed to select any one group of carbon and Sulphur channel libraries among four channel libraries of carbon, low carbon, Sulphur, and high Sulphur, when a certain carbon channel and Sulphur channel are selected if the combination of the selected channels is selected in the prompts, then the system will automatically call the working curve of the channel library, and at the same time, the pool voltage display is also selected to correspond to the pool voltage of the infrared detection cell, and the analyzed result is the actual result of this corresponding detection.
Note: This function must have corresponding hardware support, needs to increase the carbon or Sulphur pool to use normally.

8.3.5 Sample Management

Select [Sample Management], the system enters the property menu of sample management, displaying all the sample identifiers and sample names in the current sample library. At the bottom of the menu, there is a line of buttons, which can modify and delete the existing sample identifiers and names in the sample library and can add new sample identifiers and names.

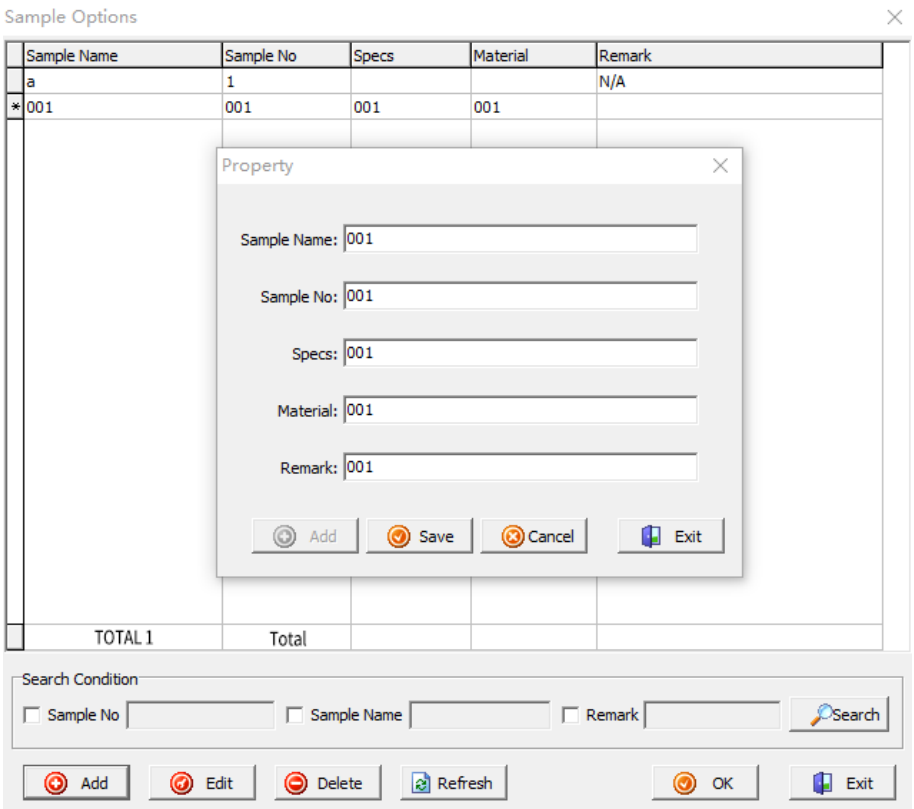

Figure-20

By selecting any sample name in the sample library and pressing the right mouse button, you can also modify and delete the existing sample identifiers and names in the sample library and add new sample identifiers and names.

8.3.6 Linear data

There are four submenus in "Linear Data", "Linear Library List", "Correct Carbon in Analysis", "Correct Sulphur in Analysis", "Correct Carbon and Sulphur in Analysis". (Kindly don't use this function in case of non-instrument failure.)

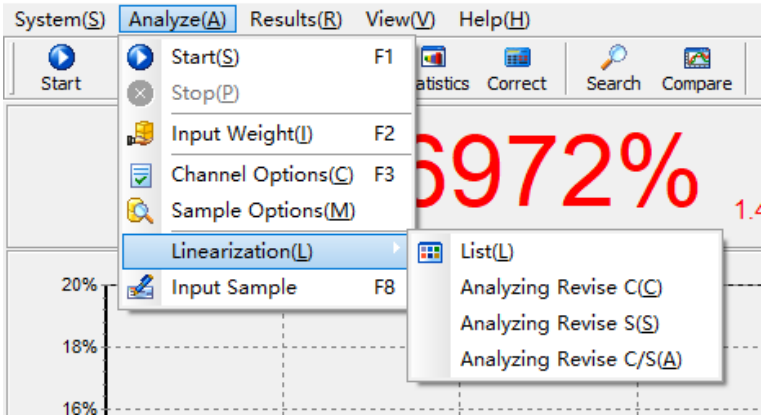

Figure-21

1) **List of Linear Libraries**
   Select "Linear Library List" in "Linear Data", the system lists the linear library data of carbon and sulphur, the user can modify the data and save it in the interface or click the right mouse button and select Export to export the database to a linear library file for saving.
2) **Corrected carbon in analysis**
   The infrared carbon and Sulphur analyser has set up the function of establishing the working curve so that the user can establish the carbon and Sulphur working curve for the instrument according to the carbon and Sulphur content of the samples to be analysed in their own units. This function is to establish the original database of carbon working curves in the analysis.
   Specific method: According to the order of content from low to high, the standard sample will be analysed in turn, at the end of each analysis, the system will prompt to enter the standard content, and then enter the next analysis, after all the analyses are finished, the data will be automatically saved in the program, and then the data will be fitted in 〖Curve Fitting〗, and then the working curve will be established (for details, Kindly refer to 5.5.6 〖Curve Fitting〗).
3) Corrected sulphur in the analysis as above.
4) Correct the carbon and sulphur in the analysis as above.

8.4 Results Processing

8.4.1 Statistics of results

When you select [Results Statistics], the system enters the property menu of Sample Management.

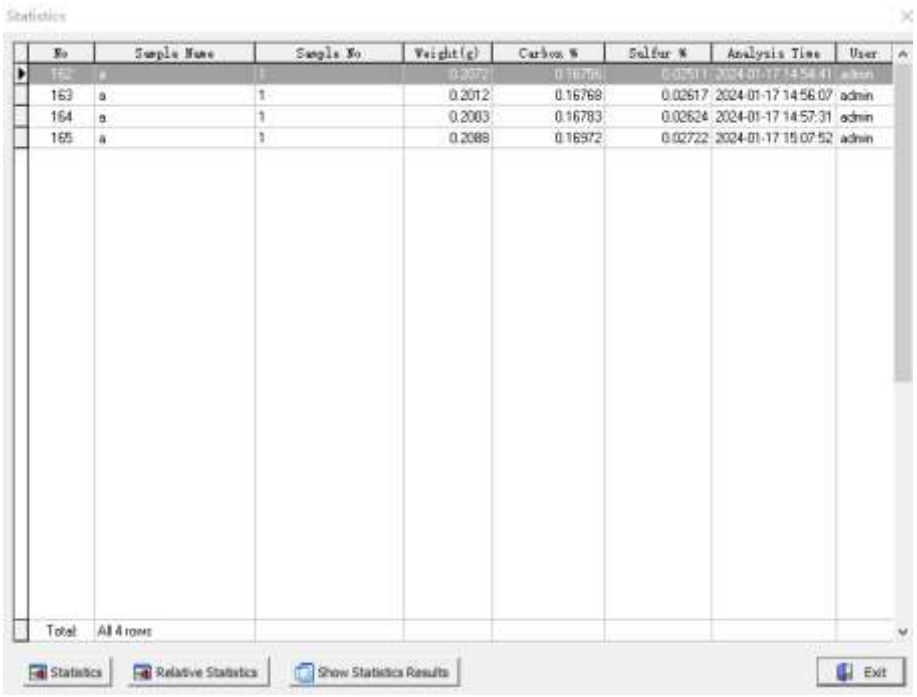

Figure-22

Use the left mouse button to select the analysis results to be counted, continuous data hold down the left mouse button to pull down, discontinuous data hold down the Ctrl key, and then use the mouse to select the data, after selecting, press the right button of the mouse to pop up the selection box.

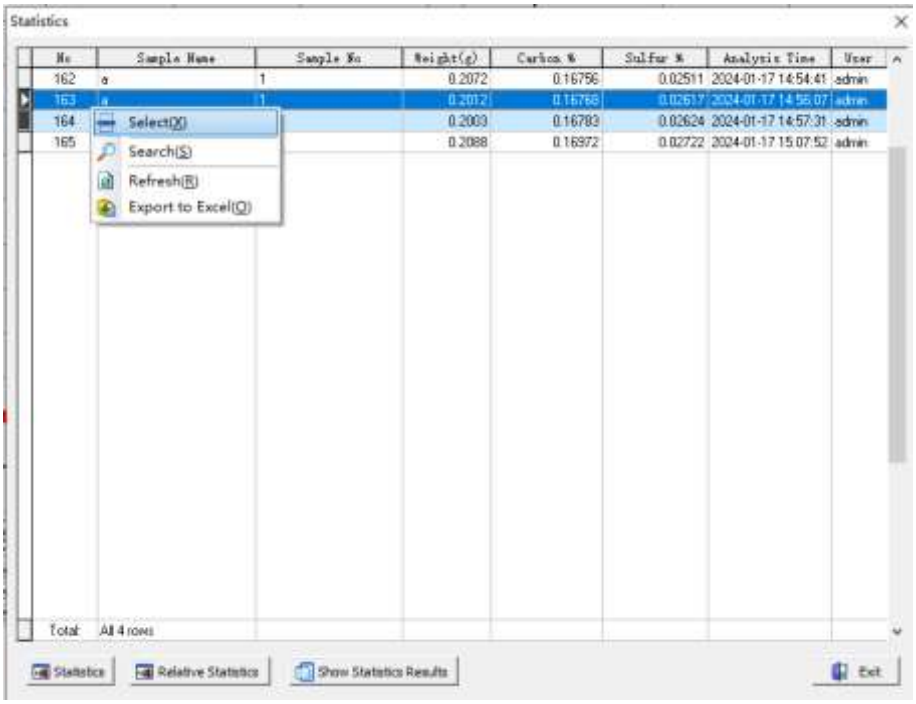

Figure-23

Select [Export Excel] in the box, you can export all the current data to Excel.

Figure-24

Press [Select] in the pop-up menu, the selected data will be listed, and the rest of the data will not be displayed. Select the [Statistics] button in the last line, the system will automatically find out the meaning and standard deviation of the selected data.

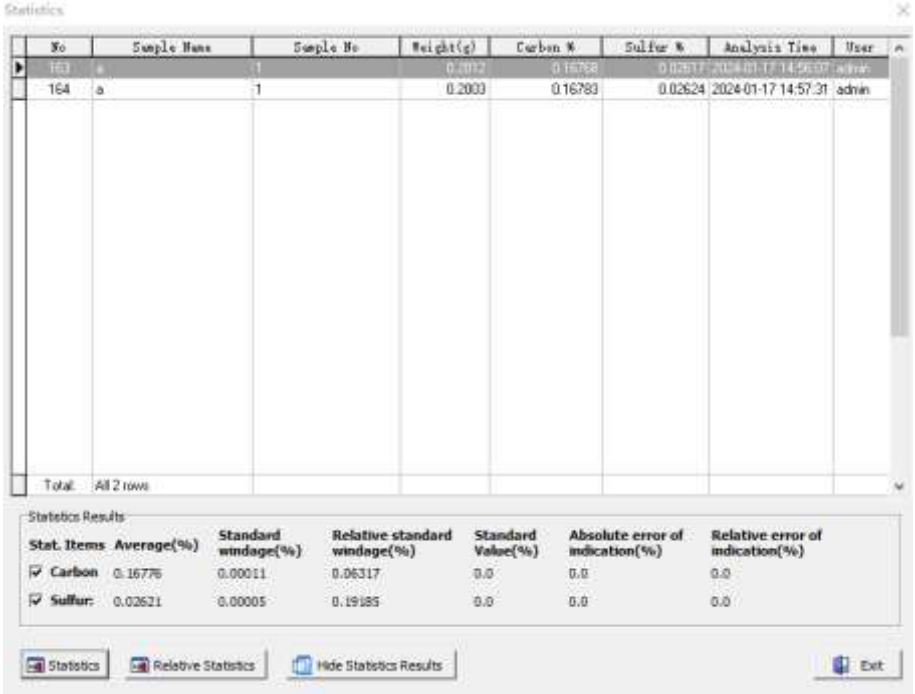

Figure-25

Press [Relative Statistics], the system prompts to input the standard value of carbon and sulphur, after inputting, press OK, then the relative standard deviation, absolute display error and relative display value error will be calculated.

8.4.2 Result Enquiry

Select [Result Query] from the menu, the result display box will pop up.

Select the [Query] button at the bottom, the query condition box will pop up, users can select any query condition according to sample identification, sample name, operator, analysis start time, and cut-off time.

Select the [Export Excel] button at the bottom, users can export the data according to the required fields, generate a file in the form of an Excel table, and save it on the disk.

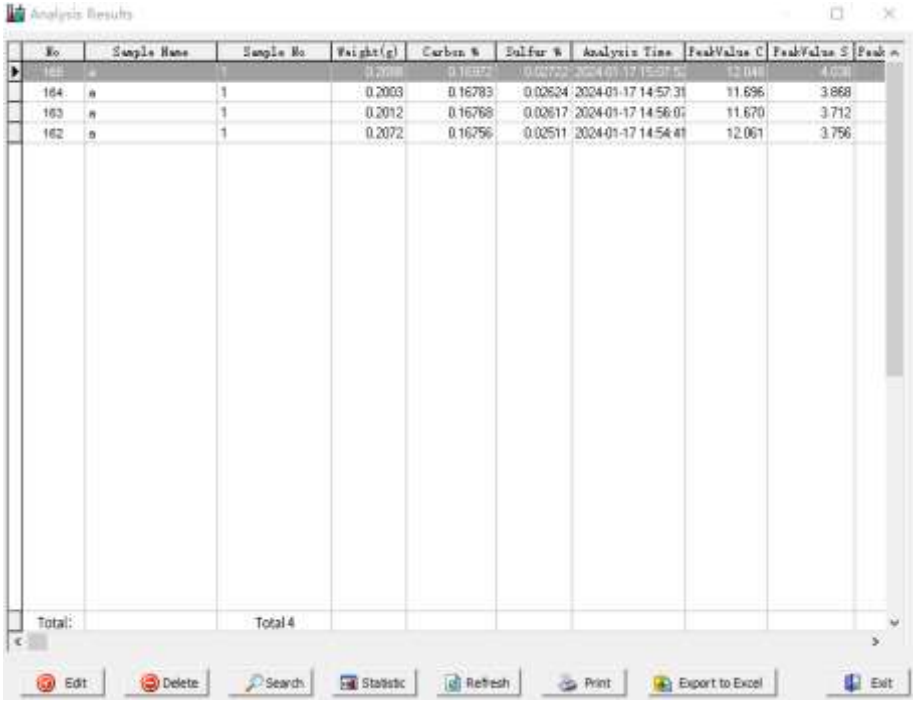

Figure-26

8.4.3 Coefficient Correction

Select [Coefficient Correction]in the menu, the system pops up the coefficient correction box.

In the analysis result, select the result with known carbon and sulphur content, and put an √ in the □ before the result. Users can calibrate Carbon alone, Sulphur alone, or both at the same time. Just put an √ in the □ below the calibration for Carbon/Sulphur and enter the standard content, then press the [Calibration] button. The system prompts whether you are sure you want to do the calibration or not, if you choose [Yes], the original calibration coefficient will be changed, and the system will calculate according to the new calibration coefficient from the next analysis.

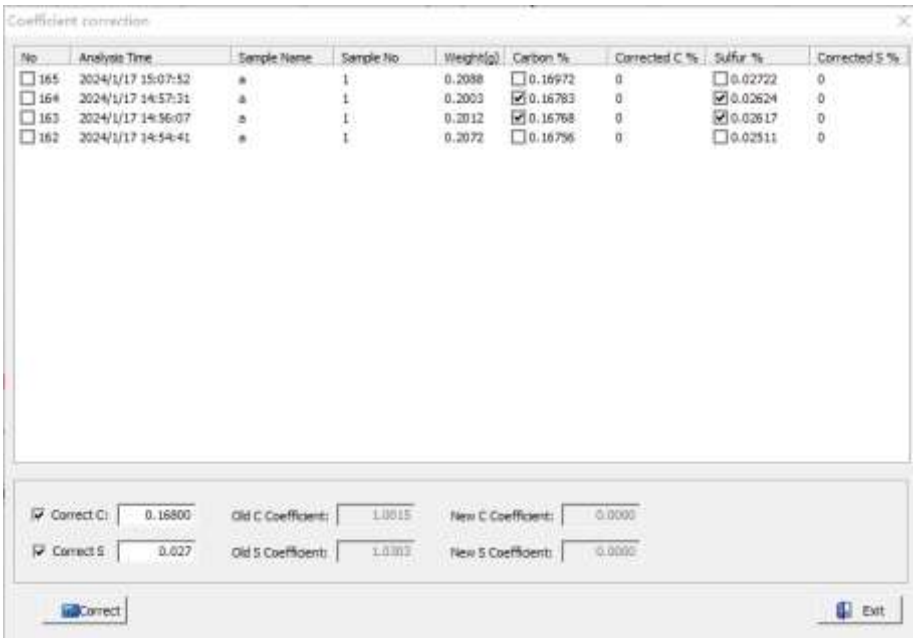

Figure-27

8.4.4 Blank Correction

Blank correction is to deduct in advance when analysing ultra-low content samples because blanks in fluxes and crucibles affect the analysis results. The specific method is the same as the coefficient correction, but the standard content is automatically defaulted to 0 by the system during the correction, no need to input. After the blank correction, the blank value is automatically deducted from the result analysed in the current carbon and sulphur channel.

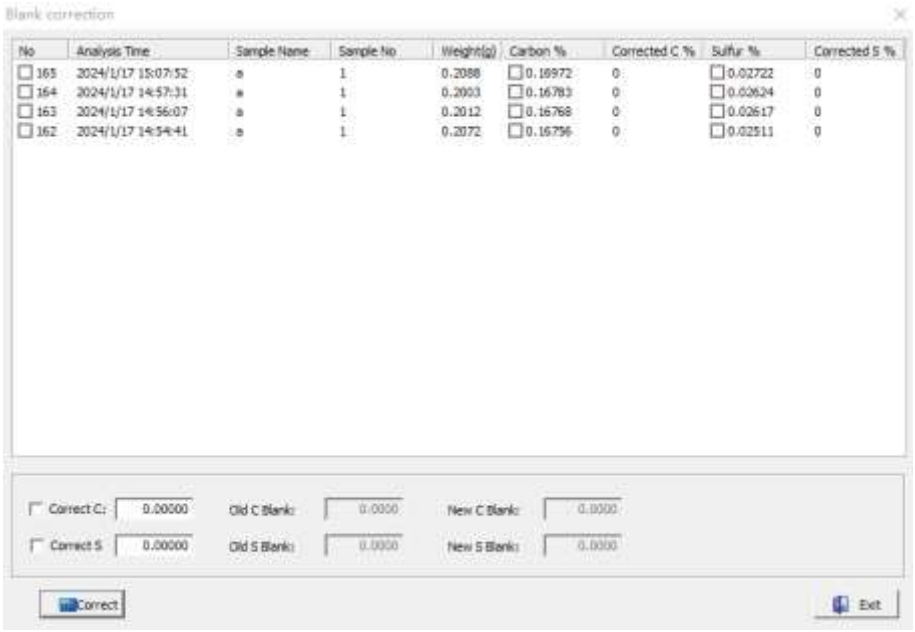

Figure-28

8.4.5 Comparison of Curves

As introduced in 8.2.3 [System Settings], at the end of each analysis, the system will be reminded whether to save the release curve or not, or it can be set to save the curve automatically. After the curve is saved, it automatically enters the result library, and the user can call and compare the release curves of the same sample at will. Select [Curve Comparison] from the menu, the system pops up the curve comparison box.

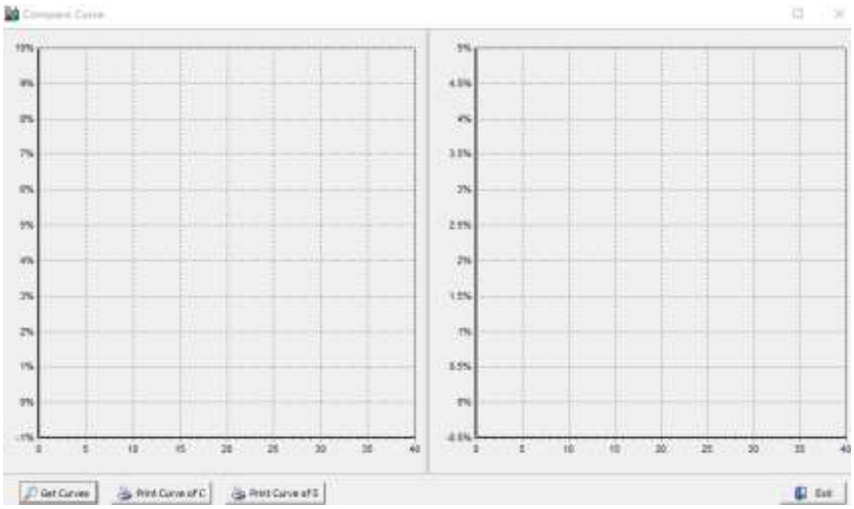

Figure-29

Select the [Extract] button in the pop-up box, and the system will display all the current analysis results with saved curves, you can double-click with the left mouse button to select them directly, or you can call the curves according to the relevant conditions in the query conditions, the selected samples will be entered into 〖Selected Curves〗, and the user can design the display color by himself.

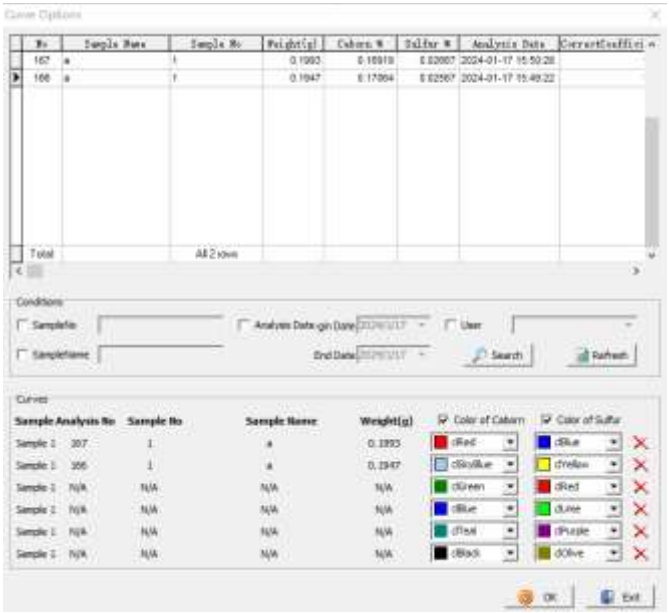

Figure-30

After selecting the curve, press **OK,** the selected curve will be displayed in the curve comparison box.

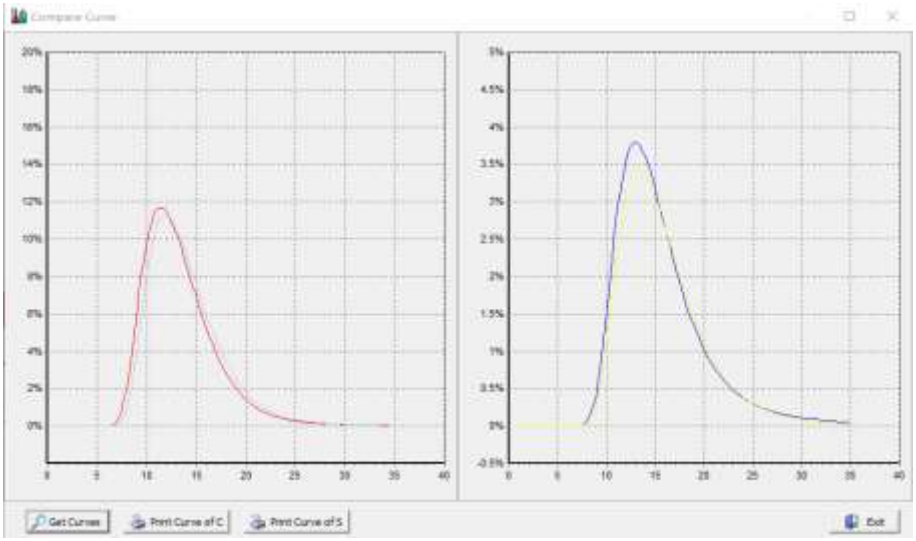

Figure-31

8.4.6 Curve Fitting

Curve fitting is to fit the result of corrected carbon/sulphur. A standard curve is fitted by adjusting the values of each parameter of C0, C1...C5 to make the analyzed result coincide with the value of the standard sample.

Note: This function is operated by the administrator, ordinary operators do not have this permission.

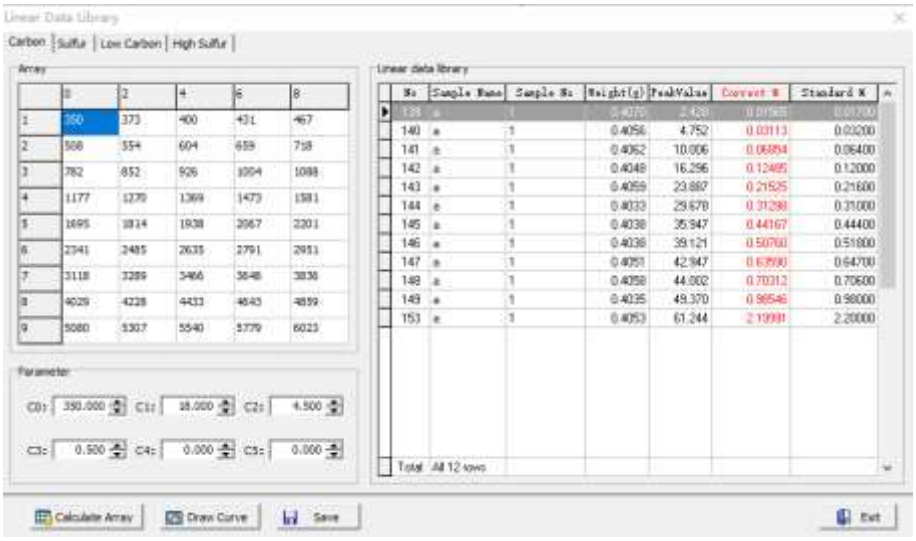

Figure-32

8.4.7 Printing of Results

The resulting printing of this software is set up in two printing modes: report mode and test station mode.

8.4.7.1 Reporting Format

The report mode is intended for general users to print the results of their analyses by entering the name of the company in the Company field and then selecting all the data to be printed.

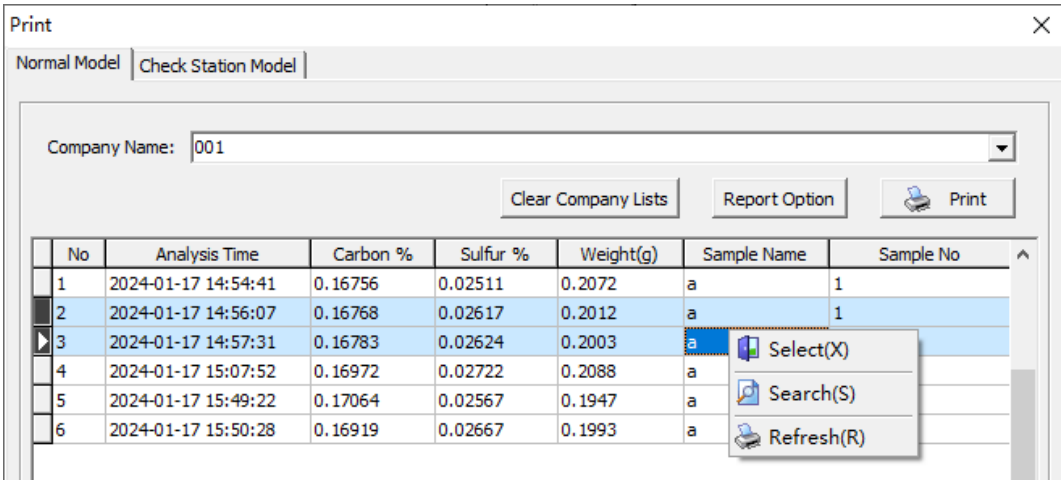

Figure-33

Selected by [Report Settings], you can adjust the format, line spacing, column width, etc. of the currently used table

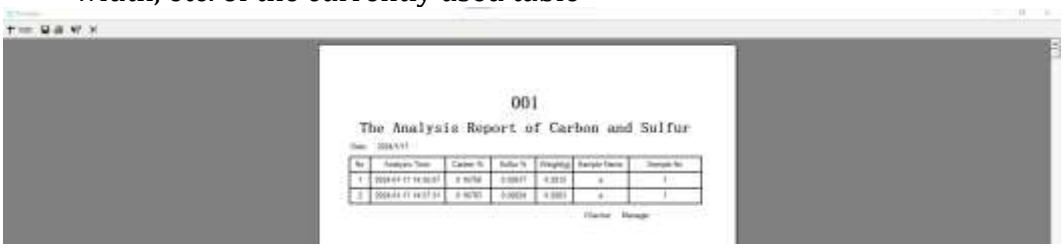

Figure-34

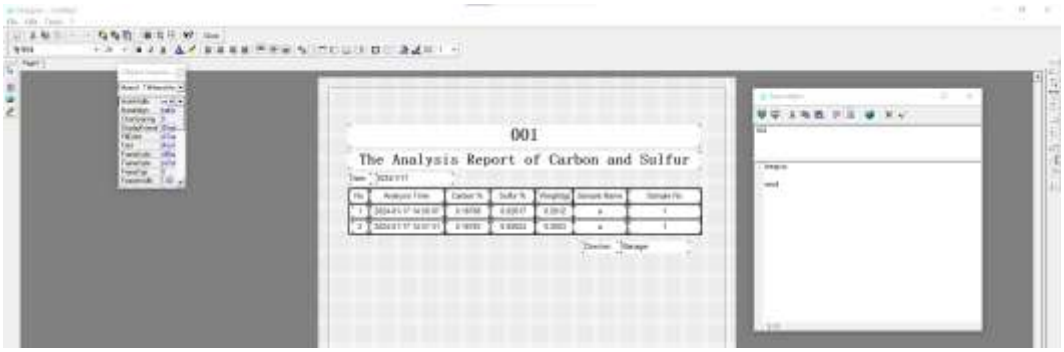

Figure-35

Adjust the form format, press the [Print] button, enter the print preview mode, press the printer icon in the upper left corner of the screen, and both start printing forms.

8.4.7.2 Testing Station Format

The printing mode of the testing station is mainly for the external provision of incoming samples for testing, and the need to issue test reports to customers. Generally, a sample is analyzed several times in a row, the results of the analysis of statistics, and then print the results.

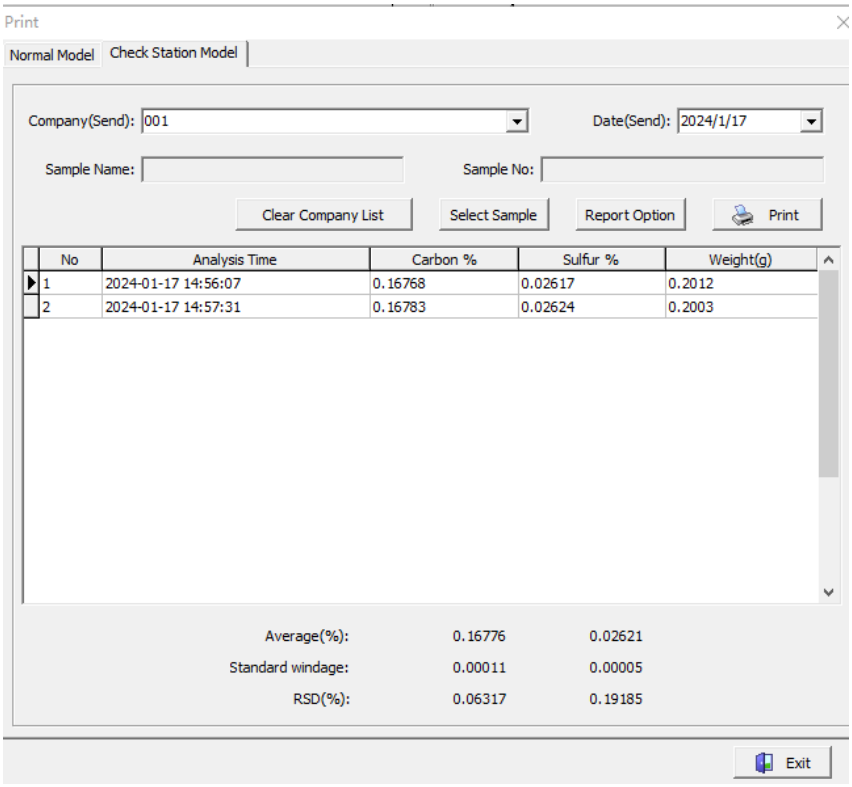

Figure-36

As in the above figure, input the Name of the Sampling Unit, select the data to be printed, and directly press the [Print] button to display the mean value, standard deviation, and RSD value of the sample.

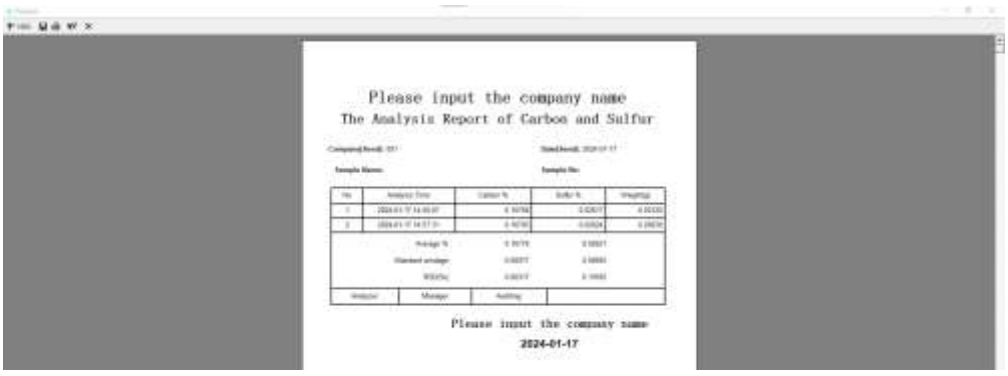

Figure-37

8.5 Interface Operations

The interface operation mainly controls whether toolbars and taskbars are displayed in the operation interface, and you can select whether to display them with the mouse.

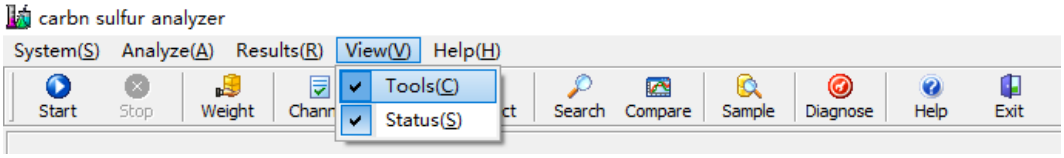

Figure-38

If these two items are unchecked, the contents of the two items are not displayed on the operation screen.

Figure-39

8.6 Help

Displays some "Help" information and information about the instrument.

Analysing Operational Processes

8.7 Preparation

- The ceramic crucible was placed in a horse-boiling furnace and heated up to 1000°C for 4 hours and then cooled down and placed in a dedicator for spare parts.
- Standard samples, fluxes.
- Crucible tongs, sample spoons.
- Oxygen and power gas for analysis (both regulated to 0.2MPa pressure).
- Adjust the oxygen-carrying pressure (0.08MPa), and top oxygen flow rate (1.5L/min), and analysing the gas flow rate (3.2L/min) to the standard values, and check whether there is any air leakage in the head section and gas chamber section.
- The infrared detection cell is preheated for 1 hour and the HF oven is preheated for 30 minutes. Use waste samples to burn 3-5 times to saturate the carbon and sulphur cells.
- Check that the carbon and sulphur pool signal of the carbon and sulphur analyser software is stable and that the pool voltage signal changes to less than 0.001V within 1 minute.

8.8 Brief description of analytical Operations

The CS High-Frequency Infrared Carbon and Sulphur Analyser is designed for the analysis of steel and other materials such as cement, coal, rubber, plastics, soil and other materials. The amount of sample weighed, the type of flux added, and the sensitivity of the instrument vary with the characteristics of the sample material being combusted.

An example of the analysis of steel is illustrated below:

Put the porcelain crucible into the electronic balance after cauterizing treatment, after tare weight, put in the sample, the weight of the sample is generally 0.05-0.04g (according to the nature of the material), and deposit the weight of the sample into the microcomputer by pressing the key, add about 1.5g of flux (the material is different, you may need to add the appropriate amount of pure iron flux or pure tin flux), use the crucible tongs to move the crucible with sample to the crucible tray on the high-frequency induction furnace, start the button 〖Lifting Furnace〗 on the high-frequency furnace, seal the gas circuit, and then the instrument will enter the analysis state. Move the crucible with the specimen to the crucible bracket of the HF induction furnace with crucible tongs, start the button of [lifting furnace] on the HF furnace, seal the gas circuit, point the analysis on the screen with the mouse, and the instrument enters the analysis state.

Note:

1) The crucible must be taken with clean crucible tongs, do not touch it by hand.
2) The instrument reads only the mass number of the sample and should not contain the mass number of the flux.

8.9 Instrument Calibration Process

8.9.1 Channel Parameter Modification

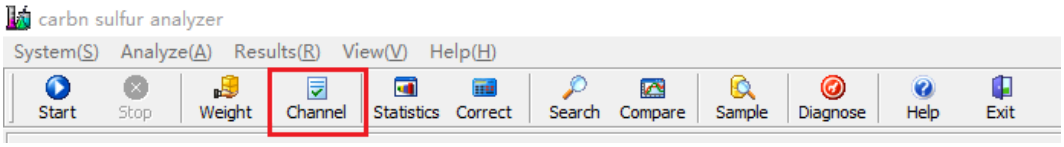

Figure-40

Click "Channel", change the carbon and sulphur coefficient of the currently used channel to "1" and the blank value to "0", and then refresh it in the main interface after confirming the modification.

8.9.2 Weight the sample and Input Weight

After changing the channel, we need to weigh the specimen with the balance according to the nature of the material and press the "**Print**" button  on the balance. Enter the weight of the currently weighed specimen into the software, i.e. the weight shown in Weight 1

If the balance is unable to print the input weight into the software, you can manually enter the current sample weight as follows:

Tap the "**Key Weight**" button on the shortcut bar, or the F2 shortcut on your keyboard.

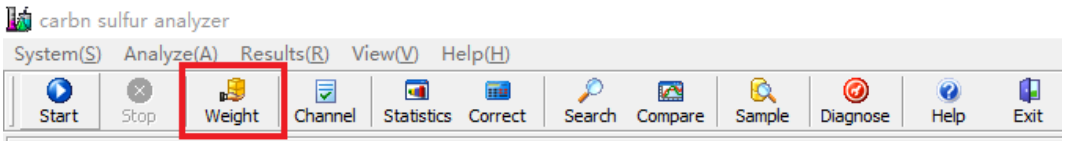

Figure-41

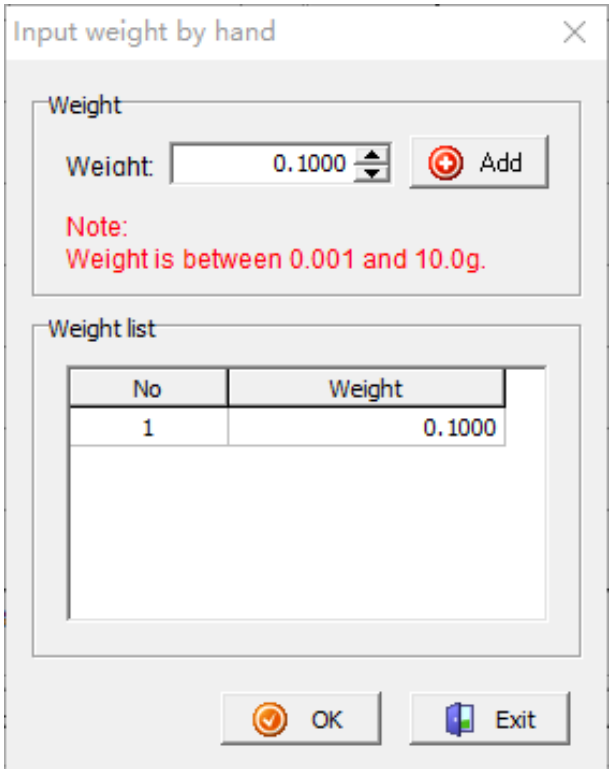

Figure-42

After weighing the appropriate weight of the sample and then the appropriate amount of flux, shake the sample and flux well and place it on the crucible tray, click the lift button to raise the sample and place it in the combustion tube.

8.9.3 Sample Combustion

Click on the software  Start the analysis by pressing the "Start Analysis" button or by clicking the F1 shortcut key on the keyboard. If you need to stop the analysis in the middle of the process, you can press the "**Stop**" button or the F1 shortcut to stop.

8.9.4 Standard Sample Calibration

We obtained three sets of carbon and sulphur data after repeated combustion of three specimens. Further corrections were made based on these three sets of data. This is done as follows:

Click "**Calibrate**" to enter the calibration interface.

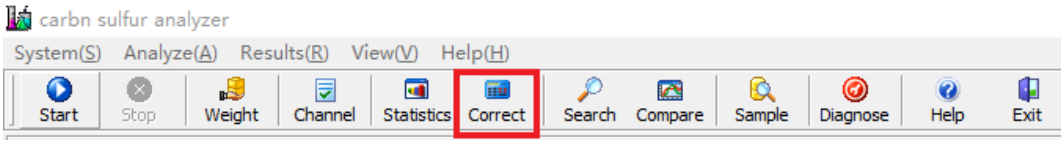

Figure-43

In the calibration interface, select the data of the three samples just tested, tick the two more stable carbon and sulphur data (you can also calibrate the carbon or sulphur, tick alone), and then in the lower left corner of the "**Calibration Carbon**" and "**Calibration Sulphur**" position, respectively, enter the standard value of the standard samples used, click on the lower-left corner of the "calibration" button to confirm that the completion of the calibration.

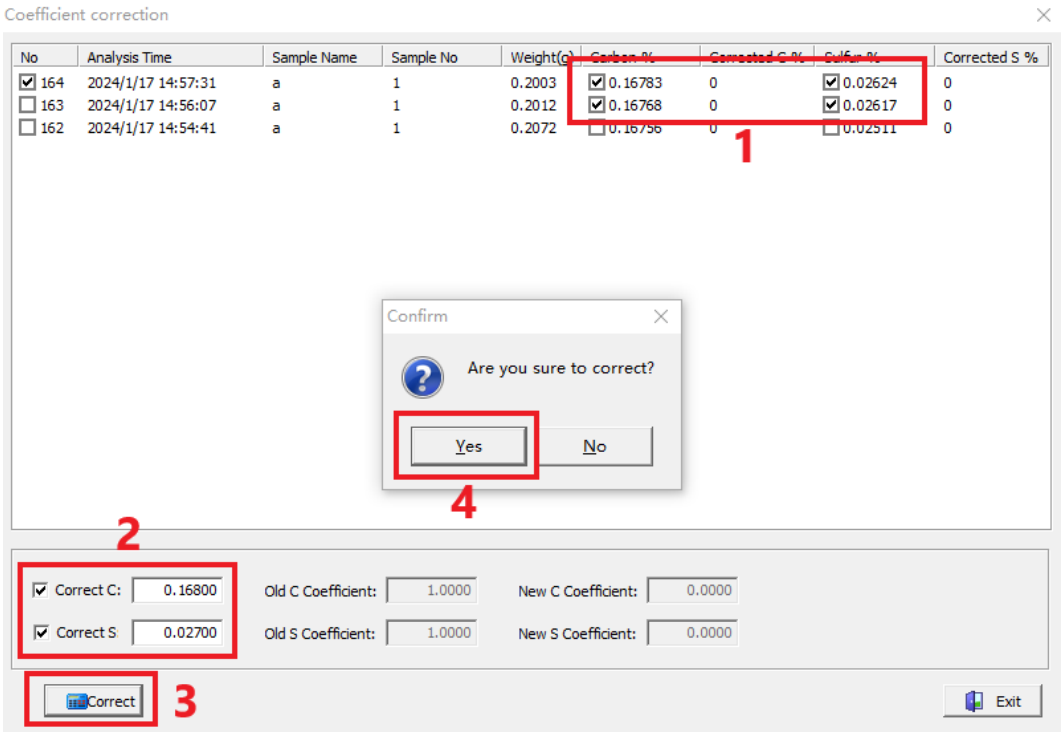

Figure-44

8.9.5 Standard Sample Verification

Re-weigh the standard sample, and carry out a combustion verification, if the data obtained with the standard data of the standard sample is consistent and the instrument calibration is correct, you can carry out the specimen test.

9. Troubleshooting

9.1 Poor Voltage Problem

9.1.1 Unstable pool voltage jumps, fluctuations greater than 0.01 V/min (normal should be less than 0.002 V/min)

- If the carbon and sulphur signal is unstable, it may be that the amplifier board components are damaged. Need to replace the amplifier board.
- If the carbon and sulphur are both unstable, it may be that the motor speed is unstable, you can check if the motor drive voltage is normal and then check the motor drive board and motor. If there is any problem, you need to replace the motor drive board or motor.

9.1.2 Low pool voltage signal, pool voltage less than 1.0000V

The pool voltage is small but jumps steadily because the inside of the gold-plated tube is dirty, and the amplification of the signal is reduced. **Extremely low pool voltage signal, less than 1.000V**

- If the carbon and sulphur have a very low signal, then the light source is not working, check whether there is voltage in the light source and whether the light source is bad. Need to replace the light source.
- Check if the modulating motor is rotating, if the motor is not rotating the pool voltage shows a zero signal. The motor driver board or motor need to be replaced.

9.1.3 No signal for poor voltage, display 0.0000V

- No signal input means that the signal from the lower unit fails to be transmitted to the upper unit, you can first check if the USB is connected properly or if the USB driver is installed correctly. The USB cable needs to be adjusted.
- If the USB connection is normal, it is a problem with the sampling chip of the motherboard. Replacement of the motherboard is required.

9.1.4 Pool Voltage Signal greater than 1.9 Without Variation

The pool voltage signal is too large, and the display is over range. Adjust the amplifier board 50K potentiometer, according to the counterclockwise direction to reduce, until the signal is stable at about 1.5000 can be.

9.2 Combustion Problems.

9.2.1 High-Frequency Furnace doesn't burn

- Check the high-frequency furnace control board: open the software, open the "diagnostic" function, press the digital key "8", and check the control board on the high frequency corresponding to the LED is bright, not bright means that the signal cannot be transmitted, you can check whether the optical fibre is connected to the normal or replaced. Check whether the optical fibre is connected normally or replace it. If the LED is on, it means that the signal has been transmitted, check whether there is DC12V on the two wires connecting the solid-state relay on the control board, if there is no 12V, the control board is bad, and it is necessary to replace the control board. If 12V is normal, it means the control circuit is intact, check the high-frequency circuit part.

- Check high-frequency circuit: high-frequency circuit by the tube as the dominant component, so first check whether the tube works, visual inspection of the tube filament is bright, and powered by the filament transformer, AC6.3V. If normal, check the entire circuit loop whether there is a circuit break, the multimeter can be used to detect the resistance value of the wire-wound resistor should be 5K, if the stop is infinite is a resistor Disconnection.

9.2.2 Analysis doesn't start

Instrument analysis cannot start normally, which means that the upper computer gives instructions to the lower computer cannot be received, it is a communication error, you can check whether the connection of the optical fibre is connected normally and replace the optical fibre. If the optical fibre is intact, then it is a hardware error in the communication part of the host board, and the host board can be replaced.

9.2.3 Burn Fuse When Start Combustion

Burns the fuse when burning because the wiring of the high-frequency circuit part is loose, or the high voltage part is not well insulated resulting in high voltage ignition, causing the insurance to be burned. You can tighten the connection parts of each part of the high-frequency circuit and add a high-voltage sleeve in the high-voltage part to ensure the insulation.

9.2.4 Poor Sealing of Airways

The gas line connector and solenoid valve part of the air leakage will not occur, replace the desiccant or clean the stove head should be checked after the sealing of the gas line, if the leakage occurs can be uniformly coated with vacuum silicone grease each sealing ring to ensure the sealing.

If you notice a rapid drop in the oxygen-carrying pressure, it is a rupture at the ash drainpipe, and you can simply replace the ash drainpipe.

9.3 Common Faults in the Analysis Process

9.3.1 Plate Current not in normal Range (normal 200-600mA)

- Plate current <200mA, indicating that the sample weighing amount is too little less, low combustion power, non-ferromagnetic samples. Can increase the sample weighing amount or increase the amount of flux.
- Plate current > 600mA, indicating that the amount of sample and flux is too much. The amount of sample or flux can be reduced.

9.3.2 Release curve irregularities

- The trailing phenomenon of the peak shape indicates that the sample is weighed too much, the content is too high and difficult to release, and the power is low.
- Releases a double peak, indicating that too much of the high-content sample was weighed.
- Peak time >20″, indicating that the sample is refractory and insufficient oxygen blowing.
- Release time>50″, high content, trailing; large crucible blank; low analytical stream gas.

Description: The role of several accelerants is to enhance the induction effect of the analytical system (Cu, Sn); reduce the melting point of the sample material, and melt completely (Fe); carbon and sulphur solubility is conducive to the release of carbon and sulphur (W, Fe), there is a dilution effect, which can increase the melting point of the sample material to help the release of complete.

9.3.3 Melt shape with bubbles

It indicates that the melt temperature is low (improper choice of flux, etc.); power is low. Appropriate flux can be selected or the sample weighing volume can be reduced.

9.3.4 Poor reproducibility of analytical results

- If the level is too high outside the linear range, reduce the sample weighing volume.
- Content of low blank instability, the crucible should be treated in an oxygen-rich atmosphere; the use of high purity oxygen; appropriate to extend some of the oxygen blowing time; the choice of high purity flux.
- Poor sample handling may clean the sample; resample; bake; and standardise sampling.
- Samples are not homogeneous and can take a large average; more parallel analyses or ask the sending unit to re-sample.
- Flux quality, blanks are unstable and should be selected for blank stabilisation.
- The instrument is not used for a long time, will cause the detector, electronic components moisture or other reasons, the use of standard samples to do experiments to check, and maintenance personnel to cooperate with the inspection or maintenance and repair.

10. Accessories

Standard Accessories

Accessories	Quantity
Main unit	1
High frequency automatic inductive combustion furnace	1
Electric balance	1
Computer	1
Printer	1

Labnics Ltd.
Unit 2D Station House, 1 Pembroke Broadway, Camberley,
Surrey GU15 3XD United Kingdom
Email: info@labnics.com | Website: www.labnics.com