

HCY-20

Nuclear Magnetic Resonance Oil Content Analyzer

User Manual



NINGBO HINOTEK INSTRUMENT CO.,LTD

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Chapter 1 Instrument Hardware

1.1 System Introduction

HCY-20 Nuclear Magnetic Resonance Oil Content Analyzer consists of two parts, one is **Host**, the other is **Magnet**. **Host** contains HF board, A/D sweep board, control board, power, etc; **Magnet** contains permanent magnet, sweep coil, probe, etc. The system structure is shown in figure 1.

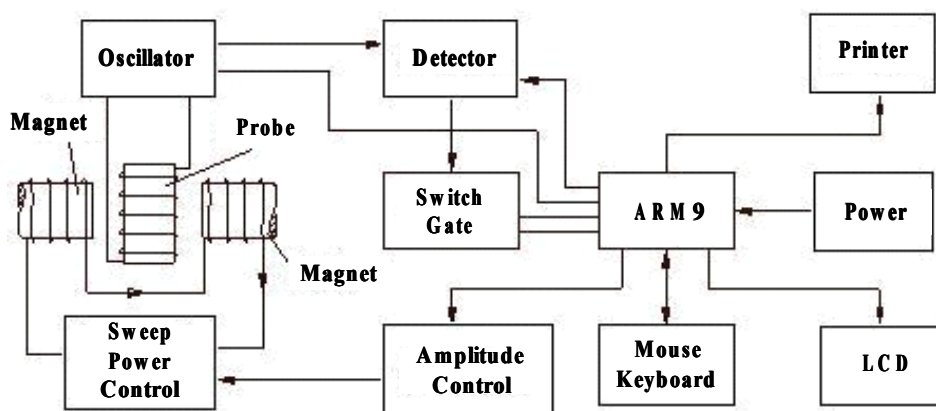


Figure 1 HCY-20 system structure

HCY-20 Nuclear Magnetic Resonance Oil Content Analyzer makes use of NMR (Nuclear Magnetic Resonance) technology, directly measuring the liquid H content to calculate oil content in samples. Under certain permanent magnetic field and RF (radio frequency) magnetic field interaction, energy level of H in material splits into two state: low level energy state and high level energy state. Low level energy state will transit to high energy state once it absorbs power from specific condition RF field, while it will go back to low energy state when condition doesn't satisfy. As long as we control the H transition condition, we control the occurring of transition. During transition, energy will be absorbed or released, we call it resonance. Measuring the amount of H transiting to high level energy state, we are able to calculate the content of H.

Usually the H in samples will be liquid, solid, or both. The required condition for liquid H and solid H resonance is different. All liquid H takes part in resonance in a small range of

external magnetic field variation: about 10^{-5}T , while solid H is in the range about 10^{-3}T , this is shown in figure 2. Making use of it, an electrical switch in instrument is going to cut the signal from solid H and save signal of liquid H, so the signal of resonance almost represents liquid H, it has direct ratio to oil in samples.

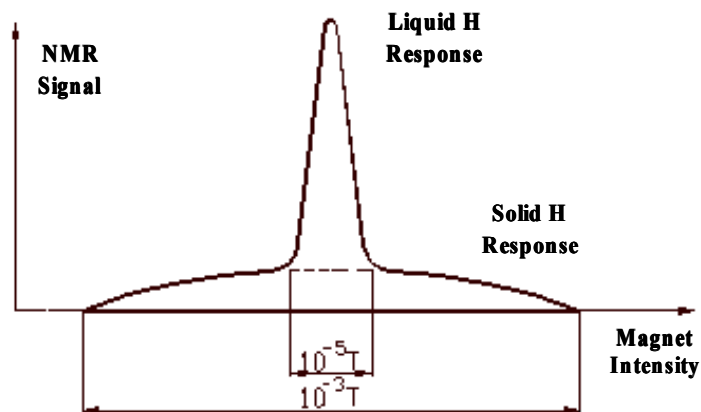


Figure 2 Relationship of NMR and Magnetic field intensity

HCY-20 Nuclear Magnetic Resonance Oil Content Analyzer is able to measure the oil content of the following material: soybean, rapeseed, sesame, corn, cottonseed, peanut, sunflower seed, oil tea seed, tung seed, etc. The process of measuring is fast, accurate, non-destructive. Test result will be displayed on LCD and can be saved in U-disk or printed out from the embedded printer.

HCY-20 consists of two parts:

① **Host**, contains control board, sweep board, LCD, power, etc. It is responsible for NMR signal receiving, processing and displaying.

② **Magnet**, contains permanent magnet, two sweep coils and probe. The uniformity of magnetic field is critical for any NMR process, because better uniformity yields better and stable SNR (signal to noise ratio) of NMR signal.

1.2 Instrument Specification

Spec. is shown in table 1.

Table 1 Spec.

Sample content	40mL
Sample oil content range	0.05% ~ 100%
Measuring precision	±0.2%

Measuring stability	$\pm 0.1\%$
Power	220V \sim 50Hz, $\leq 40W$
Weight	Host $\leq 8Kg$, Magnet $\leq 33Kg$
Operation temperature	-10 $^{\circ}C \sim +40^{\circ}C$

1.3 Instrument Installation

- ① Place on stable wood worktable, be sure that the instrument not be shaking or stroke.
- ② Host should be placed on the right of Magnet with distance about 20cm. Any ferromagnet should not approach to the instrument. Make the environment dry and temperature stable.
- ③ Host connects to Magnet with two cables, one is RF cable (two lines inside, RF), the other is Sweep cable (three lines inside, SCAN). The connectors are located at the rear of the instrument with the label RF and SCAN.
- ④ The power cable is connected from the back of the Host. Before power on, check if the power voltage is in the allowable range. The power for the instrument should be clean, any high power consumption machine is recommended not to shared the same power source with this instrument. If the power voltage fluctuates or overshoots too much, 1000VA precise purified regulated AC power supply is a good choice.

Chapter 2 Instrument Software

2.1 Software Introduction

All the operation of **HCY-20 Nuclear Magnetic Resonance Oil Content Analyzer** is based on the 7 inches LCD. The operation interface is separated into four blocks, they are Control, Status, Wave and Report, which is shown in figure 3.



Figure 3 Software main interface

2.1.1 Control

Control block contains six buttons: Search, Calibrate, Adjust, Measure, Config and Quit.

Search: Searching the current resonance frequency;

Calibrate: Measuring some standard samples in advanced;

Adjust: Fast searching current resonance frequency when the frequency shifts slightly;

Measure: Measuring the samples;

Config: Set the test times, sample duration. Load the config file from U-disk. Figure 4 shows the config dialog.

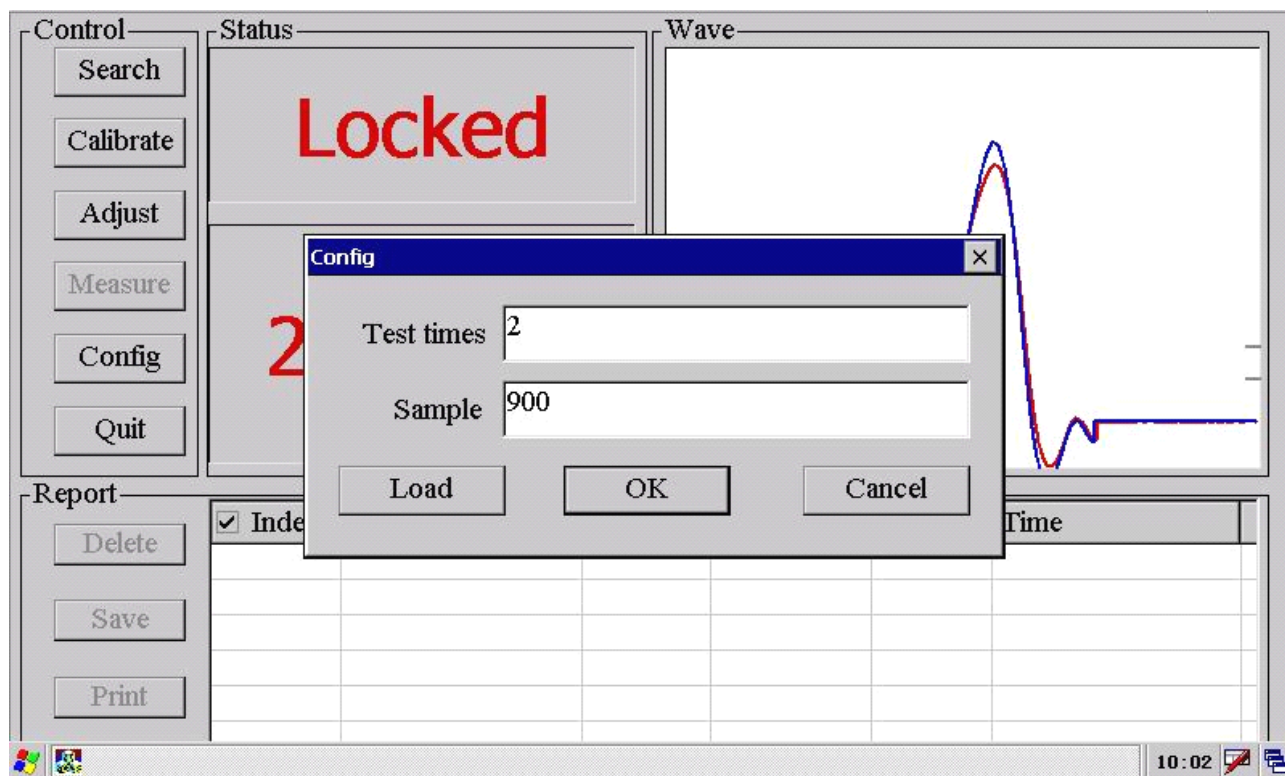


Figure 4 Config

Quit: Terminate the software and require power off manually.

2.1.2 Status

Display the current status of software and report the result of every step.

2.1.3 Wave

Display the NMR signal wave of the current sample.

2.1.4 Report

Display the detailed information of all tests. Buttons Delete, Save, Print are served for Report.

Delete: Choose one or more results in the report with tick, and then click button delete, all the results you choose are gone.

Save: Choose one or more results in the report with tick, and then click button save, all

the results you choose are saved to the file you specified.

Print: Choose one or more results in the report with tick, and then click button save, all the results you choose are printed out from the embedded printer.

2.2 Quick Start

2.2.1 Search

Put the standard pure oil sample into magnet, click button search, the Status block will show information searching and frequency value increasingly sweeping. It will not stop until two lumps appear and overlap. At the same time the status block will display Locked with the locked frequency. Figure 5 shows the searching process, figure 6 shows the result of successful search done. The whole searching usually costs 20 seconds.

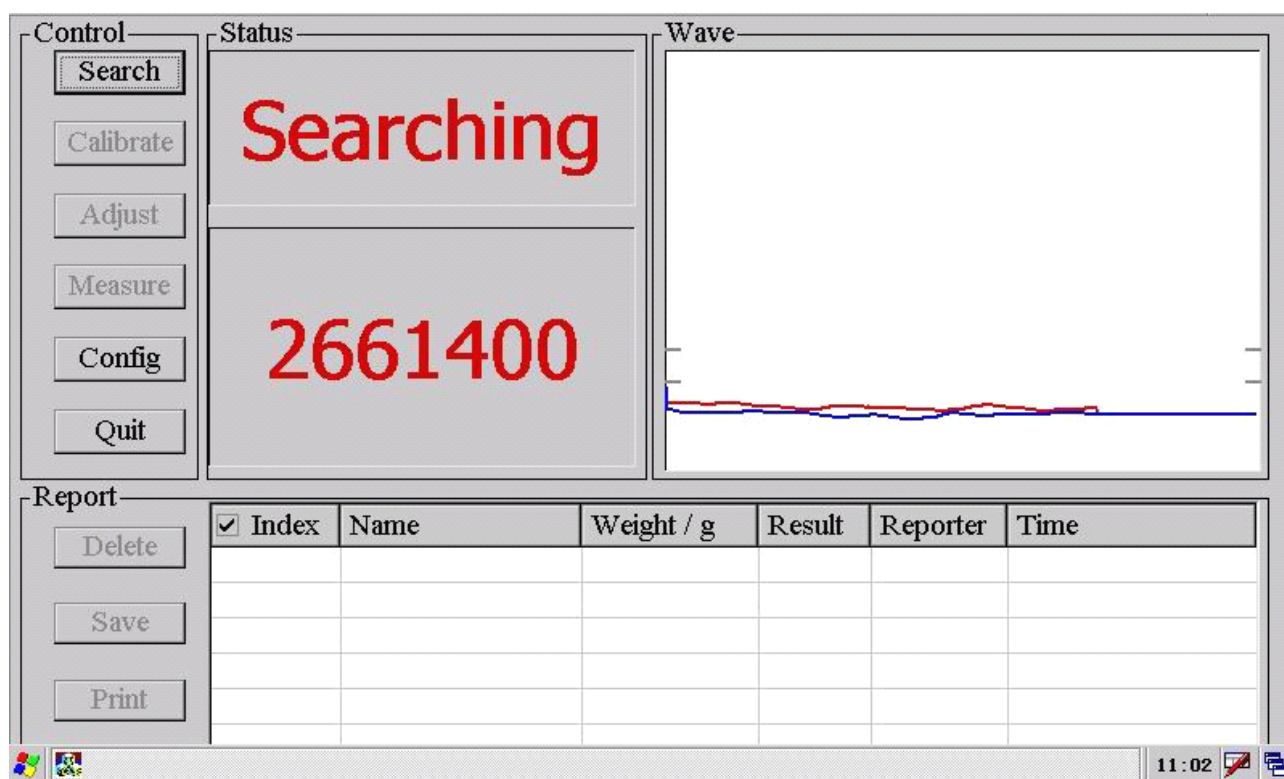


Figure 5 Searching

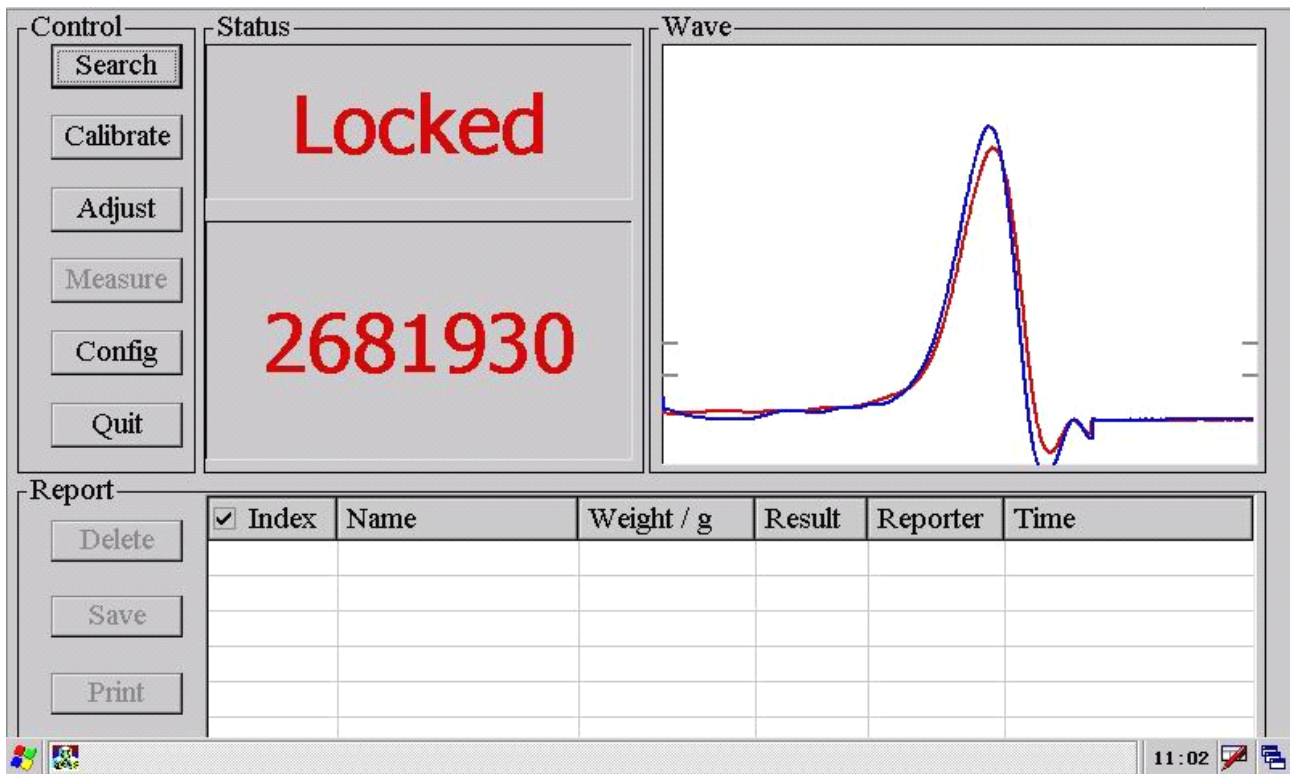


Figure 6 Search done

2.2.2 Calibrate

Calibrate must run after searching done successfully. The following step we are going to list important steps of calibrate with two samples: pure oil and empty.

① Click button Calibrate. A pop window requires entering weight and oil content of the sample;

② The 1st sample we put into magnet is pure oil. Input the corresponding information of it, so weight is the pure oil weight, oil content is 100%. After finish filling the form, click button calibrate in the pop window as shown in figure 7;

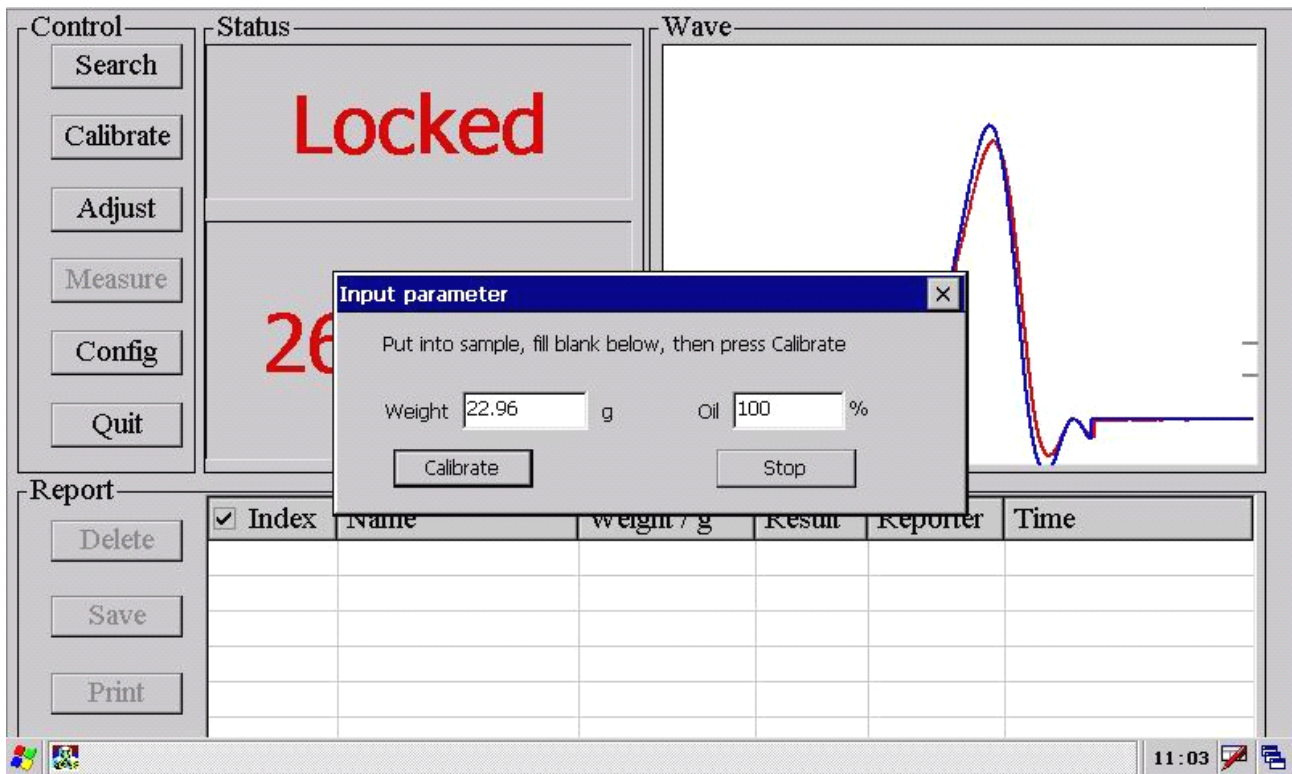


Figure 7 1st sample parameters input

③ The status block displays calibrating. It will takes about 30 seconds;

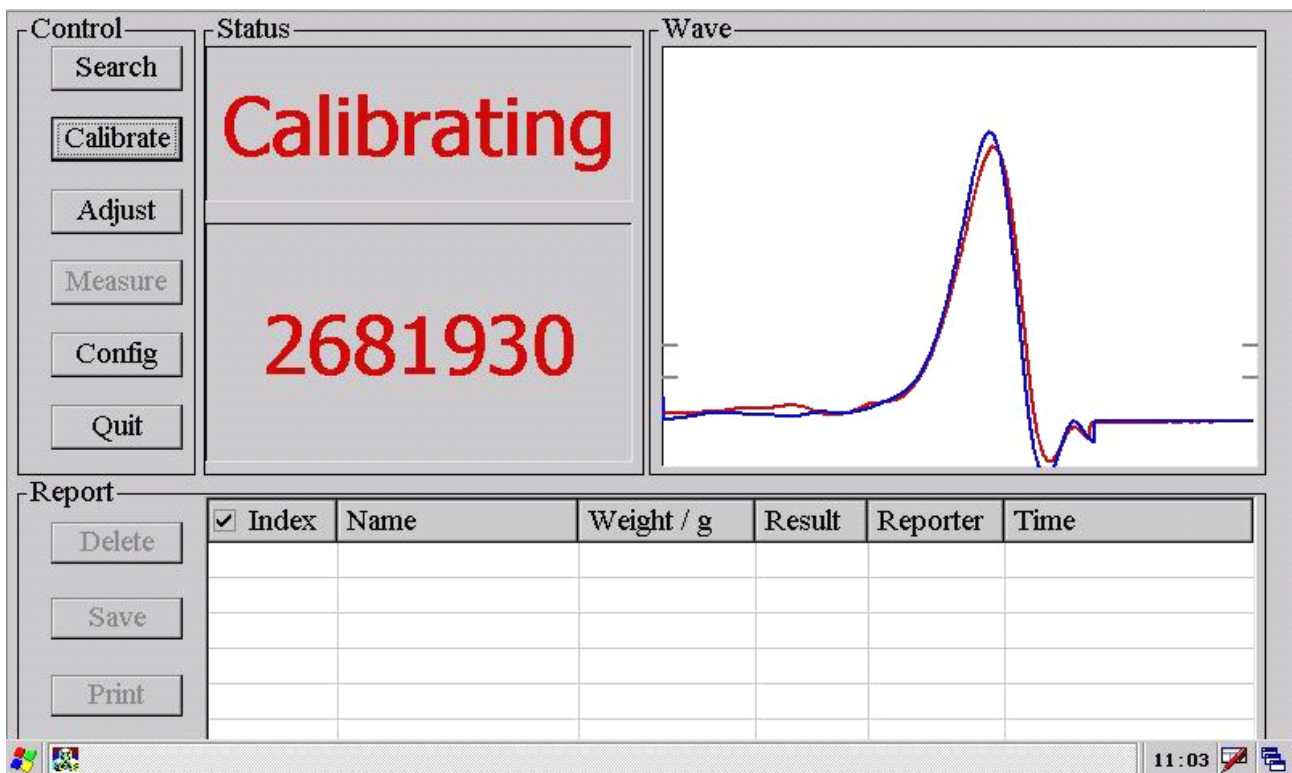


Figure 8 Calibrating

④ The status block shows Done, and then the input parameter window will pop again as shown in figure 9. This time you need to input the next sample parameters for

calibrating;

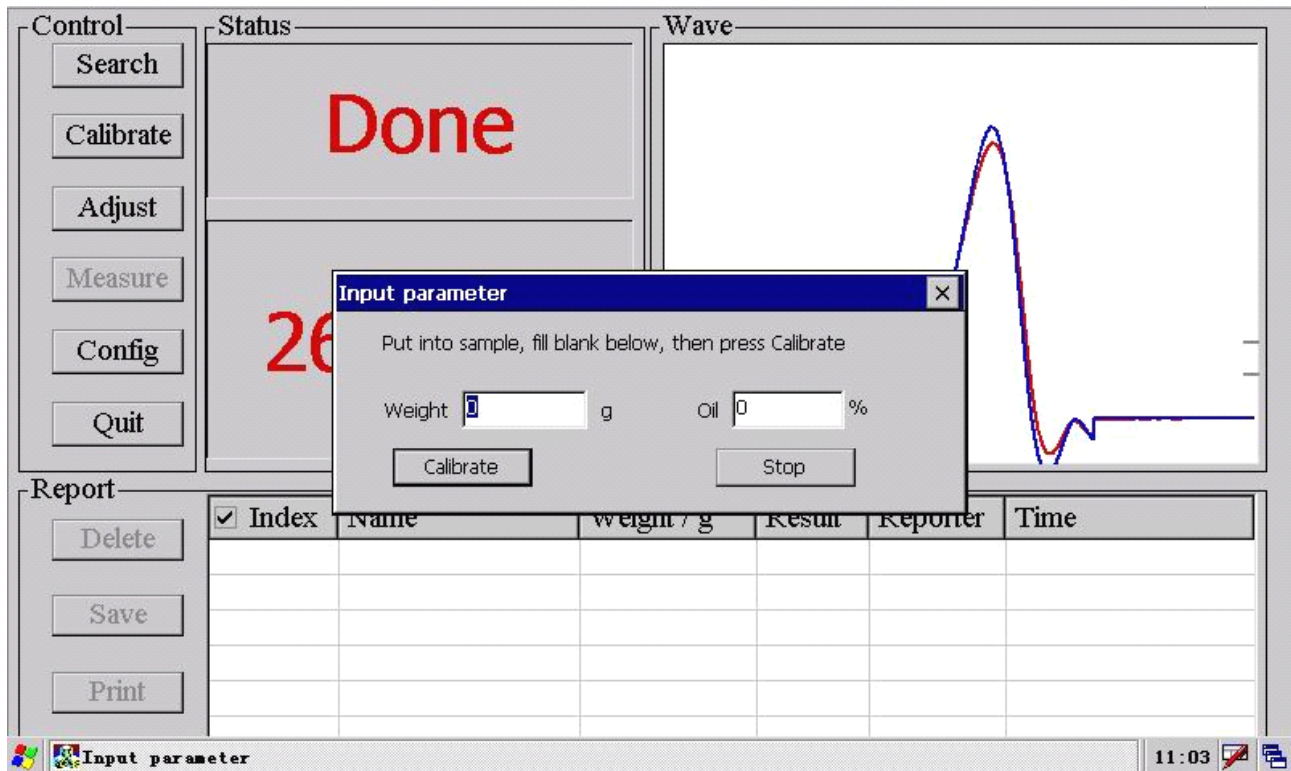


Figure 9 2nd sample parameters input

⑤ Calibrate for the empty sample. Take the pure oil sample out of magnet, input the empty sample weight and oil content which are both 0 as shown in figure 9, and the click button calibrate in pop window;

⑥ After the same process as ③, we see the interface described in figure 9 again. This time we click button stop in pop window to finish the calibrating process with 2 samples: pure oil and empty.

Note: Oil content of pure oil is 100%. Weight of pure oil is the oil exact quality. Oil content and weight of empty are both 0.

2.2.3 Measure

Put the sample you want to measure into magnet, click button measure, you will see a pop up window as shown in figure 10. Input sample name, weight, and operator, and then click button ok, you will see measuring in status block as shown in figure 11. It will take about 30 seconds to see done as well as sample oil content in status block. In report block, detailed measuring information is expanded to the tail of list automatically. Figure 12 shows

the result. If the measuring time we specified in config is larger than 1, press button cancel (During measuring, button measure change to cancel) can stop the measuring process, it will come to an end once the processing measurement done.

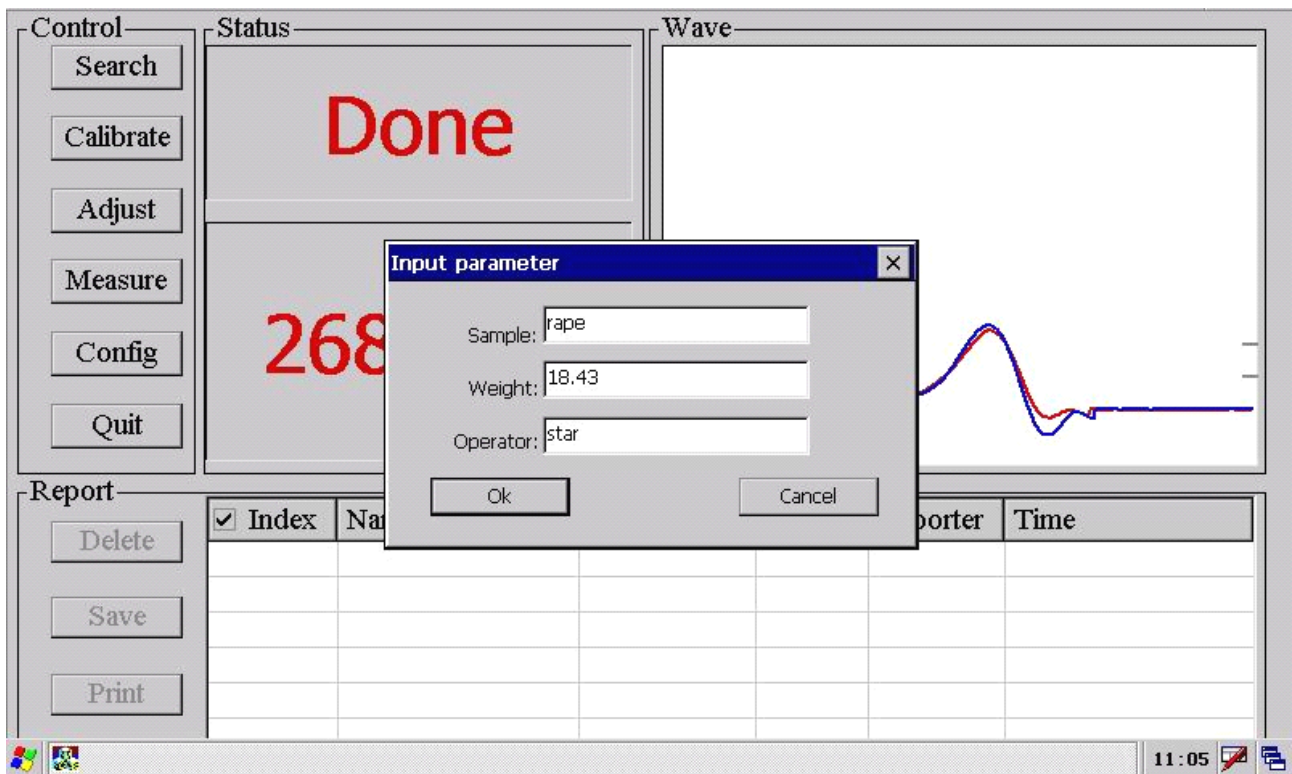


Figure 10 Input measure parameters

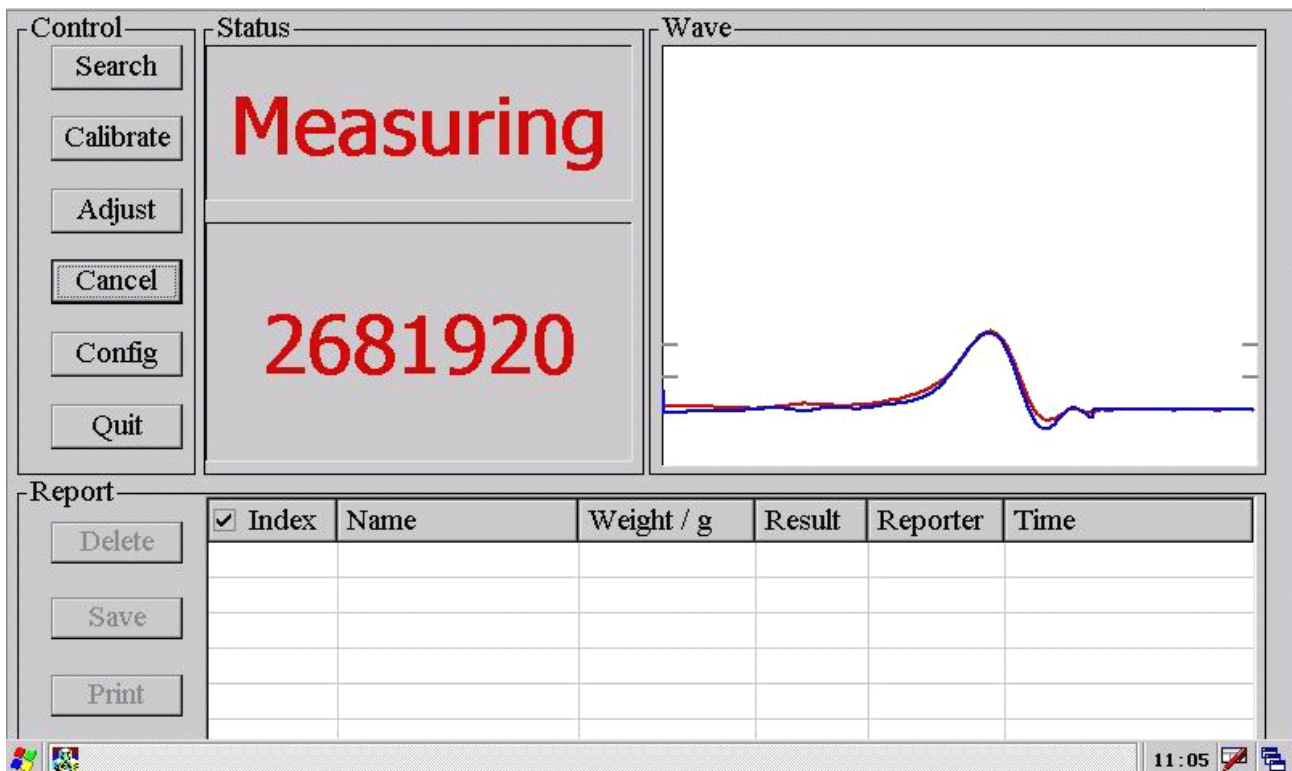


Figure 11 Measuring

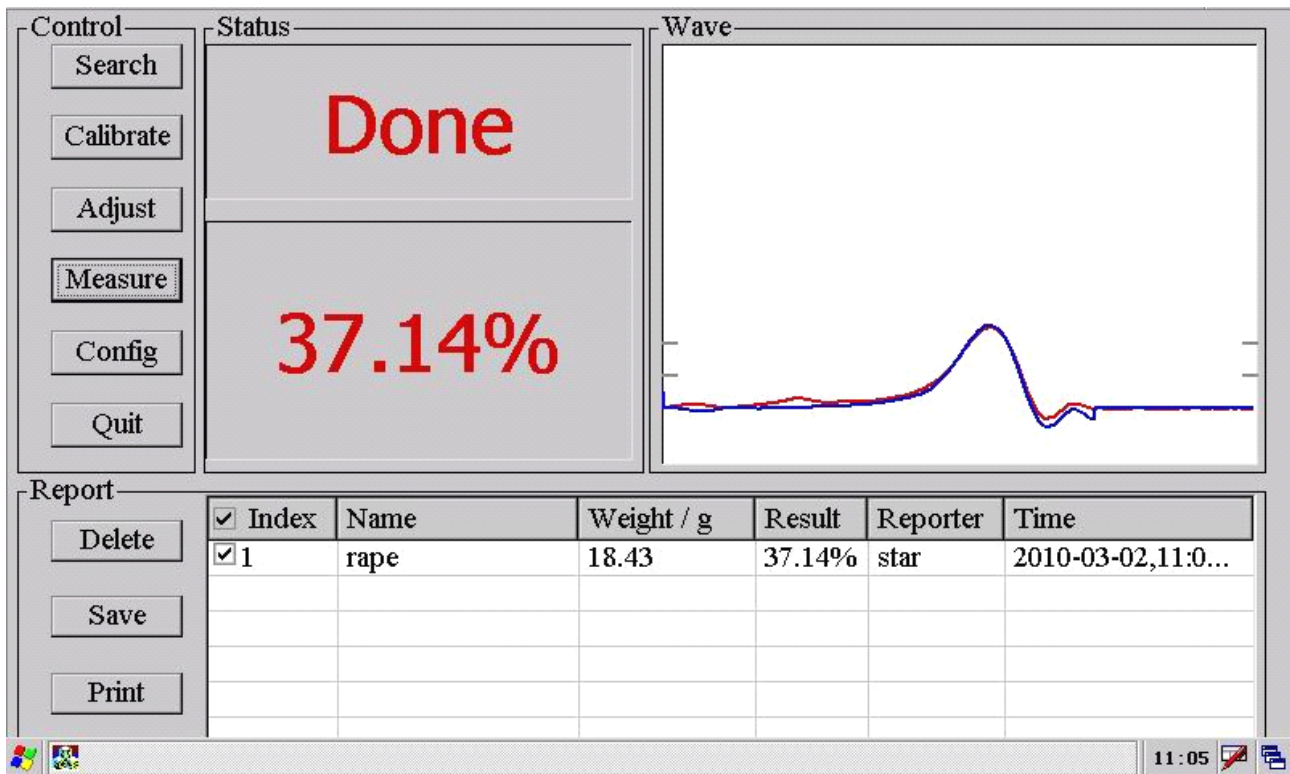


Figure 12 Measure done

When measuring over, we are able to manipulate the results in report block with function: delete, save, and print.

2.2.4 Config

In figure 4, some functions we can achieve in the config sub-window.

① Test times affects the function of measure, it defines the times sequent measuring. Normal this value is 1, the measure will only execute once. If the user needs more sequent results to handle, set the value as you want.

② Sample duration controls the duration of each time measure and calibrate. The larger value consumes more time for calibrate and measure, the result will be more stable. Value 900 corresponds to 35 seconds in each time running. Also 900 is the optimal value for most cases. So it is not recommended to modify. While in some low oil content (less than 5%) measurements, increasing this value yields better result. In such case, customer may modify it under direction from factory application engineer.

③ Load backup can restore the default setting of the system, customer should plus the U-disk associated with the machine into USB port in the front panel of Host, and then

click button load backup, it works. **This function must be used under the direction of factory application engineer.**

2.3 Result handling

2.3.1 Delete

Choose one or more rows of result in report block, “√” indicates being chosen, click button delete, a confirmation window pops up, click button confirm and results chosen will be deleted. It is shown in figure 13.

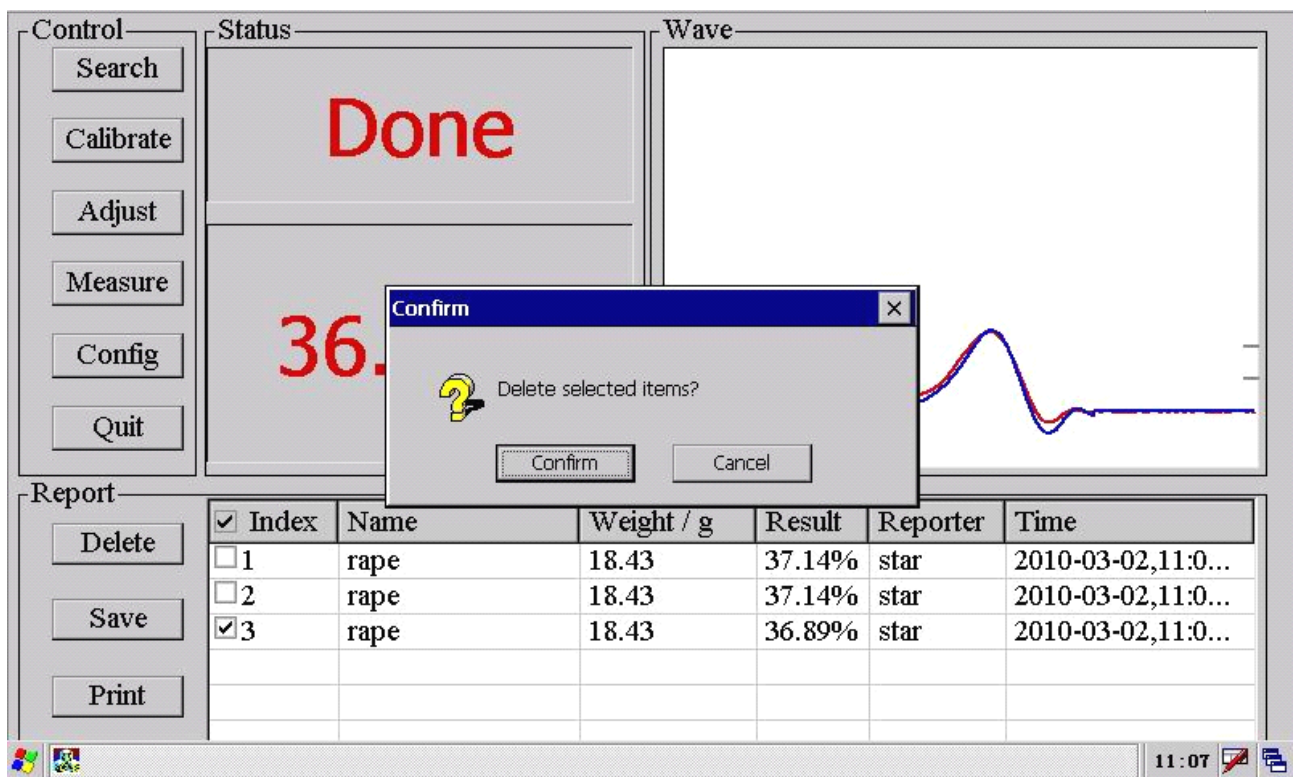


Figure 13 Delete

2.3.2 Save

Choose one or more rows of result in report block, “√” indicates being chosen, click button save, a window for save file path pops up, you can modify the name and path, the default name is string result_ combines date and time of the system clock. The file is saved in excel format. Click button OK, you get the result file in the place you want. This is shown in figure 14.

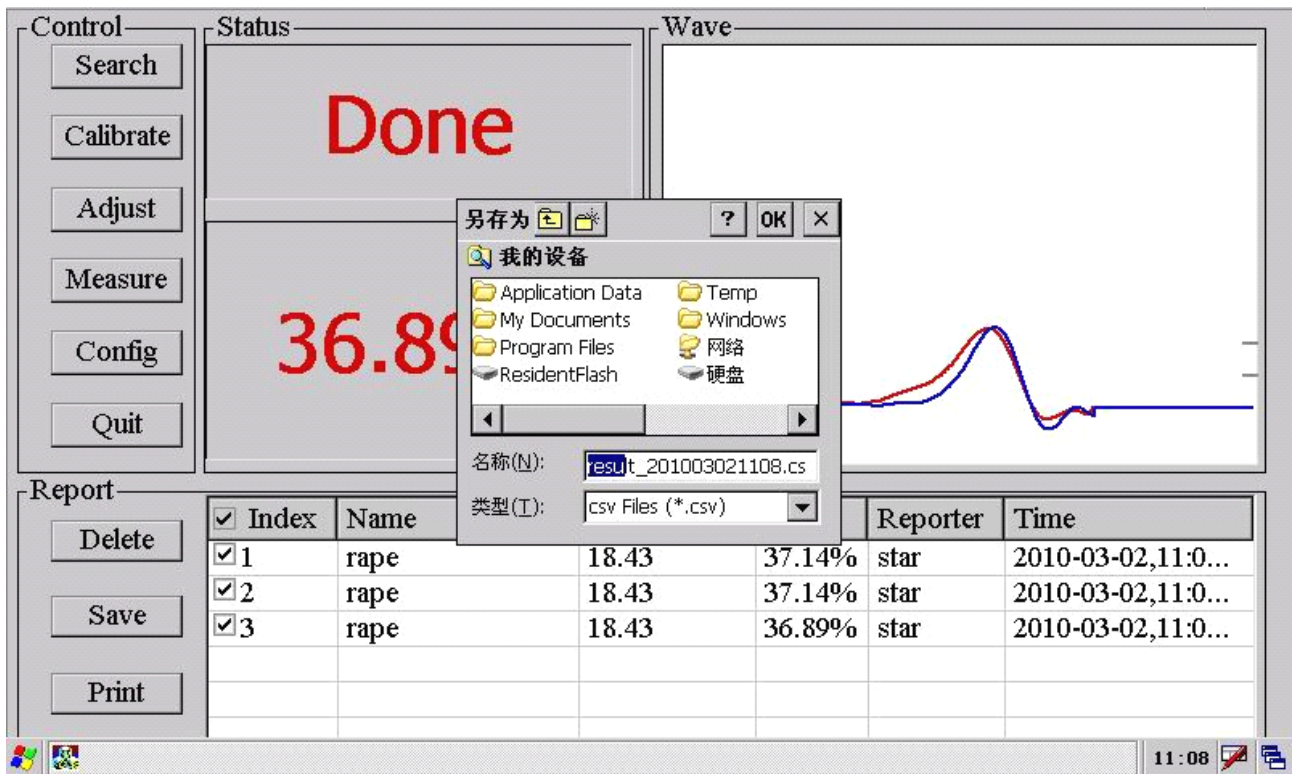


Figure 14 Save

2.3.3 Print

Choose one or more rows of result in report block, “√” indicates being chosen, click button print, a confirmation window pops up, click button confirm and results chosen will be printed out from the embedded printer. It is shown in figure 15.

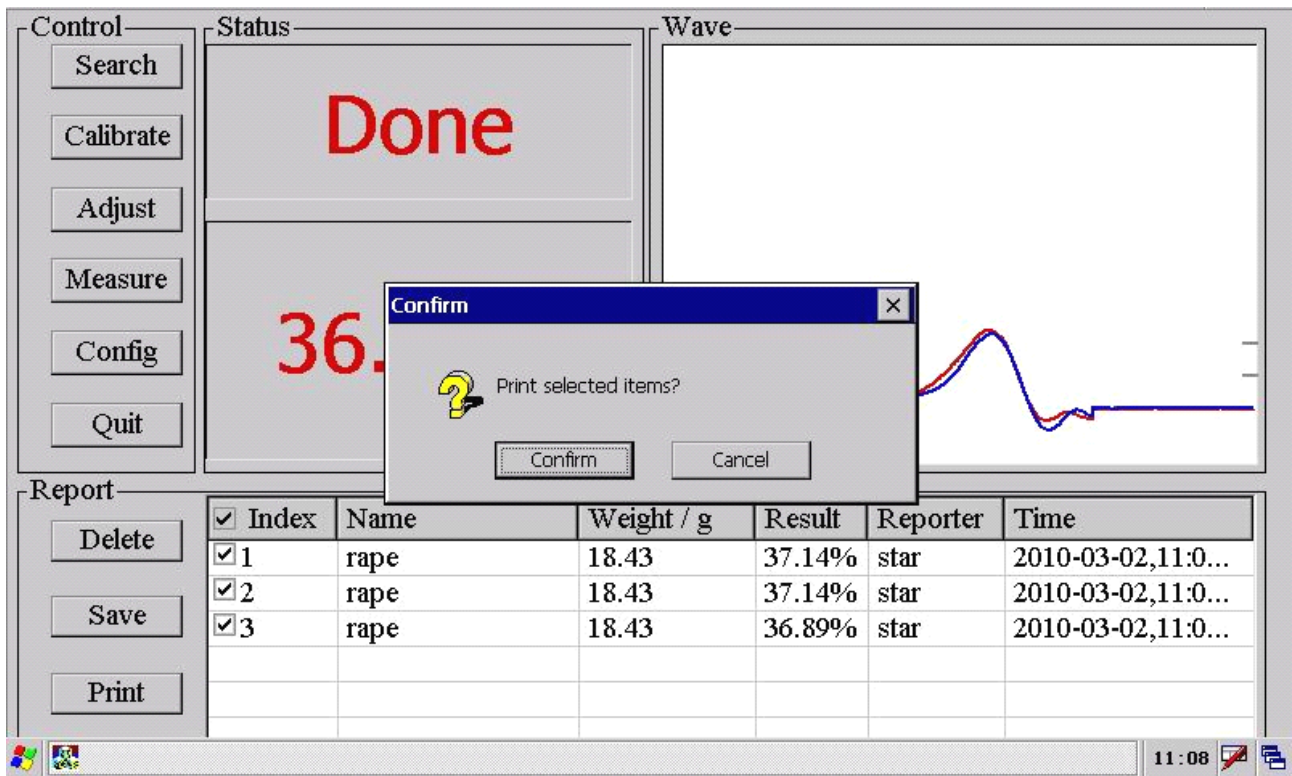


Figure 15 Print

Chapter 3 Sample Measure

3.1 Appliance Preparation

- ① Power on, pre-heats the system for about 30 minutes.
- ② Some appliances for measurement are listed in table 2.

Table 2 Appliances

#	Appliance	Note
1	Balance	Accurate better than 0.001g
2	Oven	Pre-heat to 130°C
3	Desiccators	Double , with moistureproof silica gel inside
4	Small beaker	Dry and clean
5	Thin glass stick	Longer than 180mm, dry and clean
6	Weighing disk	Diameter 75mm , several , dry and clean
7	Special test tube	Ten, dry and clean

3.2 Standard Sample Preparation

3.2.1 Pure Oil Standard Sample Preparation

Pure oil for standard sample is recommended to distill from the same kind crop that is ready to be measured. The water content and impurity of the pure oil should be less essential oil level 2. The standard oil sample should be change per year.

① Fill about 50g pure oil into the small beaker. Put the beaker into oven with temperature 130°C, after 1.5h place the beaker with oil into desiccators and wait until it cool down to room temperature. And then weigh the thin glass stick and beaker with oil together, we get the result mark M_1 , reserving 3 digits after the decimal point.

② Fill the special tube with pure oil in small beaker by thin glass stick slowly, it will be

enough until the oil reaches 2~3mm below reticle of the tube. **(Attention: Oil should not drop onto the inner wall of tube above the reticle while filling, the outer wall of tube should be clean without any oil).** After filling done, plug the tube tightly, seal the plug and tube with wax, it is good for long time use. Put the thin glass stick and beaker with spare oil into balance to weigh. This time we get a result mark M_2 , also reserving 3 digits after the decimal point.

③ M_1 minus M_2 , the result is the weight of pure oil inside the tube, write it down on the tab and stick on the outer wall of tube. We call this method decreasing weighing.

3.2.2 Oil Plants Standard Sample Preparation

We should choose the same kind representative crop of this year when make the standard sample from oil plants with known oil content. The oil content is for crop without any water. This kind of standard sample should be replaced every 6 months.

① Take pure seed sample about 30g, fill it into weighing disk. Put the weighing disk into oven with temperature 130°C , after 1.5h place the weighing disk into desiccators and wait until it cool down to room temperature. And then weigh the weighing disk, we get the result mark M_1 , reserving 3 digits after the decimal point.

② Put the seed sample processed by step ① into special tube. The amount should reaches 2~3mm below reticle of the tube. **(Attention: oil seed in powdered state should not stick onto the inner wall of the tube when filling)** After filling done, plug the tube tightly, seal the plug and tube with wax. The tube should store in desiccators when not to be used. Put the weighing disk with the spare oil seed into balance to weigh. This time we get a result mark M_2 , also reserving 3 digits after the decimal point.

③ M_1 minus M_2 , the result is the weight of pure oil seed inside the tube. And then calculate the weight of pure oil inside the oil seed with the formula:

$$(\text{Weight of pure oil}) = (\text{Oil content}) * (\text{Weight of oil seed})$$

Write the weight of pure oil down on the tab and stick on the outer wall of tube.

3.3 Sample Preparation

① Sample preparation is the same as oil plants standard sample preparation described in 3.2.2.

② Take representative sample about 30g, and fill it into the tube until reaching 2~3mm below the reticle.

③ The sample should be drying until its weight doesn't change any more. Dry the samples that do not need to keep vigor under 130°C for 1~2h reaching stable weight. For some samples with small granularity the drying duration could be shorten, while for the large size sample the drying duration could be extended. Some samples contain volatile can be dried under 105°C. Dry the samples that need to keep vigor under 60 °C until stable weight.

3.4 Operation Steps

① Search. Put the pure oil standard sample into magnet, click button search and wait until seeing 2 lumps overlap and status block displaying locked.

② Calibrate. Click button calibrate, input the weight and oil content of the standard sample in the pop-up window, also place the corresponding tube with standard sample into magnet, and then click button calibrate in pop-up window. Wait until this time calibration done, you will see the pop-up window again. As the same process, input the next sample parameters and click button calibrate, do not forget to exchange the standard sample in the magnet. Calibrate as many standard samples as you need. Two samples are the base requirement. Click button stop when you feel samples for calibration are enough. **Note: Pure oil and empty are the most common standard samples for calibration.**

③ Measure, put the sample into magnet, click button measure, input parameters in the pop-up window and click button Ok. Message measuring is shown in status block. Wait until the process done. You will see the result in the status block and the report block.

④ Save or print the result. Choose the result you want in the report block by “√”, click

button print or save to manipulate the results.

3.5 Attention

- ① Place on stable wood worktable, be sure that the instrument not be shaking or stroke.
- ② Any ferromagnet such as screwdriver, spanner, etc. should not approach to the instrument. Mechanical watch should not be worn during operation.
- ③ Make the environment dry and temperature stable.
- ④ Use special tubes which are accessories of instrument for experiment.
- ⑤ During operation. Do not touch the cables connected from host to magnet.
- ⑥ In order to keep the accurate of measurement, usually calibration should be repeated every 4h. It should be more often when temperature changes rapidly.
- ⑦ Make sure the power supply is good for the instrument.
- ⑧ When instrument idle, power it on for 2h every half month.

3.6 Failure And Maintenance

Table 3 Failure and maintenance

#	Failure	Maintenance
1	The light indicating power status inside power switch is off when power on. LCD is black when power on.	1 Check if the power cable is correctly connected. 2 Check if the power supply is in the range that the instrument required.
2	Software is running, but in wave block, no lump NMR signal	1 Check if the oil contained sample in the magnet. 2 Click button search to check if the lump NMR signal appear. 3 Check if the two cables connected

		between host and magnet is OK.
3	The wave of NMR signal or the measuring result is unstable.	<p>1 Check the power supply is in the range of 220VAC±10%.</p> <p>2 Check if there is any interference such as high power RF amplifier, electrical welding machine, etc. near the instrument.</p> <p>3 If the power voltage fluctuates or overshoots too much, 1000VA precise purified regulated AC power supply is a good choice.</p>

Do not touch the internal circuits of the instrument at any time. Call the factory application engineer once you are still unable to solve the problems after following the instructions in table 3.

Appendix

Package BOM

#	Name	Number
1	HCY-20 Host	1
2	HCY-20 Magnet	1
3	250V 5A power cable	1
4	40ml special tubes	10
5	250V 1A or1.5A fuse	5
6	RF cable	1
7	SCAN cable	1
8	User manual	1

Optional accessories

1	Printer	RD thermal printer
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Warranty Card

User Name	
User Address	
Phone	
Postal Code	
Item	Nuclear Magnetic Resonance Oil Content Analyzer
Item code	HCY-20
Purchase Date	
Purchase Address	
Warranty card number	

(Please cut it down following the broken line and send back to our company)

Warranty Register Card

User Name	
User Address	
Purchase Date	
Item code	

Dear customer,

Sincerely thank for choosing our HCY-20 Nuclear Magnetic Resonance Oil Content Analyzer.

We hope it will bring you convenience.

The following are our promises:

1 Our company endeavors to provide customer with replacement warranty for any product purchased within 1 year from the data of purchase.

2 Outside the 1 year period warranty, it is at our company's discretion to credit, replace, exchange or repair the faulty product.

3 Product damage by accident or unwise use is not in our warranty policy for free.

4 The following accessories are not in the range of free warranty: user manual, power cable, special tube, fuse, optional accessories.

5 Do not disassembly the product without our allowance, or this product is not in the range of free warranty.

6 Please contact us if you have any other questions.