Air Pollution and Control
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Lecture 59
Indoor Air Quality Assessment Using Multi Gas Monitor

Hello friends. So, these days we are discussing about practical aspects or laboratory based measurements of air quality. So, we have already discussed how to measure PM_{10}, $PM_{2.5}$ even how to carry out stack mon itoring, today we will see how to assess the indoor air quality using multi gas monitor because nowadays, indoor air quality is as important as ambient air quality because most of the time we work in the indoors and especially during corona period everyone was housed in their premises and inside their houses, whatever environment was there. So, micro environments air quality has also affected our health issues or other issues.

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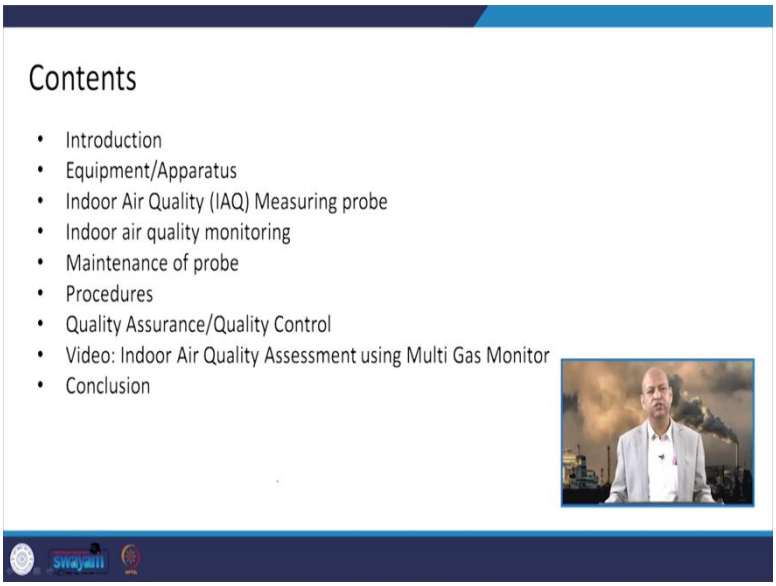

So, if we talk about indoor air quality and assessment of indoor air quality using multi gas monitor, then we will look into the introductory part then what are the equipment or apparatus which are used for indoor air quality assessment**.** Then, like this is particularly based on probe**,** sensor based measurements.

So, we will discuss about the probe also and how to carry out monitoring then how to maintain the probe so that there is no error in the measurements, what is the procedure we follow**,** then how to control the quality or how to asssure the quality. Then we will see the video to operate this multi gas monitor and lastly we will conclude.

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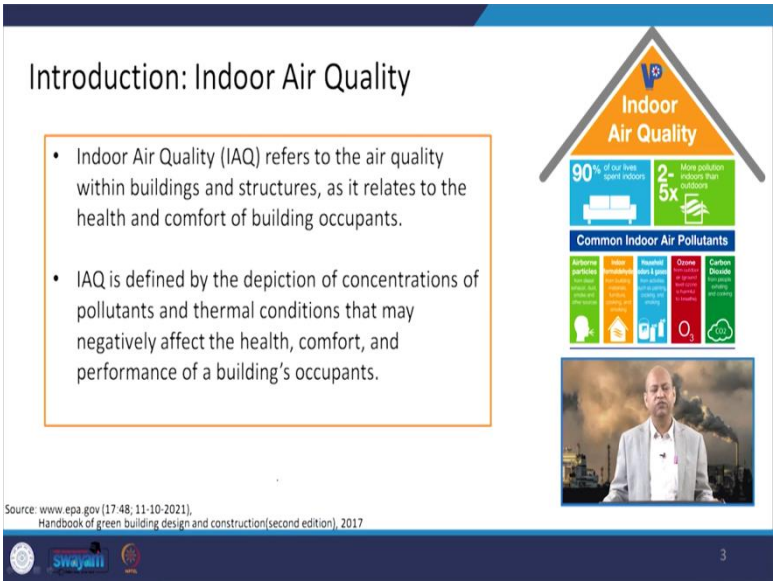

So, as you know indoor air quality is very important because there are several sources inside the micro environments where we live and they can contribute to deterioration of air quality which we are surrounded with and they can also cause certain health issues or they can affect our comfort level. So, we should monitor the indoor air quality also.

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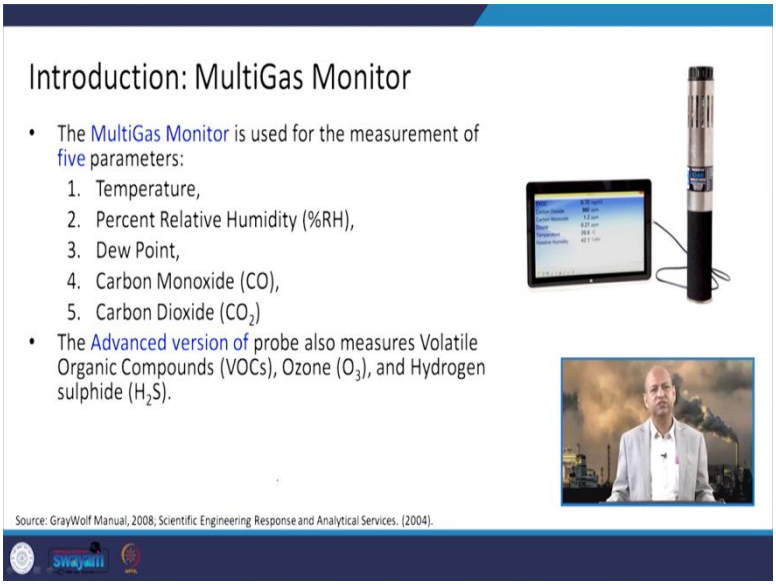

Well if we use the multi gas monitor, so, multi gas monitor is basically sensor based monitor of different gases and it can monitor five parameters like temperature or percent relative humidity then the dew point or carbon monoxide and carbon dioxide. But there are some advanced probes also which can also monitor additional three compounds like VOCs volatile

organic compound, ozone and hydrogen sulphide. So, these three can be added. So, total eight parameters can be measured by multi gas monitor.

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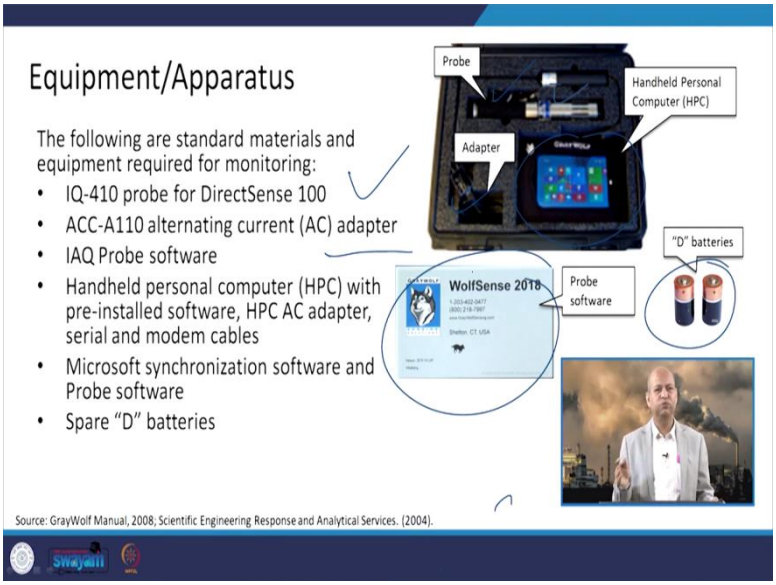

Well when we talk about the equipment means different parts or components of the instrument then we can see here one is probe and then this is handheld personal computer HPC and adapter is there so that you can directly use with AC otherwise batteries we can use for running this probe based monitoring. So, this is the sensor based monitoring equipments and this is IQ 410 probe which is used for the direct sense of hundred. It is known as per their parameters handling.

Then AC adapter is there as we have seen and then software this is the software which comes with the instrument basically this is WolfSense 2018 version and then Microsoft synchronization software is also needed the along with the probe software basically so that we can transfer data and we can deal with the data analysis.

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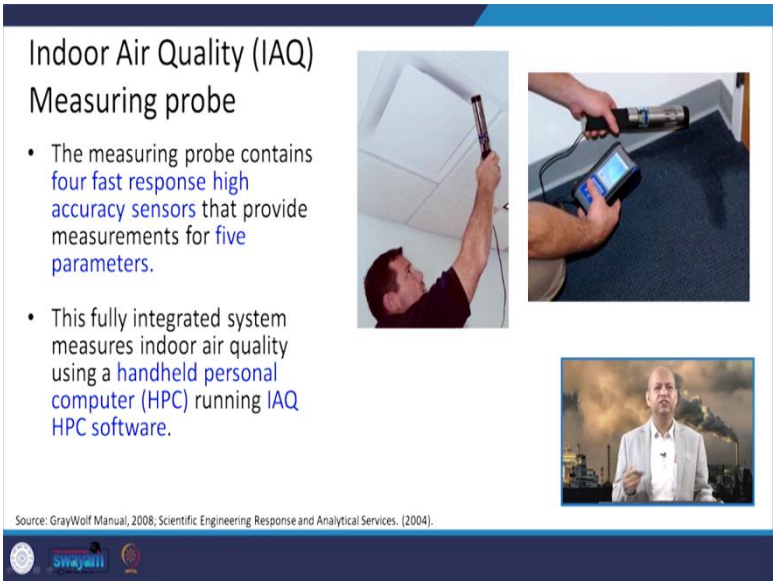

So, if we talk about how to use this probe or sensor based equipment, so anywhere indoor environment, you can take this probe and keep there for certain time. So, it has certain reactions and then it can give the reading of those particular components whether it is gasconcentration or humidity or temperature etc plus it can record the data into this HPC handheld personal computer.

So, from there we can transfer to the desktop computer and we keep this probe for certain period because otherwise there is a variation in the reading and consequently we can take three or four readings and then we can take the average of it.

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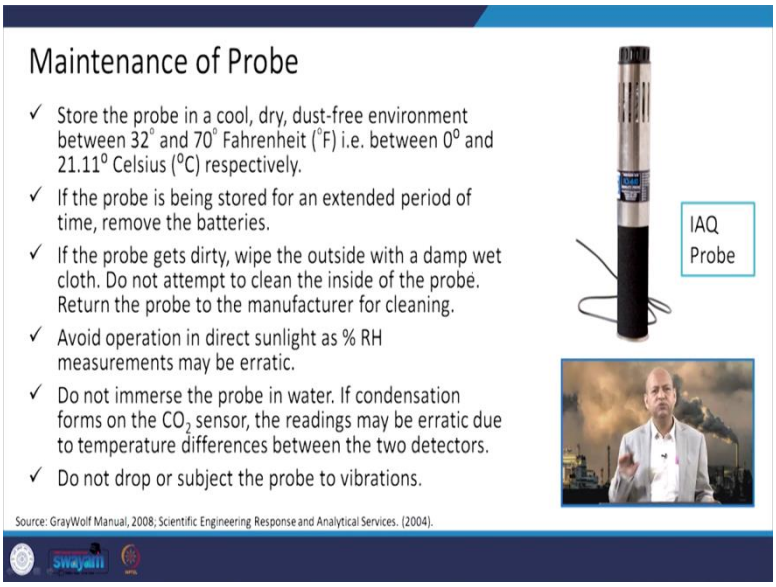

Then, how to maintain or what is the requirement of the maintenance of the probe so that it gives better reading or reliable reading and does not give us the erroneous readings. First of all, we need to store those probes or sensors in a cool, dry and dust free environment the temperature should be less than around 21 degrees Celsius, 21.11 or so.

Then if the probe is being stored for an extended period then we should remove the batteries otherwise it can damage its functioning. If the probe gets dirty then we have to clean it, but it should be cleaned by damp wet cloth only, it should not be attempted to clean from the inside otherwise it may get damaged. So, better give it to the manufacturer or their agents they can clean it properly following the proper protocol and they can give it back to you otherwise, just clean from outside using damp wet cloth.

Also we need to avoid operating this sensor in direct sunlight because otherwise it will influence the relative humidity reading those measurements may be very erratic in that case and we should not immerse this probe into water otherwise it will be damaged and if there is some condensation formation, then on the CO_2 sensor especially, the readings may be very erratic it may give different readings of the temperature as well as those sensor based readings.

So, we need to keep it safe basically, and we should not also drop it, it should not be come across some vibrations otherwise, some damage maybe. So should keep it very safely otherwise readings may not be reliable.

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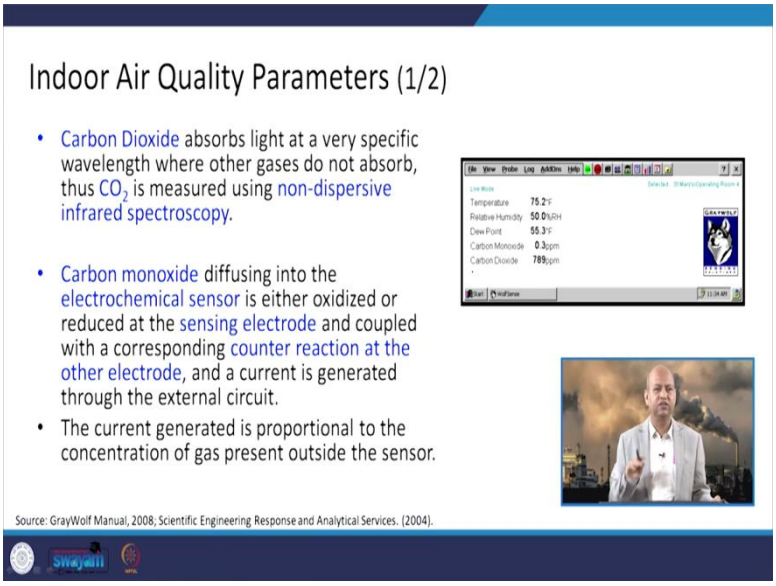

Well, so, how to do the monitoring basically like carbon dioxide and we know that carbon dioxide absorbs light at a very specific wavelength, where other gases do not absorb in that

particular wavelength. So, the CO_2 measurement is based on non-dispersive infrared spectroscopy in this particular equipment, but on the other hand like carbon monoxide, so, the diffusing of the carbon monoxide in to this electrochemical sensor is either oxidized or reduced like using that the sensing electrodes and then it can coupled with the corresponding outer reaction at the other electrode.

So, a current is generated basically at the two ends. So, according to that current generation and flow the proportional amount is the carbon monoxide concentration. So, that relationship is there and the sensor gives the reading based on that particular activity.

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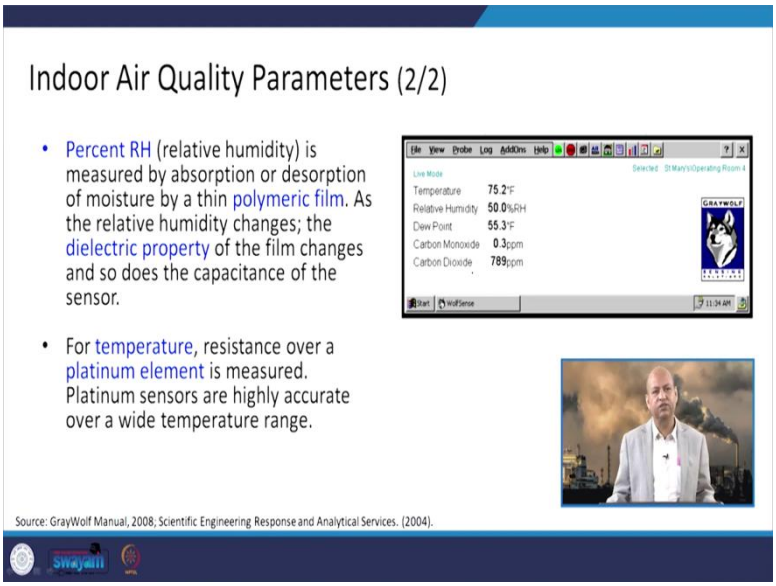

If we talk about like percent relative humidity, so, it is measured by either absorption or desorption methodology of the moisture by a thin polymeric film. So, the relative humidity changes the, this dielectric property of the film also changes. So, according the variation comes in concentration are measured. For temperature basically we use the platinum element which is quite robust to give readings about the temperature. So, this is the way different parameters are used.

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Procedures

❖ **Powering Up and Installation of Software**

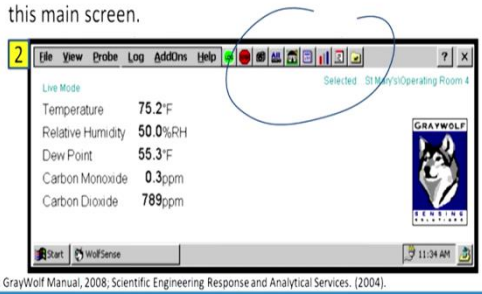
- The HPC operates both on battery and on electricity. The probe can be used with two "D" cell batteries or with an AC adapter.
- Install the Microsoft synchronization software (Windows ActiveSync) on your desktop PC. The HPC comes pre-installed with the IAQ software. When prompted, connect the HPC to the desktop with the serial cable.
- Install the Probe software from the CD-ROM. If the CD doesn't run automatically, run Setup.exe from the PC Start menu.

Source: GrayWolf Manual, 2008, Scientific Engineering Response and Analytical Services. (2004).

Procedures

❖ **Navigating in HPC**

1. Double click on the software logo on the HPC.
2. The user interface with the toolbar buttons and pull-down menus are shown below. All functions are performed from this main screen.

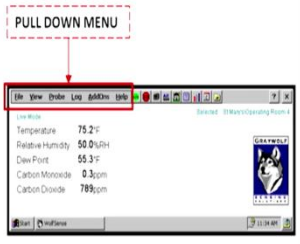


Source: GrayWolf Manual, 2008, Scientific Engineering Response and Analytical Services. (2004).

Procedures

➢ **PULL DOWN MENUS (1/2)**

- **File**: Manages stored files. *Open*, Notebook, Copy to Clipboard and then *export* to Excel or Word, E-mail Location files from the HPC,
- **View**: View Readings, Details, or Statistics for live readings. *View Location* where readings have been logged. *View All* will display all measurement parameters. Change *Units* of Measure.
- **Probe**: View information about the probe or to Calibrate the probe. View *Active Cal* for probe calibration data. *Detect* PCMA/Port Probes.



Source: GrayWolf Manual, 2008, Scientific Engineering Response and Analytical Services. (2004).

Then we need to take this data to this HPC it goes through software and from HPC to the desktop computer and if you look into this procedure, like the software gives different kinds of Windows. So, for example, it gives this toolbar button toolbar button and the pull down button also. So, this has different kinds of buttons where we can play with it to know what kind of parameters we are dealing with like pull down button, this pulldown menu has like file, view, probe similar to MS Office software as you know like Windows Excel etc.

So, file can be used for management of different files to open it or to export the file in terms of Excel or Word or whatever we need and whatever it applies to then view give the readings details and a statistics of those data which we have collected and probe gives like whether it is active or it needs to be calibrated. So, the probe button is used for that particular purpose.

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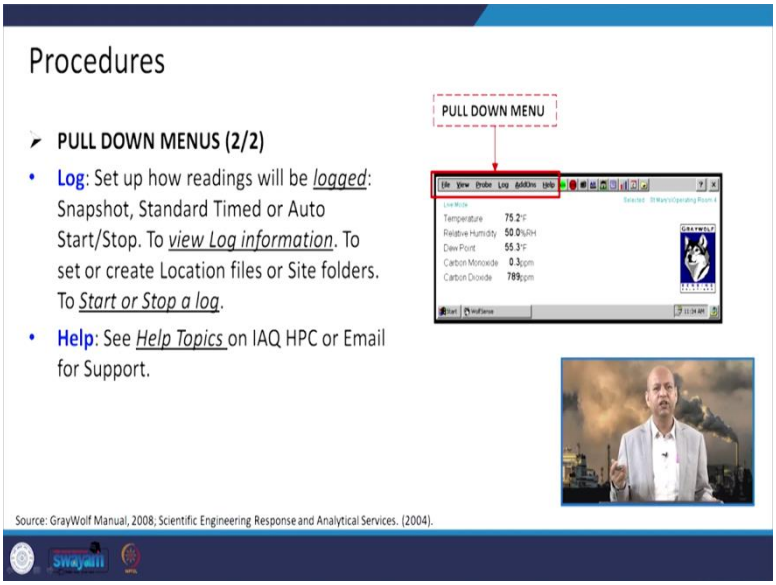

Then log button is there to set up how readings will be logged into**,** snapshots can be taken by manually or like that, then help button is there which can give you different topics, frequently asked topics plus email if we have certain queries we can email. So, those kinds of facilities are there**.**

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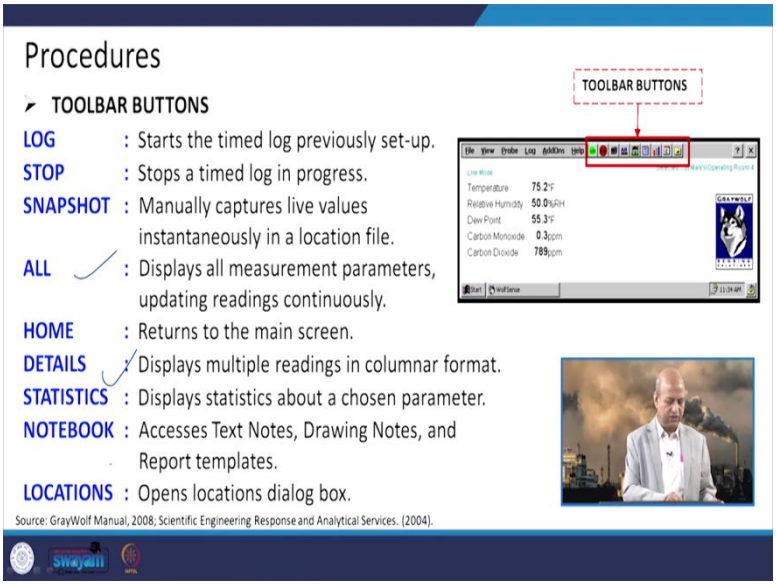

Toolbar button says like log, stop, snapshot, all these buttons so, this log is to start the time log previously which has been stored and then Stop button is to stop the that functioning or the reading, snapshot can be taken manually and all button gives all measurement data related to parameters which can be seen. So all these statistics, notebook, locations, they have their own functioning which we can look into.

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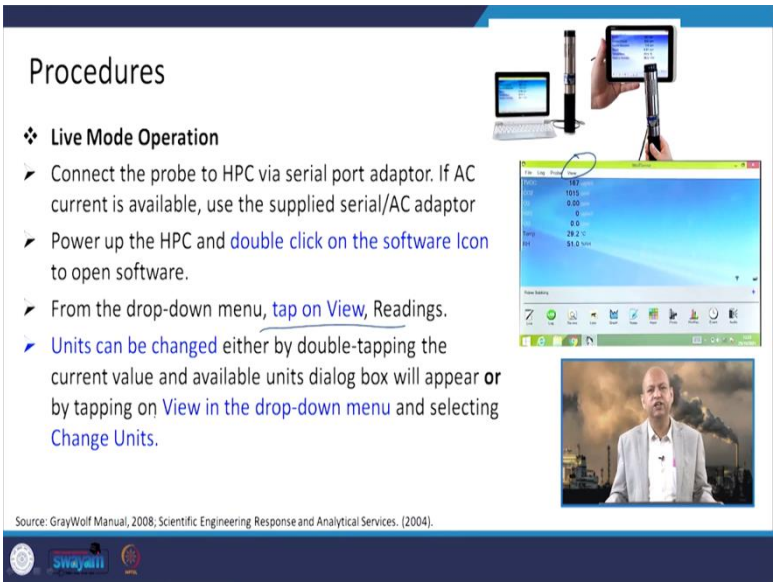

Then this live mode operation is there and through serial port adapter we use either using AC current or battery operation is also possible. Then we can use the tap on View button readings and those units can also be changed depending upon what kind of unit we are needing the values into.

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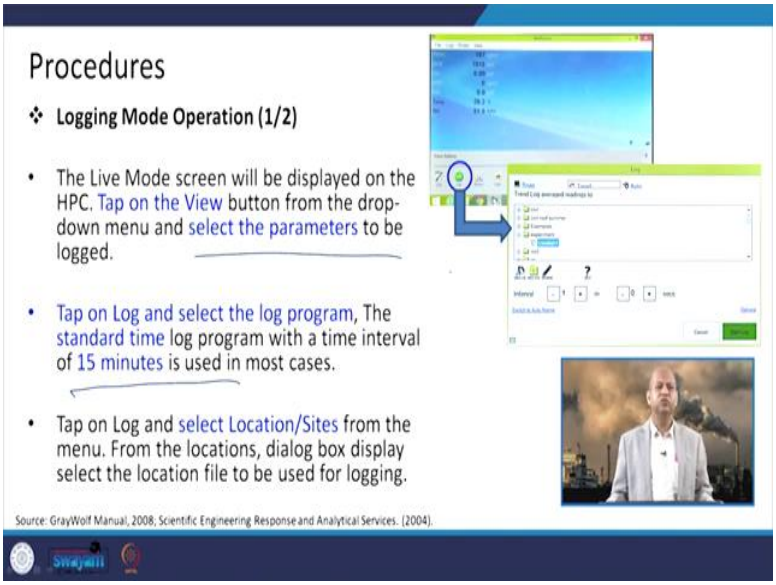

Then if we log into this mode operation basically then we can select the parameters according to the need, and we can also ensure which interval we need to have like per minute or 15 minute those kinds of default values 15 minutes, so, that kind of most of the cases we use 15 minutes otherwise we can change it for per minute or depending upon the need of the data**.**

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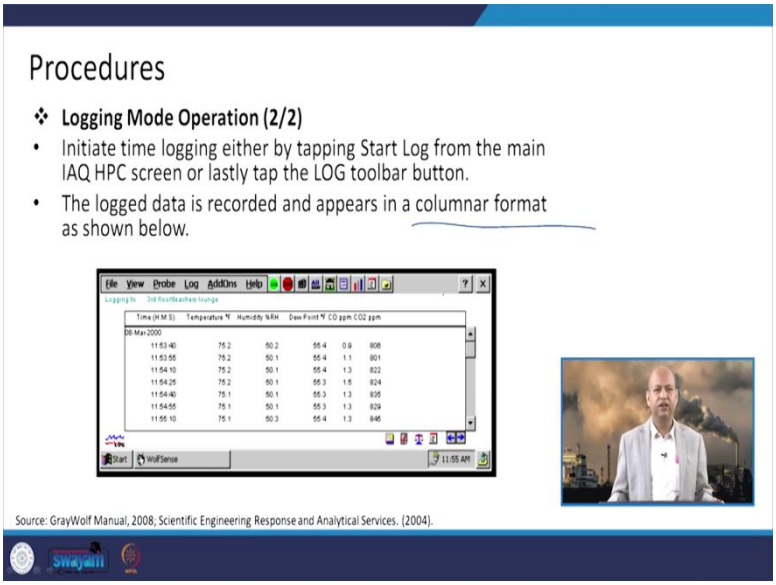

Well, so, this is the way this log data appears in column form. And ultimately, it can, go to the Excel sheet basically.

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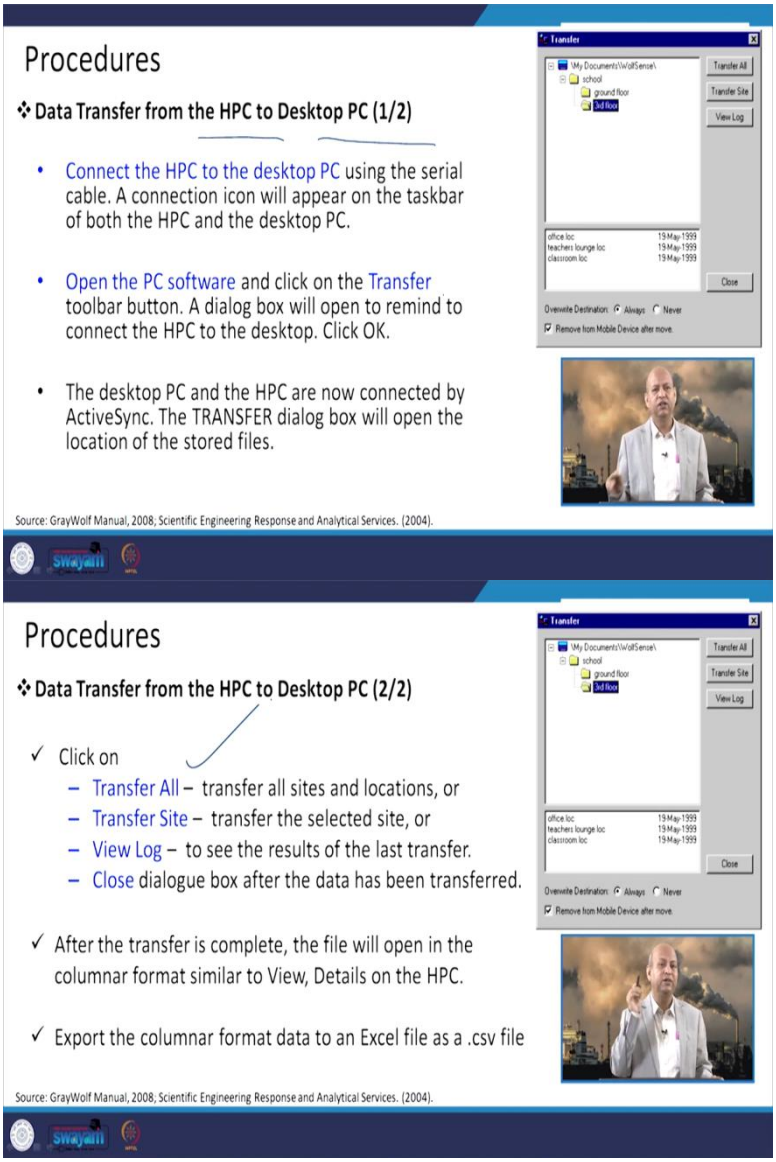

So, the data transfer takes place when we connect it with the desktop PC, and then this popup menu is there to transfer the data and the data is transferred then it can be opened in Excel sheet or different kind of software basically. So, you can see these are the possibilities transfer all if we transfer all the data which are stored there or transfers site specific data. So, those kinds of facilities are there.

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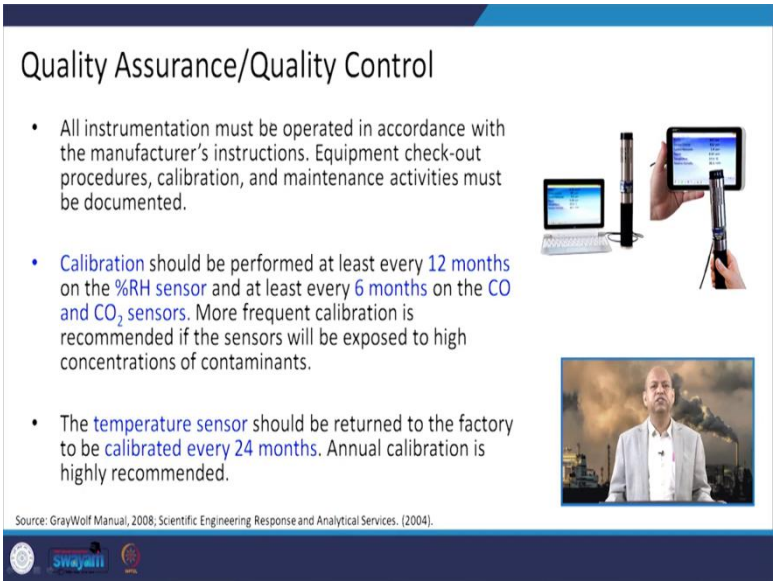

Well, we need to do quality control as I said, because certain protocol has to be followed and calibration is very important, otherwise erroneous data will be collected, sensors are very sensitive. So, we need to calibrate them periodically. For example, 12 months for this relative humidity sensor needs that every 12 month it should be calibrated and CO or CO_2 sensors, they need to be calibrated every six months, but better if you can calibrate more frequently, but these are the minimum time period**.**

Similarly, temperature sensor needs to be calibrated every two years it is more robust, but annual calibration is recommended basically. So, now, we present a short video for you to give you a feeling that how this indoor air quality assessment is carried out by multi gas monitor and this video has been recorded in air pollution laboratory of Civil Engineering Department of IIT Roorkee. So, enjoy the video please**.**

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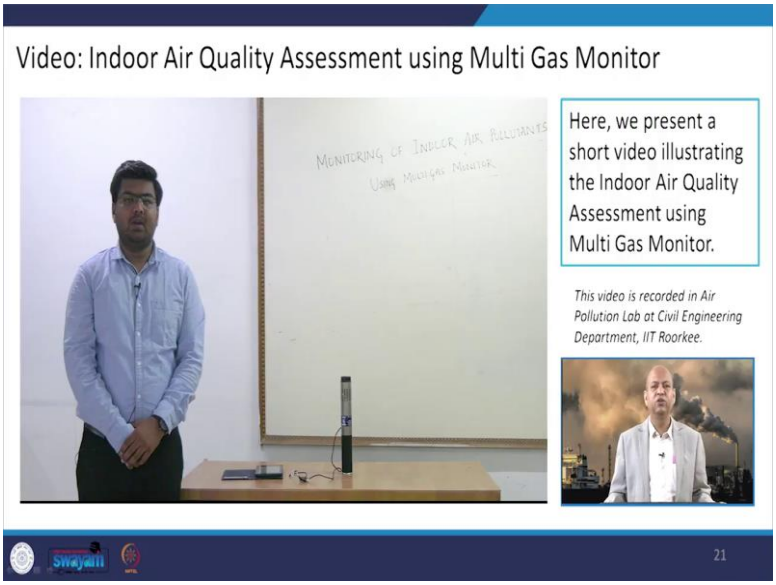

Good afternoon everyone and in the series of this lab based measurement lectures. So, our next experiment is the monitoring of indoor air pollutants using the multi gas monitor. So, for that we are using this probe which is being provided by the GrayWolf. So, in this particular probe, the sensors are there from which we are measuring the indoor air pollutants or gases we are which are for example volatile organic compounds ozone, hydrogen sulphide and carbon dioxide, carbon monoxide, etc.

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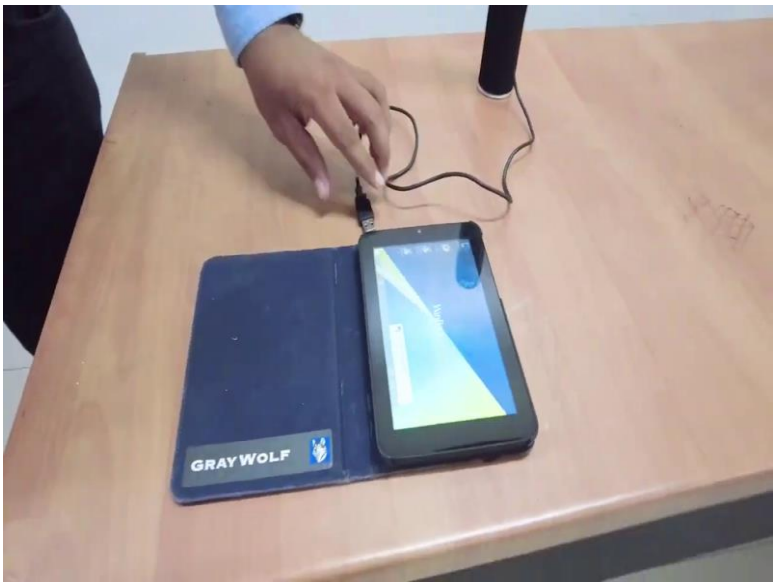

So, this probe is attached with this tablet. So, in this tablet a software has been installed in this tablet from which we are able to monitor the indoor air pollutants at various locations. So, what we need to do**,** we simply need to just attach this probe in this particular tablet and at any locations.

So, in a particular indoor environment if where you are able to measure the gases for example the ventilation corner or the corner of the room or office or lab in that particular sense, we simply need to for example, I need to measure this at here. So you simply need to place here and it will stabilize and we will be getting the readings. So, next I will tell you how we are taking the readings in this particular software.

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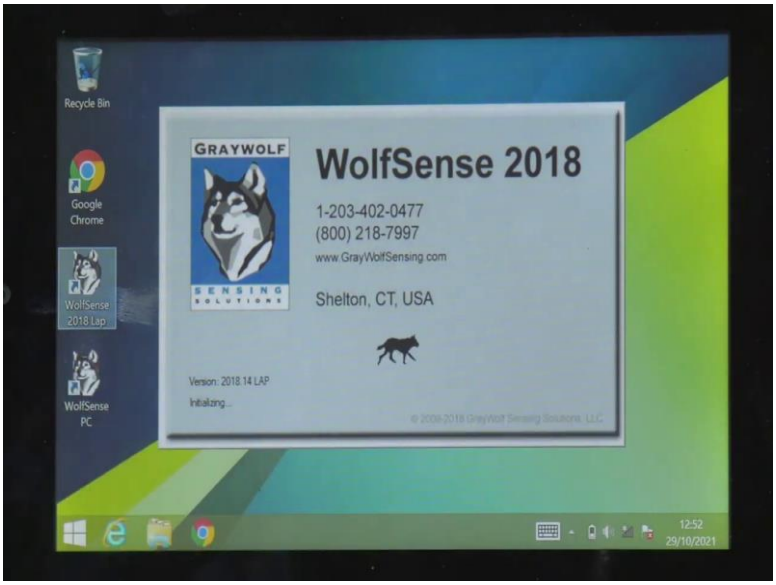

This is the tablet which is being provided by the gravels and particle software installed you can see WolfSense 2018 lab and WolfSense PC. So these two software has been provided by the gravels company and they are being installed in this tablet. So now we will connect the probe with this tablet using this USB cable.

So now I have connected now what next we have to do we have to open the first application that is WolfSense 2018 lab. You can see this the similar like what we are using in the Windows laptop, the user interface is same.

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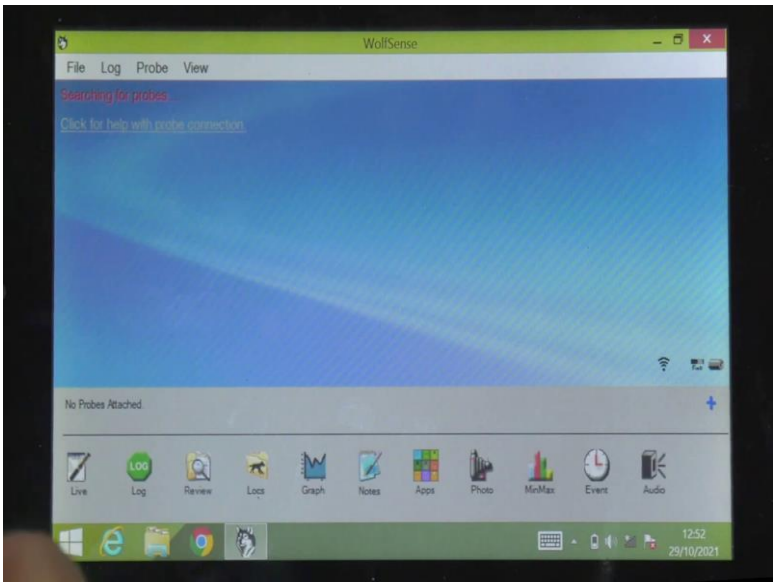

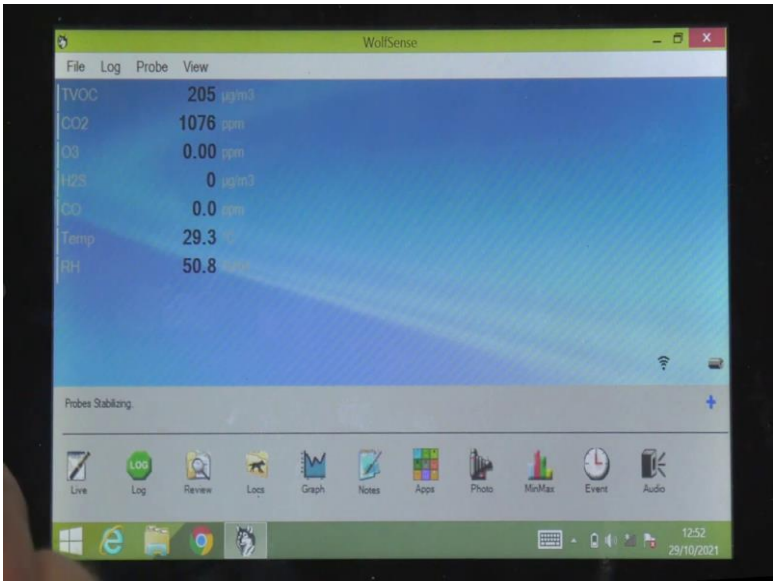

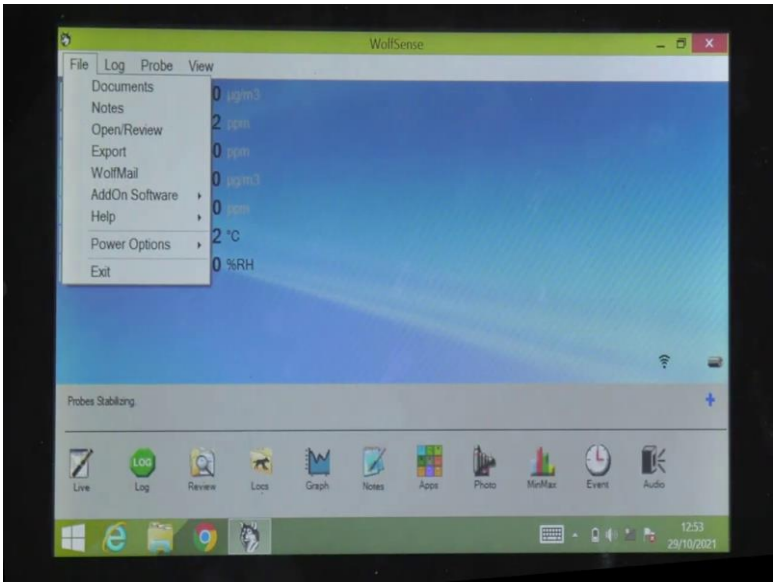

So this is the software of WolfSense where we will be observing the readings of different types of gases. And as I have connected this probe, it takes little time to detect the probe. So after the probe has been detected, it takes us some more times to get the probe to stabilize. Here you can see a small message is being showing there that this probe is stabilizing.

So after the probe gets stabilize we can see the different types of reading are there for different gases, here we are seeing the different types of gases and parameters are being shown here, that is total volatile organic compounds, carbon monoxide, ozone, H_2S, CO, and having some particular units.

Now I will explain the different types of toolbars which is being shown in this user interface. So, in the upper side you can see this file**,** log. Probe and view. So, this is known as the pulldown menu. So, in the file in the file, you can see there are a number of options available you can

open the documents, you can take down the notes of this particular experiment which you are performing or else you can open the previous documents which you have earlier performed for and edit documents and carry on your particular experiments.

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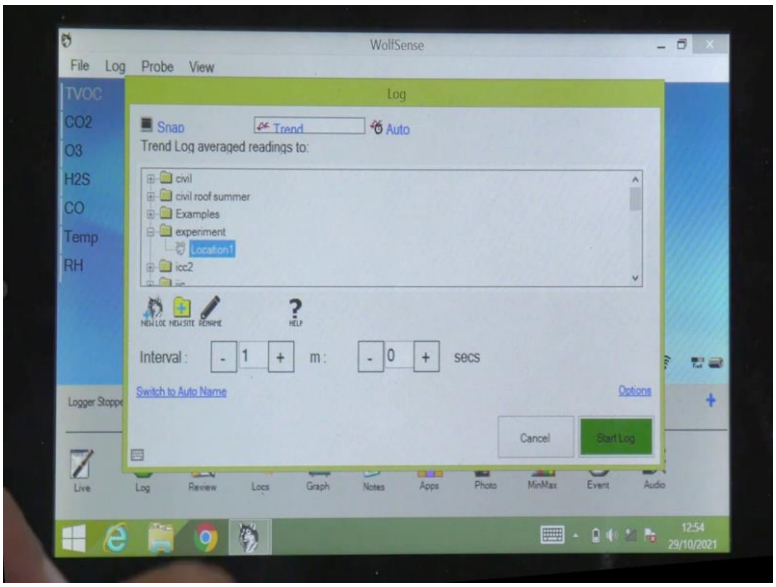

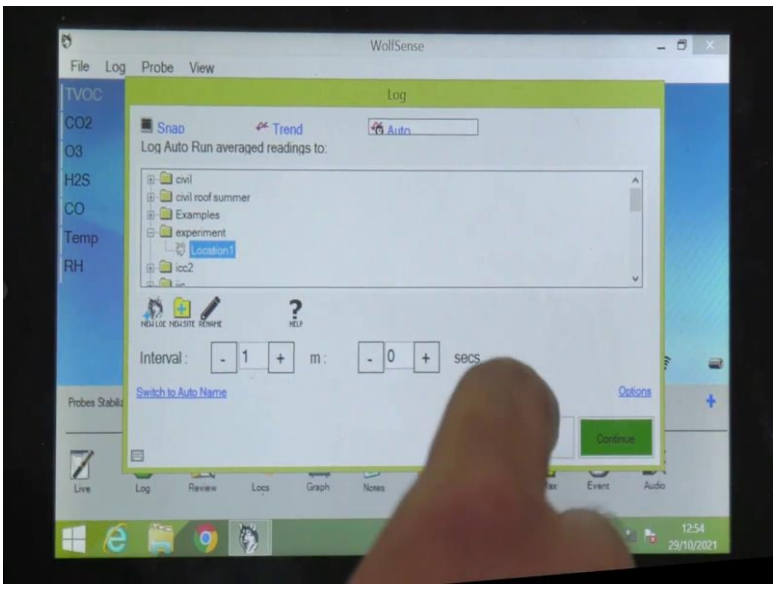

And next, next is the log. Here we are, in this particular menu, we are we are filing the experiment if I click so after clicking on the Start log, you can see you are having the three options that is snap**,** trend and auto**.** Snap mode is for generally your if you are getting the instant reading**,** trend mode is for giving the particular time interval. So, and auto mode is the same, the difference between trend and auto mode is that in trend mode user has to stop the readings and auto mode user can define the particular time of readings.

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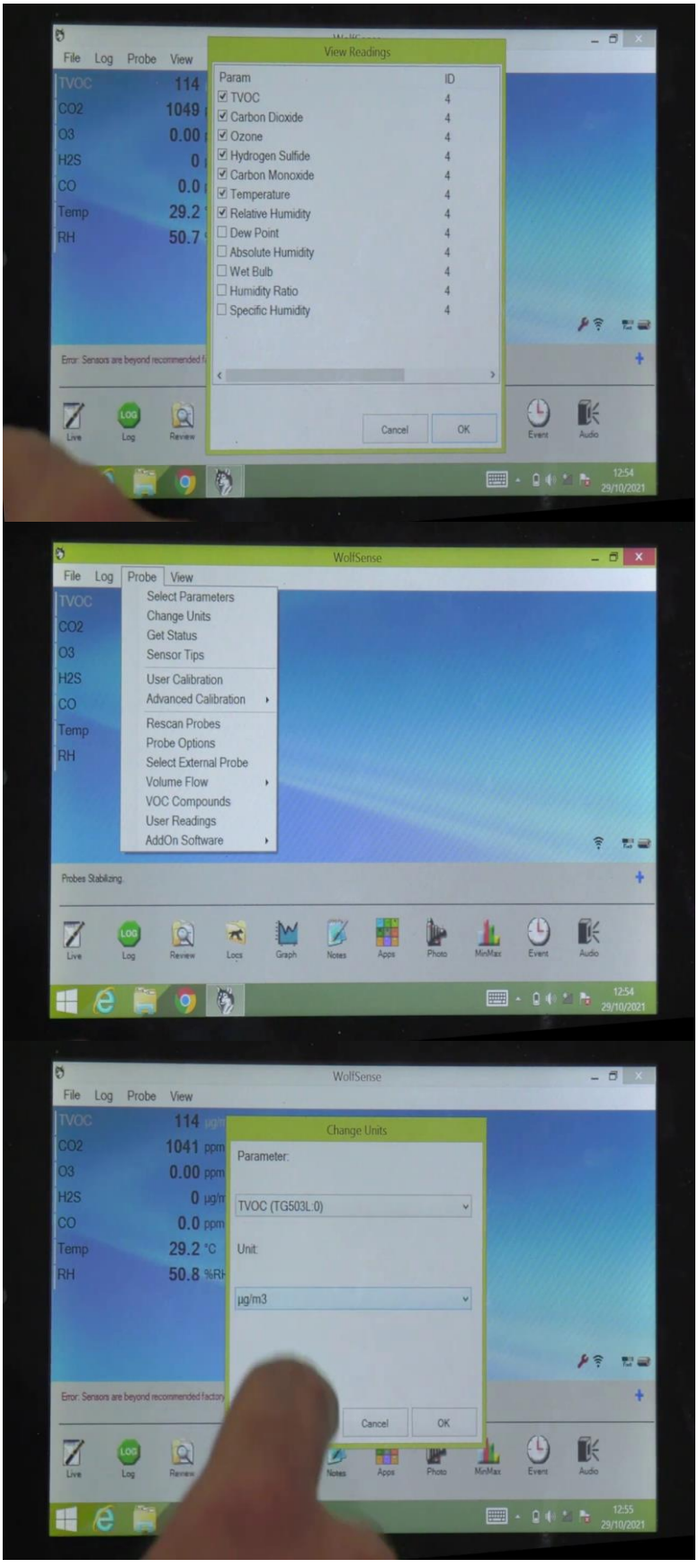

Next is the probe, in probe you can select the different parameters, you can see we have selected total volatile organic compounds, carbon dioxide, ozone, hydrogen sulfide and also you can select the dew point and all from this particular parameters menu.

Also you can change the units for different type of compounds, different types of units are being available in this software, so you can change according to your requirements. Then, other options, we will have in the probe manual like calibration of the device, you can calibrate the device for different kinds of pollutants.

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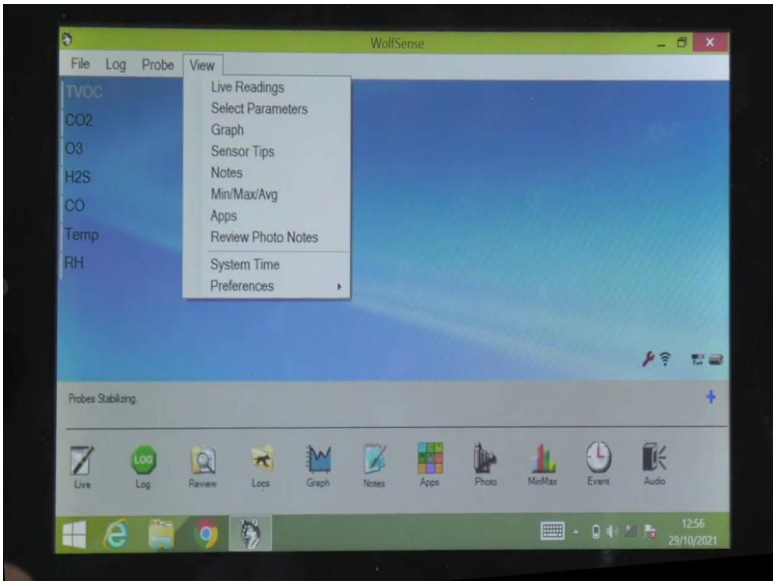

And next menu is the view. View is the way we are using the live readings of the gases. So, live readings have been available. And next you can also select the parameters, which I have already shown in the probe. Next, you can see the graph, sensor tips, notes minimum, maximum, average. So, these types of features are available, where you can visualize your readings and take down the notes and also you can see what is the minimum maximum average of your readings.

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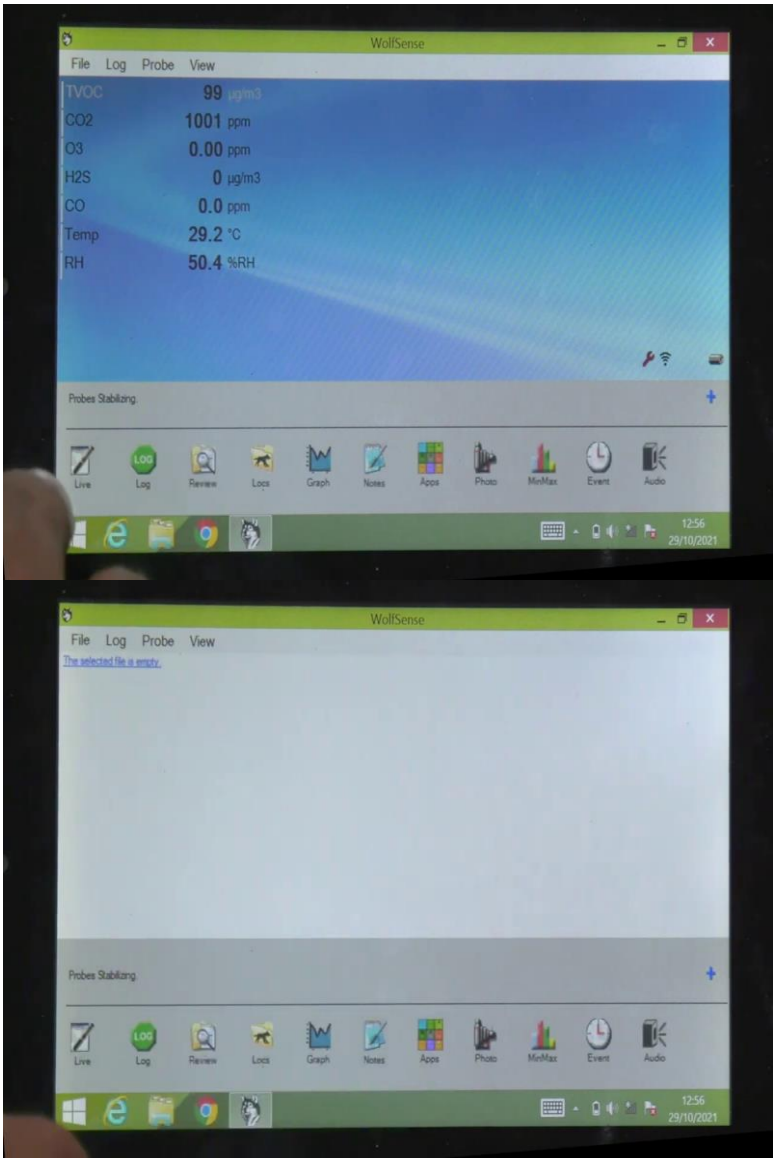

So next is the**,** this downside Menu**,** it is also known as the toolbar. So toolbar, we can see the live readings, you can see the logs**,** you can see review, the log is the same which I have explained in the tool of this pulldown menu and then there is a review. So review, you can see the earlier recorded experiments you can visualize here**.**

And next is the graph**,** notes, photos, minimum, average and audio. So, graph will be showing graph of your experiments with which you are performing you can take down some notes or else photo is also there you can take down the photo of a particular site and minimum, maximum average which I have already explained. And next is the audio**,** audio mode is also available**.**

If you want to just add a voice note for a particular experiment then you can use this audio note. So in this process in this manner here you can just monitor the different types of gases in the indoor air environment using this multi gas monitor, which has been connected with this PC. So, this is the complete kit for measuring the indoor air pollutants using multi gas monitor provided by Graywolf. Thank you

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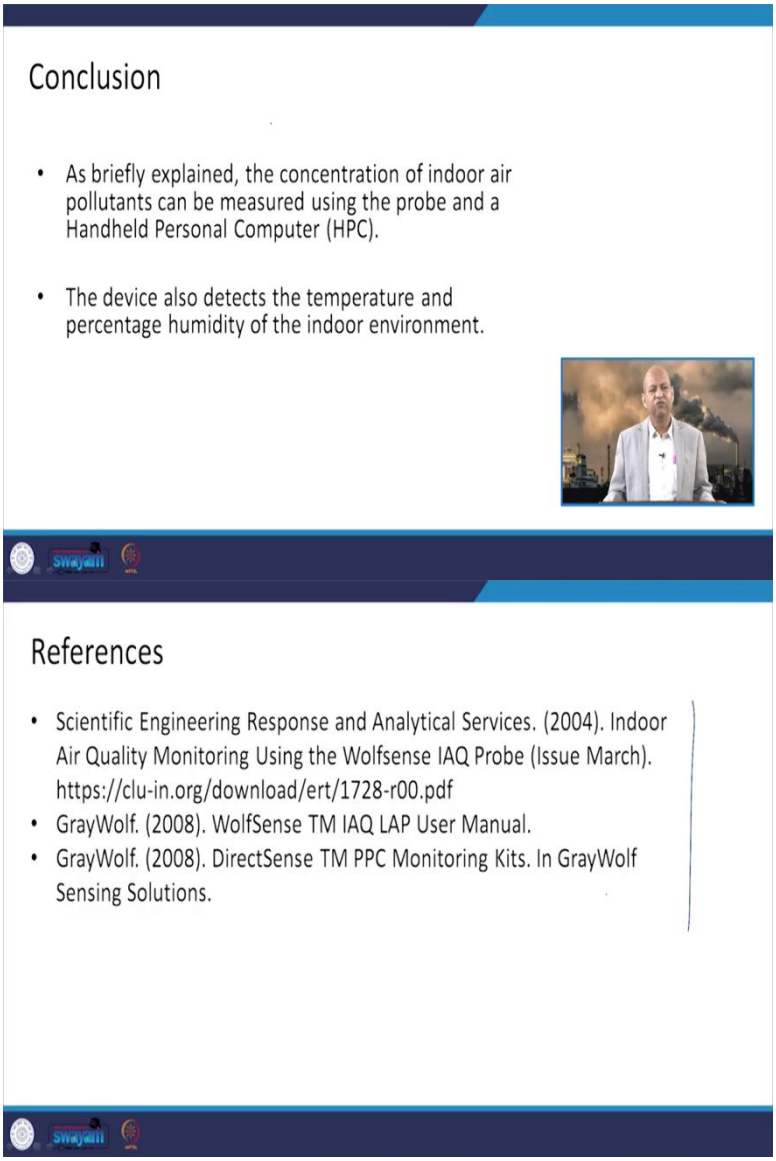

Well, so, on the basis of this video, you can easily visualize how this instrument function and what are the ways to transfer the data and other issues. So, in conclusion, we can say that indoor environment gas concentration in the micro environments where we are living because VOC concentration maybe the CO_2 concentration maybe built up because of so many activities in the indoor environment.

So they can be monitored by this multi gas monitor and sensor based monitoring is there and if we carry out proper monitoring and analysis then we can compare with the recommended values whether it is fine or not. And accordingly we can recommend some solutions if concentration is higher. So this is all for today thank you for your kind attention. These are the references we have taken information from. And you can go through them if you want to know more information. So thanks again and see you in the next lecture.