PART Ⅰ

ENGLISH NARRATION

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BASIC OPERATIONS IN CHEMICAL ANALYSIS

ANALYSIS VIDEO SERIES FOR ENVIRONMENTAL TECHNOLOGY TRANSFER

PROLOGUE

Explanation 1
A beautiful and abundant natural environment is essential for a healthy life.
To be able to protect and hand down the natural environment of today, we must push forward research and carry out various environmental protection policies.

Explanation 2
For that, it is necessary to understand objectively the present condition of the environment and get accurate scientific data.
One of the most effective ways to know how much pollution is in the environment is environmental analysis.

Explanation 3
In order to understand the data and interpret the environmental analysis correctly, it is important to choose appropriate methods for all environmental study processes, such as planning, sampling, pretreatment of the sample, chemical analysis, and data processing.

Explanation 4
We collect the sample in the field, bring it into the laboratory, do the pretreatment necessary for the testing method for the target components, and then analyze them.

Explanation 5
In this video, we will discuss the four basic but very important areas that we must understand to do analysis in the laboratory.

WASHING AND KEEPING OF GLASSWARE

Explanation 6
Glassware must be clean at all times, and contamination reduced as much as possible for correct and precise chemical analysis.
Analysts are responsible for washing experimental apparatuses.

Explanation 7
The analysts, in theory, wash and manage glass apparatuses by themselves in analytical chemistry.
However, in reality the washing is often done by other personnel. In this case, the analysts are still responsible for proper instruction and supervision to ensure that it is done correctly.
If good data is not obtained because the washing was inadequate, the analysts are responsible.

Explanation 8
Used glassware apparatuses need to be sorted and the proper washing method selected for intended use.

Explanation 9
If used glassware is left dirty the glass surface adsorbs material and is hard to clean.
At a minimum, throw away the contents in the correct place and rinse with water immediately after every use.

First, let's look at basic glassware washing methods.

Explanation 10
Glass apparatuses for environmental analysis should be washed with a sponge or a soft brush in diluted laboratory detergent.

Explanation 13
Rinse glassware that was washed with cleanser with tap or warm water to remove all detergent and make sure that there are no bubbles left.
Also, not only the inside but also the outside of apparatuses must be kept clean.

Explanation 14
To make sure that oil or stains have been removed from the surface hold up the apparatus and make sure that the surface is uniformly covered by a thin water film.
If water drops bead on the surface, the washing is inadequate.

Stains come out much more easily with warm water.

Explanation 15
Using a washing bottle, rinse the inside and rim of washed glassware with pure water three times.
Carefully using small amounts of pure water several times, cleans better than using a large amount of water once and it doesn't waste pure water.

Explanation 11
When you clean places like the inside of a flask with a brush, that brush should fit the apparatus's shape and size.

You should not use worn-out brushes or powdered cleansers because they will scratch the glass surface.

Explanation 12
Soaking very dirty items over night in a rinsing bath with laboratory detergent is effective.

In heavy metal analysis, apparatuses are sometimes soaked in dilute nitrate or hydrochloric acid to remove metallic elements on the glass surface.

Explanation 16
Put rinsed glassware in a dish drainer, and then store it on a drying shelf or dry it in a clean and relatively dust-free area.

Explanation 17
Dirty samples should never be left in a drying oven in case it needs to be used.

Explanation 18
Use an ultrasonic cleaner to wash apparatuses too small to clean by brush.
They should be washed in a rinsing bath with a small amount of diluted cleanser and water.

Explanation 20
Used pipettes should always be quickly rinsed with tap water while they are wet.

Explanation 21
If you use a pipette cleaner, the pipettes should be placed pointing upward in a basket to prevent the tip from breaking.

Explanation 22
Rinse pipettes with tap water, and don't leave them soaking in the rinsing bath too long.

Rinse the washed pipettes with pure water.

Explanation 23
Volumetric glassware such as pipettes and volumetric flasks expand if heated and shrink if cooled, resulting in a change in size.
Thus always dry them at room temperature and never dry them in an oven.

Explanation 24
Care must be taken to protect carefully cleaned apparatus from room dust.
Keep glassware in a cabinet with a door.

Explanation 25
To protect the inside of glassware from dust, they should placed upside down on paper towels

on a shelf.

Protect small apparatuses by keeping them in a small box.
They can be kept in air-tight containers depending upon the how they are to be used.

PURE WATER MAKING AND PURITY CHECK

Explanation 26
You cannot get correct results if the water used for chemical analysis contains impurities.

Various water purification production systems are available.
But the most important thing to remember is that it is expensive to maintain pure water quality.

Explanation 27
This is a still which is comparatively easy to assemble.
Distilled water can be made by putting a large flask with a condenser on a gas range.

Fill it with water to 80% of flask capacity, and add several boiling stones to prevent sudden boiling.

Explanation 28
Add a little potassium permanganate to decompose and remove organic materials in tap water.

By adding tap water at the rate of production water can be distilled for an extended period of time.
But, if there are scales in a distillation flask, the efficiency of distillation drops.
In that case, wash the inside of the apparatus with acid.

Explanation 29
There are many other types of commercially available water purification systems.
Purified water can be produced using the best system for the intended use, combining processes such as activated carbon adsorption, ion exchange, reverse osmosis, and filtration.

Explanation 30
The cartridges, used in activated carbon or filtration systems, have to be replaced on a regular basis.

Explanation 31
The quality of purified water produced can be checked with an electric conductivity meter.
Commercial systems have indicators that show when conductivity ratio exceeds a set value and the cartridge must be changed.

DILUTION OF STANDARD SOLUTIONS

Explanation 32
In general stock solutions are highly concentrated.
They need to be diluted to the proper concentration for each specific use.

First, let's look at the basic operation for diluting a stock solution to the proper concentration for absorption spectrophotometric analysis.

Explanation 33
Volumetric glassware such as graduated cylinders, pipettes, volumetric flasks, and burettes are available to measure a set amount of a solution.

Explanation 34
Use a volumetric pipette or measuring pipette to measure solution.
There are various sizes available to fit a variety of needs.

Explanation 35
When you need to measure a specific amount of solution for operations like making a standard solution, use a volumetric pipette.
Exactly10 ml of solution can be obtained by drawing in fluid up to the line in this volumetric pipette.

Explanation 36
This measuring pipette has a scale on it.
It is useful for adding an approximate amount of solution.

Explanation 37
Some pipettes are accurate down to the tip, while others have been graduated for partial delivery.
So, check the scale of a pipette before using it.

Explanation 38
Use a pipetter when you draw a solution into a pipette.
When you use a rubber ball, squeeze it to push out the air, and then put it on the end of the pipette.

Explanation 39
Be careful with the tip of the pipette when drawing in a solution.
It should be inserted into the solution.
You must be very careful, because the tip comes out of the liquid while drawing in solution, some of it will get into the rubber ball.

Explanation 40
Draw in the solution up to a little more than the line, tilt the pipette, quickly take off the rubber ball, and then cover the end of the pipette with your index finger.

Explanation 41
Normally, a pipette must be dry.
If it's wet, drain it as much as possible and then rinse it by drawing in a small amount of the solution to be measured.
This is called washing with the solution to be measured and is repeated three times.

Explanation 42
To bring the drawn solution precisely to the line, hold the pipette vertically while looking at the solution level slowly release your index finger and allow the solution to fall to the target line.

Explanation 43
Next, put the tip of the pipette on the inside surface of the volumetric flask, and completely release your index finger.
The solution will drain out naturally.

Explanation 44
To get the last drop from the pipette, once again cover the edge of the pipette with your index finger, and hold the bulge with your other hand.
Your body heat will raise the air pressure and force out all of the solution out.

Explanation 45
We will look at volumetric flasks.
Volumetric flasks are generally used to make a solution with a given concentration and come in various sizes.

Explanation 47
First, add 80% of the purified water for the dilution.
Then, draw up 5 ml of solution with a pipette, add it to the volumetric flask and mix gently.

Explanation 48
Then, put a stopper on the volumetric flask, hold the stopper with your finger repeatedly, turn the flask upside-down and mix the solution thoroughly.

Explanation 49
Add purified water up to the line, and mix it again the same way as before.
This is the diluted solution.
The stock solution is diluted 20 fold by this process.
The concentration of the standard solution can be further changed by repeating this dilution process.

ABSORPTIOMETRIC ANAYSIS OF NO2 ION

Explanation 50
Next, let take a look at a spectrophotometric analysis of nitrate as an example.

Explanation 51
Three concentrations of nitrate, 0.6, 0.2, and 0.06 milligram per liter were made in stages from a stock nitrate solution.

Explanation 52
These are two water samples which have unknown concentrations.
Purified water has also been prepared as a blank.

Explanation 53
Then, 1 ml of surfanil amide solution is added to each sample, under acidic conditions, mixed and allow to stand for five minutes.

Explanation 54
Then, 1 ml of naftylethylenediamine solution is added and mixed.
Experimental conditions have to be the same for all samples, standards, and blank.

After allowing the solutions to stand for twenty minutes, we see the color change toward a reddish purple, proportional to the concentration of nitrate.

Explanation 55
A spectrophotometic check of the concentration of the color changed solution is made by measuring the amount of light absorption at the wavelength of 540 nanometers.

TITRATION

Explanation 56
Next, let's look at how to do a titration analysis as an example of measuring solution concentration.
Titration is widely used in various fields because it requires only basic apparatus and gives precise results.

Explanation 57
The burette for titration is one important type of glass volumeter.
Choose the size of the burette, to fit the amount of reagent used for the particular titration.
Use an amber glass burette when using light-sensitive reagents such as potassium permanganate and silver nitrate.

Explanation 58
Place the burette in a stand, and slowly pour the standard solution from the upper part of the funnel to a little above the line.

Explanation 59
Both the inside of the burette and funnel must be well rinsed with standard solution.
Discard the standard solution used in rinsing.
Repeat this process three times.

Explanation 60
Allow the rinsed burette to stand, and then reduce the solution to the line on the burette.

Explanation 61
For a 25 ml burette, eyeball the position of level of the solution up to 0.01 milliliter and record the results in your field notes.

Explanation 62
Let's look at an example of iodometry for dissolved oxygen in water.

Assume a sample has been collected and pretreated for example by fixing dissolved oxygen in water.
Here 25 millimoles per liter sodium thiosulfate solution is used as a standard.

Explanation 63
Put the sample in an Erlenmeyer flask and hold it with your right hand, grasp the cock of the burette with your left hand and open it slightly.
While the standard solution is dripping in, shake the flask with your right hand.

Explanation 64
A magnetic stirrer is generally used for uniform mixing.
Choose the appropriate stirring rod, rinse with purified water, put it in a conical beaker or an Erlenmeyer flask and adjust the speed for proper stirring.

Explanation 65

Slowly add the standard solution from the burette, and stop adding at the moment when the yellow color fades.
It will turn blue when you add 1 ml of starch solution, as an indicator, because of the starch-iodine reaction.

Explanation 66
Add the standard, two to three drops at a time.
The volume of one drop is about 0.03 ml.
Practice in advance to achieve the reproducibility within a range of 0.05 ml when you repeat the same titration.

When the color grows faint, add the standard solution a drop at a time.
When the blue color is disappears the end point of the reaction has been reached.

Explanation 67
Read and record the burette's scale at the end point to 0.01 ml in your field notes.

EPILOGUE

Explanation 68
Even though you use highly advanced analytical apparatus, you will never get correct analytical data for environmental analysis without correctly doing the basic operations introduced here.

To increase the reliability of research and investigation, never skip simple but essential work such as washing glassware.
It is important to train and guide people who do analysis so they can do it correctly.

To obtain analytical data close to true values, you have to do analysis with as much precision as possible.
For environmental protection, it is important that these results are reflected in environmental policy.
Doing the important work of environmental analysis correctly helps protect the natural environment of a nation and the health of its citizens.