



برنامج المسار الوظيفي للعاملين بقطاع مياه الشرب والصرف الصحي

دليل المتدرب

البرنامج التدريبي كيميائي مياه

Physical analysis – الدرجة الثالثة



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أهداف البرنامج التدريبي

في نهاية البرنامج التدريبي يكون المتدرب قادر على :-

- ١ - القدرة على قياس درجة حرارة المياه
- ٢ - القدرة على قياس اللون والطعم والرائحة
- ٣ - القدرة على تقدير الاملاح الذائبة والعوالق الصلبه
- ٤ - القدرة على قياس العكارة والتوصيل الكهربائي
- ٥ - القدرة على قياس اللون

TEMPERATURE**Temperature-2550****Scope and Application:**

Measurements of temperature are required in studies of self-purification of rivers and reservoirs, and for the control of waste treatment plants. Water temperature is important in relation to fish life. In limnological studies; temperature at different depths is measured. Data on the water temperature are necessary for cooling purposes or for process use in industry, as well as for the calculation of the solubility of oxygen and the carbon dioxide-bicarbonate-carbonate equilibrium. Identification of the water source, such as deep wells, is often possible by temperature measurement alone.

The temperature of drinking water has an influence on its taste. It is also important in connection with bathing and agricultural irrigation.

Temperature reading is used in the calculation of various forms of alkalinity in studies of saturation and stability with respect to calcium carbonate.

Apparatus:

A thermometer has a quick response with 0.1°C divisions, checked against a precision thermometer.

Normally, temperature measurements may be made with any good grade, mercury filled, centigrade thermometer, provided it is checked occasionally against a precision thermometer certified by the bureau of standards. Field instruments should be provided with a metal case to prevent breakage.

Procedure:

Measurement should be made with the thermometer immersed directly in the water body, after a period of time sufficient to permit constant reading.

ODOR**Threshold Odor Test-2150 B**

- The effect of odors on human produces mainly psychological stress instead of any specific harm to the body.
- As mentioned, in drinking water, taste and odor are not normally a problem until the consumer complains. The problem is that most consumers find taste and odor in water aesthetically displeasing.
- As mentioned, taste and odor do not directly present a health hazard, but they can cause the customer to seek water that tastes and smells good, but may not be safe to drink. Most consumers consider water tasteless and odorless. When consumers find that their drinking water has a taste,

odor, or both, they automatically associate the drinking water with contamination.

- In water treatment, one of the common methods used to remove taste and odor is to oxidize the materials that cause the problem. Oxidants, such as potassium permanganate and chlorine, are used.
- Another common treatment method is to feed powdered activated carbon before the filter. The activated carbon has numerous small openings that absorb the components that cause the odor and tastes.

Principle:

- Determine the threshold odor by diluting a sample with odor-free water until the least definitely perceptible odor is achieved.
- There is no absolute threshold odor concentration, because of inherent variation in individual olfactory capability.
- A given person varies in sensitivity over time. Day-to-day and within-day differences occur.
- The number of persons selected to measure threshold odor will depend on the objective of the tests.
- Under such circumstances, panels of no fewer than five persons, and preferably ten or more, are recommended.¹ Measurement of threshold levels by one person is often a necessity at water treatment plants.

Application:

This threshold method is applicable to samples ranging from nearly odorless, natural water to industrial wastes with threshold numbers in thousands.

Sampling and storage:

- Collect samples for odor testing in glass bottles with glass or TFE-lined closures.
- Complete tests as soon as possible after sample collection.
- If storage is necessary, collect at least 500 mL of sample in a bottle filled to the top; refrigerate, making sure that no extraneous odors can be drawn into the sample as it cools. Do not use plastic containers.

De-chlorination:

- Most tap water and some wastewater are chlorinated. Often it is desirable to determine the odor of the chlorinated sample as well as that of the same sample after dechlorination. De-chlorinate with sodium thiosulphate.

Temperature:

Threshold odor values vary with temperature. For most tap waters and raw water sources, a sample temperature of 60°C will permit detection of odors

that otherwise might be missed; 60°C is the standard temperature for hot threshold odor tests. For some purposes, because the odor is too fleeting or there is excessive heat sensation, the hot odor test may not be applicable; where experience shows that a lower temperature is needed, use a standard test temperature of 40°C. For special purposes, other temperatures may be used. Report temperature at which observations are made.

Apparatus:

To assure reliable threshold measurements, use odor-free glassware. Clean glassware shortly before use with no odorous soap and acid cleaning solution and rinse with odor-free water. Reserve this glassware exclusively for threshold testing. Do not use rubber, cork, or plastic stoppers. Do not use narrow-mouth vessels.

- A. Sample bottles, glass-stoppered or with TFE-lined closures.
- B. Constant-temperature bath: A water bath or electric hot plate capable of temperature control of $\pm 1^\circ\text{C}$ for odor tests at elevated temperatures. The bath must not contribute any odor to the odor flasks.
- C. Odor flasks: Glass-stopper, 500-ml Erlenmeyer flasks, to hold sample dilutions during testing.
- D. Pipets:
 1. Transfer and volumetric pipets or graduated cylinders: 200-, 100-, 50-, and 25-ml.
 2. Measuring pipets: 10-ml, graduated in tenths.
- E. Thermometer: Zero to 110°C, chemical or metal-stem dial type.

Odor-Free Water

Prepare odor-free water by passing distilled, deionized, or tap water through activated carbon. If product water is not odor-free, rebuild or purify the system.

Procedure

- A. Precautions: Carefully select by preliminary tests the persons to make taste or odor tests. Insure that the tester is free from colds or allergies that affect odor response.

Keep room in which tests are conducted free from distractions, drafts, and odor. For precise work use a panel of five or more testers.

- B. Threshold measurement the "threshold odor number," designated by the abbreviation TON, is the greatest dilution of sample with odor-free water yielding a definitely perceptible odor. Bring total volume of sample and odor-free water to 200 mL in each test. Follow dilutions and record corresponding TON presented in Table. These numbers have been computed thus:

TABLE 2150:I. THRESHOLD ODOR NUMBERS CORRESPONDING TO VARIOUS DILUTIONS

Sample Volume Diluted to 200 mL mL	Threshold Odor No.	Sample Volume Diluted to 200 mL mL	Threshold Odor No.
200	1	12.0	17
140	1.4	8.3	24
100	2	5.7	35
70	3	4.0	50
50	4	2.8	70
35	6	2.0	100
25	8	1.4	140
17	12	1.0	200

$$\text{TON} = \frac{A + B}{A}$$

Where:

A = mL sample

B = mL odor-free water.

Calculation:

The threshold odor number is the dilution ratio at which odor is just detectable.

The smallest TON that can be observed is 1, as in the case where the odor flask contains 200 mL undiluted sample. If no odor is detected at this concentration, report "No odor observed" instead of a threshold number.

Interpretation of Results:

- A threshold number is not a precise value. In the case of the single observer it represents a judgment at the time of testing.
- One or two observers can develop useful data if comparison with larger panels has been made to check their sensitivity.
- Do not make comparisons of data from time to time or place to place unless all test conditions have been standardized carefully

FLAVOR

Flavor Rating Assessment (FRA)-2160 C

General Discussion:

- This procedure has been used with samples from public sources in laboratory research and consumer surveys to recommend standards governing mineral content in drinking water.

- Each tester is presented with a list of nine statements about the water ranging on a scale from very favorable to very unfavorable.
- The tester's task is to select the statement that best expresses his or her opinion.
- The individual rating is the scale number of the statement selected.

Samples:

- Sample finished water ready for human consumption or use experimentally treated water if the sanitary requirements.

NOT:

- Make flavor tests only on samples known to be safe for ingestion. Do not use samples that may be contaminated with bacteria, viruses, parasites, or hazardous chemicals, that contain dechlorinating agents such as sodium arsenate or that are derived from an unaesthetic source. Do not make flavor tests on wastewaters or similar untreated effluents.
- Observe all sanitary and esthetic precautions with regard to apparatus and containers contacting the sample.
- Use odor-free water as criterion samples and a solution of 2000 mg NaCl /L prepared with taste.

Procedure:

A. Panel selection and preparation:

- In tasting samples, testers work alone. Do not let testers know the composition or source of specific samples.

B. Rating test:

- A single rating session may be used to evaluate up to 10 samples, including the criterion samples
- Present samples at a temperature that the testers will find pleasant for drinking water; maintain this temperature throughout testing. A temperature of 15°C is recommended; but in any case, do not let the test temperature exceed tap water temperatures customary at the time of the test. Specify test temperature in reporting results.
- Independently randomize sample order for each tester. Instruct each to complete the following steps:
 1. Taste about half the sample by taking water into the mouth, holding it for several seconds, and discharging it without swallowing;
 2. Form an initial judgment on the rating scale;
 3. Make a second tasting in a similar manner;
 4. Make a final rating and record result on an appropriate data form;
 5. Rinse mouth with reference water;
 6. Rest 1 min before repeating Steps 1 through 5 on next sample.

Calculation:

- Use the following scale for rating. Record ratings as integers ranging from one to nine, with one given the highest quality rating.
- Action tendency scale:
 1. I would be very happy to accept this water as my everyday drinking water.
 2. I would be happy to accept this water as my everyday drinking water.
 3. I am sure that I could accept this water as my everyday drinking water.
 4. I could accept this water as my everyday drinking water.
 5. Maybe I could accept this water as my everyday drinking water.
 6. I don't think I could accept this water as my everyday drinking water.
 7. I could not accept this water as my everyday drinking water.
 8. I could never drink this water.
 9. I can't stand this water in my mouth and I could never drink it.

Interpretation of Results:

- Values representing the central tendency and dispersion of quality ratings for a laboratory panel are only estimates of these values for a defined consuming population.

ELECTRICAL CONDUCTIVITY**Conductivity-2510 B****Principle:**

Conductivity is the ability of a material to conduct current. Positive and negative ions in a solution (free ions) will move to the oppositely charged electrode when an electric charge is applied to the solution, thus conducting current. In addition to the current applied, ion movement is affected by the solvent properties (temperature, viscosity) and the physical properties of the ion (size, charge, concentration...). As temperature increases, ions move faster and conduct more current. As viscosity increases, the ions move slower and conduct less current. For our purposes, conductivity is measured by placing a cell (probe) in an electrolytic solution. A cell consists of two electrodes of a specific size, spaced at a specific distance apart. The conductivity of a liquid is the ratio of current to voltage between the electrodes. The conductivity value changes if the electrodes are spaced closer or further from each other. To have useful analyses, the distance between the two electrodes must be considered in the conductivity calculation.

Equipment:

- Conductivity meter with temperature compensation.
- Conductivity probe (Electrode).

Chemical and reagents:

Standard conductivity solution (1000, 1410, 1413 or 500 μ S/cm) any of them is available.

Precaution:

- If the conductivity meter gets dirty, wipe the surface with a damp cloth.
- During normal use, rinse the probe with Deionized water between measurements. (This will minimize the interfering substances on the probe element).
- The cell must be stored dry.
- The solution must be clear from particles or suspended matter, don't allow the cell to come into contact with any sediment which may be present by leaving sample for sedimentation and measure conductivity for supernatant.
- You can store the electrode either wet or dry but if it is stored dry you will need to recondition the electrode before use.

Procedure:**Instrument calibration:****1. Calibrating with a known standard:**

The conductivity meter must be calibrated before use by using standards with known electrolytic conductivity (1000, 1410, 1413 μ S/cm at 25°C, as available).

2. Turn on conductivity meter by pressing exit then place the probe in a conductivity standard, Agitate the probe to dislodge bubbles in the cell.
3. Press **CAL**. Functional keys will appear in the lower left part of the display. **CAL**,**?**, and 1000 μ S/cm will appear in the upper display. If the meter has been calibrated, the last calibration value will appear.
4. Press the arrow keys to scroll to the factory calibration options (1000 μ S/cm or 18 mS/cm). To calibrate using one of these standards, Press **ENTER**,
5. If using a standard with a different value, use the number keys to enter the standard conductivity at 25 °C, and then press **ENTER**. The meter will automatically correct the calibration measurement to 25°C using the NaCl based, non-linear temperature coefficient.
6. When the reading is stable, the calibration is automatically stored and the instrument returns to reading mode.
7. Verify conductivity meter by putting the electrode in suitable certified buffer, press read then record result in form for performance and verification of conductivity

Measurement:

1. For measurement, rinse the probe with tap water then Deionized water then dry it.
2. Immerse the probe in sample, press **ENTER**, and allow the readout to stabilize.
3. Record conductivity reading when stabilize on sampling recording sheet

Calculation:

- Internal calculation in Conductivity meter.

Quality control:

Perform a duplicate analysis/sample set.

Construction of Accuracy chart (Shewarte- quality control charts):

- The laboratory shall construct accuracy chart to control accuracy by plotting the results of the suitable conductivity buffer against time in X chart to ensure that the results are within the criteria of acceptance to continue the method.

Calibration and verification of conductivity meter:

Calibration by a certified buffer (1000, 1410, 1413 $\mu\text{S}/\text{cm}$ at 25°C, as available).

Verification by a measure suitable certified conductivity buffer solution in the range of our measurements from another batch or another company.

Reporting:

Sample results are read directly from the meter display, $\mu\text{S}/\text{cm} = \mu\text{mhos}/\text{cm}$, so no conversion is necessary. Sample results are reported in $\mu\text{mhos}/\text{cm}$.

$1 \mu\text{mhos} = 1 \mu\text{S}$ (Siemens)

$1 \text{ mho} = 1000 \mu\text{mhos} = 1 \text{ S}$

TOTAL SOLIDS (Dried at 103–105°C)**Total Solids-2540 B****Principle:**

A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103 to 105°C. The increase in weight over that of the empty dish represents the total solids. The results may not represent the weight of actual dissolved and suspended solids in wastewater samples.

Interferences:

Highly mineralized water with a significant concentration of calcium, magnesium, chloride, and/or sulfate may be hygroscopic and require prolonged drying, proper desiccation, and rapid weighing.

- Exclude large, floating particles or submerged agglomerates of nonhomogeneous materials from the sample if it is determined that their inclusion is not desired in the final result.
- Disperse visible floating oil and grease with a blender before withdrawing a sample portion for analysis.

Apparatus:**1. Evaporating dishes:**

Dishes of 100-ml capacity made of one of the following materials:

1. Porcelain, 90-mm diam.
2. Platinum—Generally satisfactory for all purposes.
3. High-silica glass

4. Muffle furnace for operation at 550°C.
5. Steam bath.
6. Desiccator
7. Drying oven, for operation at 103 to 105°C.
8. Analytical balance, capable of weighing to 0.1 mg.
9. Magnetic stirrer with TFE stirring bar.
10. Wide-bore pipets
11. Graduated cylinder.
12. Low-form beaker

Procedure:

Preparation of evaporating dish:

- If volatile solids are to be measured ignite clean evaporating dish at 550°C for 1h in a muffle furnace.
- If only total solids are to be measured, heat clean dish to 103 to 105°C for 1h.
- Store and cool dish in desiccator until needed. Weigh immediately before use.

Sample analysis:

- For homogeneous samples, pipet from the approximate midpoint of the container but not in the vortex.
- Choose a point both mid depth and midway between wall and vortex.
- Evaporate to dryness on a steam bath or in a drying oven.
- When evaporating in a drying oven, lower temperature to approximately 2°C below boiling to prevent splattering.
- Dry evaporated sample for at least 1h in an oven at 103 to 105°C, cool dish in desiccator to balance temperature, and weigh.
- Repeat cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained, or until weight change is less than 4% of previous weight or 0.5 mg, whichever is less.
- Analyze at least 10% of all samples in duplicate.
- Duplicate determinations should agree within 5% of their average weight.

Calculation:

$$\text{mg total solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

Where:

A = weight of dried residue + dish, mg.

B = weight of dish, mg.

TOTAL DISSOLVED SOLIDS (TDS) (Dried at 180°C)**Total Dissolved Solids-2540 c****Principle:**

- A well-mixed sample is filtered through a standard glass fiber filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C.
- The increase in dish weight represents the total dissolved solids.
- The results may not agree with the theoretical value for solids calculated from chemical analysis of sample.

Interferences:

Highly mineralized waters with a considerable calcium, magnesium, chloride, and/or sulfate content may be hygroscopic and require prolonged drying, proper desiccation, and rapid weighing.

- Samples high in bicarbonate require careful and possibly prolonged drying at 180°C to insure complete conversion of bicarbonate to carbonate.
- Because excessive residue in the dish may form a water-trapping crust, limit sample to no more than 200 mg residue.

Apparatus:

Apparatus listed in Section 2540B.2 a-h (look at standard methods for the examination of water and wastewater) is required, and in addition:

- A. Glass-fiber filters disks without organic binder.
- B. Filtration apparatus: One of the following, suitable for the filter disk selected:
 - 1. Membrane filter funnel.
 - 2. Gooch crucible, 25-ml to 40-ml capacity, with Gooch crucible adapter.
- C. Suction flask, of sufficient capacity for sample size selected.
- D. Drying oven, for operation at $180 \pm 2^\circ\text{C}$.

Procedure:**Preparation of glass-fiber filter disk:**

- Insert disk with wrinkled side up into filtration apparatus.
- Apply vacuum and wash disk with three successive 20-ml volumes of reagent- grade water.
- Continue suction to remove all traces of water. Discard washings.

Preparation of evaporating dish:

- If volatile solids are to be measured, ignite cleaned evaporating dish at 550°C for 1h in a muffle furnace.
- If only total dissolved solids are to be measured, heat clean dish to 180 ± 2°C for 1h in an oven.
- Store in desiccators until needed and Weigh immediately before use.

Selection of filter and sample sizes:

- Choose sample volume to yield between 2.5 and 200 mg dried residue.
- If more than 10 min are required to complete filtration, increase filter size or decrease sample volume.

Sample analysis:

- Stir sample with a magnetic stirrer and pipet a measured volume onto a glass-fiber filter with applied vacuum.
- Wash with three successive 10-ml volumes of reagent-grade water, allowing complete drainage between washings, and continue suction for about 3 min after filtration is complete.
- Transfer total filtrate (with washings) to a weighed evaporating dish and evaporate to dryness on a steam bath or in a drying oven.
- Dry evaporated sample for at least 1h in an oven at 180 ± 2°C, cool in a desiccator to balance temperature, and weigh.
- Repeat drying cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until weight change is less than 4% of previous weight or 0.5 mg, whichever is less.
- Analyze at least 10% of all samples in duplicate.
- Duplicate determinations should agree within 5% of their average weight.

Calculation:

$$\text{mg total dissolved solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

Where:

A = weight of dried residue + dish, mg.

B = weight of dish, mg.

TOTAL SUSPENDED SOLIDS (Dried at 103 – 105°C)**Total Suspended Solids - 2540 D**

Principle:

- A well-mixed sample is filtered through a weighed standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105°C.
- The increase in weight of the filter represents the total suspended solids.
- If the suspended material clogs the filter and prolongs filtration, it may be necessary to increase the diameter of the filter or decrease the sample volume.
- To obtain an estimate of total suspended solids, calculate the difference between total dissolved solids and total solids.

Interferences:

- Exclude large floating particles or submerged agglomerates of nonhomogeneous materials from the sample if it is determined that their inclusion is not representative.
- Because excessive residue on the filter may form a water-entrapping crust, limit the sample size to that yielding no more than 200 mg residue.
- For samples high in dissolved solids thoroughly wash the filter to ensure removal of dissolved material.

Apparatus

- Apparatus listed in Section 2540B.2 and Section 2540C.2 (look at standard methods for the examination of water and wastewater) is required, except for evaporating dishes, steam bath and 180°C drying oven.

Procedure:**Preparation of glass-fiber filter disk:**

- Apply vacuum and wash disk with three successive 20-mL portions of reagent-grade water.
- Continue suction to remove all traces of water and turn vacuum off, and discard washings.
- Remove filter from filtration apparatus and transfer to an inert aluminum weighing dish.
- If a Gooch crucible is used, remove crucible and filter combination.
- Dry in an oven at 103 to 105°C for 1h.
- If volatile solids are to be measured, ignite at 550°C for 15 min in a muffle furnace.
- Cool in desiccator to balance temperature and weigh.
- Repeat cycle of drying or igniting, cooling, desiccating, and weighing until a constant weight is obtained or until weight change is less than 4% of the previous weighing or 0.5 mg, whichever is less.

Selection of filter and sample sizes:

- Choose sample volume to yield between 2.5 and 200 mg dried residue.
- If volume filtered fails to meet minimum yield, increase sample volume up to 1 l.
- If complete filtration takes more than 10 min, increase filter diameter or decrease sample volume.

Sample analysis:

- Wet filter with a small volume of reagent-grade water to seat it.
- Stir sample with a magnetic stirrer at a speed to shear larger particles, if practical, to obtain a more uniform (preferably homogeneous) particle size.
- **Not:** Centrifugal force may separate particles by size and density, resulting in poor precision when point of sample withdrawal is varied.
- While stirring, pipet a measured volume onto the seated glass-fiber filter.
- For homogeneous samples, pipet from the approximate midpoint of container but not in vortex.
- Choose a point both mid depth and midway between wall and vortex.
- Wash filter with three successive 10-ml volumes of reagent-grade water, allowing complete drainage between washings, and continue suction for about 3 min after filtration is complete.
- Samples with high dissolved solids may require additional washings.
- Carefully remove filter from filtration apparatus and transfer to an aluminum weighing dish as a support.
- Dry for at least 1h at 103 to 105°C in an oven, cool in a desiccator to balance temperature, and weigh.
- Repeat the cycle of drying, cooling, desiccating, and weighing until a constant weight is obtained or until the weight change is less than 4% of the previous weight or 0.5 mg, whichever is less.
- Analyze at least 10% of all samples in duplicate.
- Duplicate determinations should agree within 5% of their average weight.

Calculation:

$$\text{mg total suspended solids/L} = \frac{(A - B) \times 1000}{\text{sample volume, mL}}$$

Where:

A = weight of filter + dried residue, mg.

B = weight of filter, mg.

Salinity:

- (1) The relative concentration of dissolved salts in water.
- (2) The total dissolved solids in salt water after all carbonates and organic matter has been oxidized and all bromide and iodide have been replaced with chloride. This type of salinity is usually reported in grams per kilogram or parts per thousand.

Salinity in parts per thousand empirically is equal to 0.03 plus the value of 1.805 multiplied by chlorinity in parts per thousand. See also chlorinity and chlorosity.

Chlorinity:

- (1) The relative concentration of halides in salt water (typically, seawater).
- (2) The weight of halides in seawater, usually reported in grams per kilogram or parts per thousand of chlorine in seawater. See also chlorosity and salinity.

Chlorosity:

Chlorinity multiplied by the density of the solution water at 68° Fahrenheit (20° Celsius). See also chlorinity and salinity.

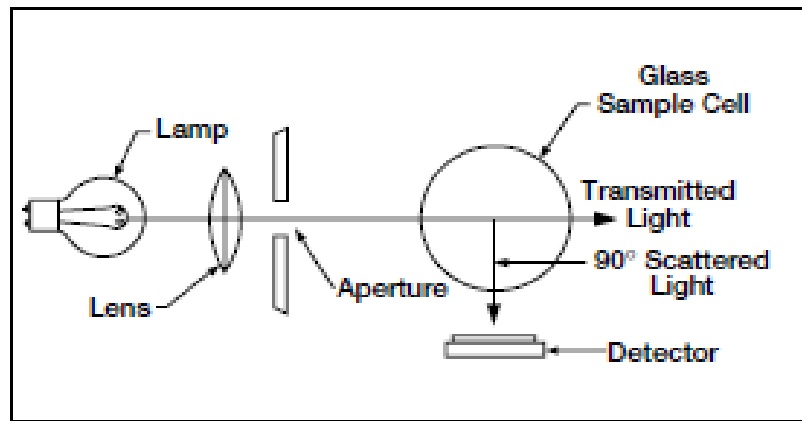
TURBIDITY**Nephelometric turbidity Method-2130 B****Sources and Significance:**

Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms.

Clarity of water is important in producing products destined for human consumption and in many manufacturing operations. Beverage producers, food processors, and potable water treatment plants drawing from a surface water source commonly rely on fluid-particle separation processes such as sedimentation and filtration to increase clarity and insure an acceptable product. The clarity of a natural body of water is an important determinant of its condition and productivity.

Principle:

This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity and vice versa



Interference:

Debris and rapidly settling coarse sediment interfere with turbidity measurements. Dirty glassware and the presence of air bubbles give false results. “True color” i.e., Water color due to dissolved substances that absorb light causes measured turbidities to be low. This effect usually is not significant in treated water.

Apparatus:

A. Laboratory or Nephelometer

Turbidity measurements are done conveniently through the use of photometers. A beam of light from a source produced by a standardized electric bulb is passed through a sample vial. The light that emerges from the sample is then directed to a photometer that measures the light absorbed.

B. Sample cells

Reagents:

- Deionized water its Turbidity less than limit of quantitation of the method.
- Formazin set of standards ready to use its values 1, 20, 200, 1000 and 4000 NTU

Procedure:

A. General measurement techniques:

The measurement will be more accurate, precise, and repeatable if close attention is paid to proper measurement techniques.

1. Measure turbidity immediately to prevent temperature changes and particle flocculation and sedimentation from changing sample characteristics.
2. If flocculation is apparent, break up aggregates by agitation.

3. Particles suspended in the original sample may dissolve or otherwise change characteristics when the temperature changes or when the sample is diluted.
4. Remove air or other entrained gases in the sample before measurement. Preferably degas even if no bubbles are visible. Degas by applying a partial vacuum, adding a non foaming-type of surfactant, using an ultrasonic bath, or applying heat.
5. If degassing cannot be applied, bubble formation will be minimized if the samples are maintained at the temperature and pressure of the water before sampling.
6. Do not remove air bubbles by letting sample stand for a period of time because during standing turbidity-causing particulates may settle and sample temperature may change.
7. Condensation may occur on the outside surface of a sample cell when a cold sample is being measured in a warm, humid environment. This interferes with turbidity measurement.
8. Remove all moisture from the outside of the sample cell before placing the cell in the instrument.
9. If fogging recurs, let sample warm slightly by letting it stand at room temperature or by partially immersing it in a warm water bath for a short time.
10. Make sure samples are again well mixed.

Measurement

1. Fill the sample cell to the line (approximately 10 ml), cap the sample cell.
2. Hold the sample cell by the cap, and wipe to remove water spots and fingerprints.
3. Gently mix the sample cells **by slowly and gently inverted the sample cell** to homogenize the sample, be sure to eliminate the air bubbles
4. Apply a thin bead of silicone oil from the top to bottom of the cell just enough to coat the cell with a thin layer of oil. Using the oiling cloth provided spread the oil uniformly, then wipe off the excess. The cell should appear nearly dry.



5. Insert the cell in the cell holder, and press the ENTER key.
6. The instrument displays the turbidity measure of the sample in NTUs (Nephelometric turbidity units)

Note: The instrument's response time is 14 seconds.

Calculations:

- Sample results are read directly from the meter display.

Quality control:

Internal quality control

12.1.1 Construction of quality control chart.

Accuracy chart (Schwarte-chart)

- The laboratory shall construct accuracy chart to control accuracy for the analyzing of Control samples by analyzing 1NTU standard solution with each sample batch and plot the result in X chart to ensure that the results within the criteria of acceptance to continue the method.

N.B.: the control charts are printed every 20 readings.

Reagent Blank:

- A reagent blank or method blank consists of reagent water and all reagents that normally are in contact with a sample during the entire analytical procedure.
- The reagent blank is used to determine the contribution of the reagents and the analytical steps to error in the measurement.
- The Milli-Q water or deionized water is used as blank. The reagent blank should be analyzed with each sample batch.

Duplicate sample:

- At least 10% of each sample batch shall be analyze in duplicate.

Relative percent difference (RPD)

$$RPD = \frac{(\text{sample result} - \text{duplicate result})}{(\text{sample result} + \text{duplicate result})/2} \times 100\%$$

Reporting:

- Turbidity value expressed by NTU unit
- Number of significant figures is three.

COLOR

Principle

- Color in water may result from the presence of natural metallic ions (iron and manganese), humus and peat materials, plankton, weeds, and industrial wastes. Color is removed to make water suitable for general and industrial applications. Colored industrial wastewaters may require color removal before discharge into watercourses.
- Color may be expressed as “apparent” or “true” color. The apparent color includes that from dissolved materials plus that from suspended matter. By filtering or centrifuging out the suspended materials, the true color can be determined. The procedure describes true color analysis. If apparent color is desired, it can be determined by measuring an unfiltered water sample. Color, either true or apparent, after pH adjustment, is determined at wavelength 465 nm.

Definition:

- True color: That is, the color of water from which turbidity has been removed.
- Apparent color: Includes not only color due to substances in solution, but also that due to suspended matter. (Apparent color is determined on the original sample without filtration or centrifugation).

Interference:

- For True color, turbidity may interfere, remove by filtration.

Equipments:

- Spectrophotometer.
- Filter membrane, 47-mm, and 0.45-microns.
- Flask, 500-mL.
- Sample Cells, 1-inch square, 10 mL, matched pair.

Chemical and reagents:

- Color Standard Solution, 500 platinum-cobalt units.
- Hydrochloric Acid Solution, 1.0 N.
- Sodium Hydroxide, 1.00 N.
- Water, deionized.

Precautions:

- Collect samples in clean plastic or glass bottles. Most reliable results are obtained when samples are analyzed as soon as possible after collection.

If prompt analysis is impossible, fill bottles completely and cap tightly. Avoid excessive agitation or prolonged contact with air.

- Samples can be stored for 24 hours by cooling to 4 °C (39 °F). Warm to room temperature before analysis.

Procedure:

- Note: to test for apparent color, Omit steps 6, 7, 8, 9 and 11, use unfiltered deionized water in step 10, and unfiltered sample in step 12.

1. Sample preparation:

Adjust the sample pH to 7.6 using 1.0 N sodium hydroxide and 1.0 N Hydrochloric acid, so that the overall volume change should not exceed 1%. If the volume change exceeds 1%, start over and use a stronger acid or base.

2. Switch the Instrument On, by pressing the On/Off switch at the back of the instrument.
3. Collect 250 ml of sample in a 500 ml beaker.
4. Assemble the filtering apparatus (0.45 micron membrane filter & Syringe).
5. Rinse the filter by pouring about 50 ml of deionized water through the filter. Discard the rinse water.
6. Pour another 50 ml of deionized water through the filter.
7. Blank Preparation: fill a square sample cell with 10 ml of filtered deionized water from and discard the excess water in the flask.
8. Pour about 50 ml of the sample through the filter.
9. Prepared sample: fill a second square sample cell with 10ml of filtered sample.
10. Wipe the blank and insert it into the cell holder with the fill line facing right.
11. Press "ZERO", the display will show 0.00 units Pt Co.
12. Wipe the prepared sample and insert it into the cell holder with the fill line facing right. Press READ, results are displayed in mg/L Pt Co.

Calculations:

- Sample results are read directly from the instrument display

Quality control:

Construction of quality control chart.

Accuracy chart (Schwartz-chart)

The laboratory shall construct accuracy chart to control accuracy for the analyzing of Control samples by analyzing 20 Pt/Co standard solution with each sample batch and plot the result in X chart to ensure that the results within the criteria of acceptance to continue the method.

Reagent Blank:

A reagent blank or method blank consists of reagent water and all reagents that normally are in contact with a sample during the entire analytical procedure.

Laboratory Fortified matrix (LFM)

One sample is select from each batch to be fortified with known concentration of color standard, the fortified sample is analyze and the sample is analyze without fortification.

$$\% \text{ Recovery} = \frac{(\text{LFM sample result} - \text{sample result})}{\text{known LFM added concentration}} \times 100\%$$

Duplicate sample:

At least 10% of each sample batch shall be analyzed in duplicate.

Relative percent difference (RPD)

$$RPD = \frac{(\text{sample result} - \text{duplicate result})}{(\text{sample result} + \text{duplicate result})/2} \times 100\%$$

Laboratory-Fortified Blank or lab. control sample (LCS)

A laboratory-fortified blank is a reagent water sample to which a known concentration of the analytes of interest has been added. A LFB is used to evaluate laboratory performance and analyte recovery in a blank matrix. As a minimum, include one LFB with each sample set (batch)

$$\% \text{ Recovery} = \frac{\text{found value}}{\text{true value}} \times 100\%$$

Reporting:

Results are expressed as Pt Co unit for two decimals above 15 Pt Co Units, and results below 15 Pt Co units are reported as "Nil".

المراجع

• تم الإعداد بمشاركة المشروع الألماني GIZ

• و مشاركة السادة :-

- د/ سناء أحمد الإله شركة مياه الشرب والصرف الصحى بالفيوم
- د/ شعبان محمد على شركة مياه الشرب والصرف الصحى بالفيوم
- د/ حمدى عطيه مشالى شركة مياه الشرب والصرف الصحى بالغربية
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- د/ عبدالحفيظ السحيمي شركة مياه الشرب بالقاهرة الكبرى
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