ffem match user manual

ffem
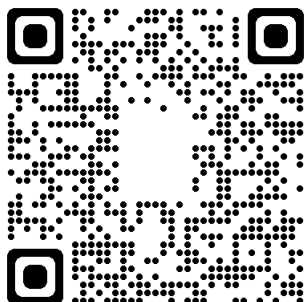
November 23, 2022

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1 Introduction

ffem match is a water testing app from Foundation for Environmental Monitoring (ffem). Download the app from https://play.google.com/store/apps/details?id=io.ffem.match or scan the QR Code below.

2 General Operation

2.1 Principle

ffem builds water and soil tests based on colorimetry or titration. We ocassionally ship third party meters to complete functionality provided by our kits.

2.2 Colorimetry

Colorimetry is principle of measuring the concentrations of analytes by measuring a change in colour induced by a reagent. Usually this would be done by eye comparing against a colour card in the field, or using a colorimeter, or for best results, using a spectrometer. ffem's colorimtric tests work by using the camera on an Android phone and produces results that are close to that of a standard laboratory test.

Before you begin to test using colorimetry, you need to calibrate your phone. The calibration step creates an internal table with which colours captured by the camera are compared with. There are two kind of calibrations offered: the minimal calibration and the complete calibration.

Colorimetric testing is carried out by mixing the sample with the reagent in the quantities and method specified. The resulting solution is then placed in the appropriate cuvette. Clip the ring light over your phone and turn it on to its brightest setting. Place the cuvette under the light stand and the phone over the light stand. Position the cuvette so that it is directly under the camera and the sampling circle is in the brightest central spot. On analysing the colour, the app with match it with the calibration table and produce an interpolated result.

The exact steps to be followed for testing are listed against each parameter.

2.3 Titration

ffem offers some simplified titration tests. First the sample is to be prepared for titration by adding one or more reagents. Add the titrant dropwise to the sample and shake, while keeping count of the drops. At some point there will be a colour change, the app will convert the number of drops added till the change in colour to the concentation of the analyte.

The steps to be followed for each titration is listed against the respective parameter.

3 Precautions

Most tests use standard solutions, chemical reagents, and titrants. It is important to exercise care and cautions while using them.

3.1 Precautions while storing and using the kit

Store the kit in a cool, dry place. Keep out of reach of children and animals. Avoid chemicals coming in contact with skin and eyes. Recommended usage of gloves and eye protection. If chemicals do come in contact with skin

and eyes, rinse thoroughly with water and seek medical attention. Conduct tests in well lit and well insulated areas away from direct sunlight.

3.2 Disposal of reagents

Dispose used reagents in the bottle mrked for disposal. This bottle contains activated charcoal. Dry out the bottle outdoors to allow more liquids to be disposed. After using the entire kit, empty out the activaed charcoal and dipose it in your area's medical / hazardous waste facility.
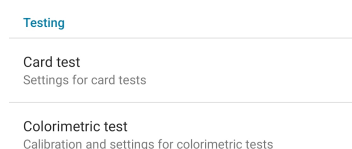
4 Minimal and Full Calibration

4.1 Why

Colorimetric tests are fairly accurate, but require calibration to work. There is always an investment in time, effort and material with each point that needs to be calibrated. A minimal calibration is the least number of points you need to calibrate for to have a working device of reasonable accuracy. Typically these are three points per parameter. A full calibration will give you accurate results, but need a larger number of points.

4.2 Calibration settings

Go to `Settings`.
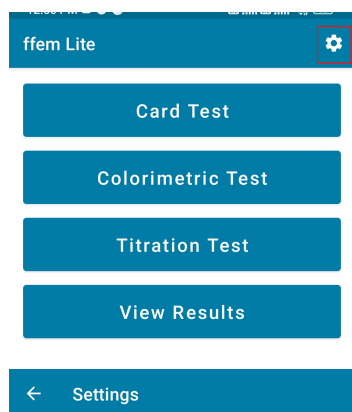
Choose `Colorimetric Test`
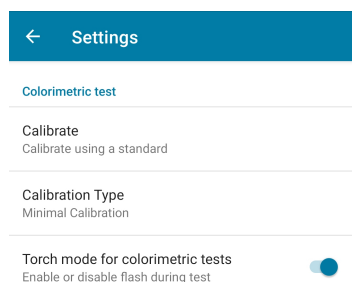
Choose Minimal or Full Calibration as required.

5 Colour / Hazen Units

5.1 Principle

Water colour is measured in Hazen Units (HU), and is a measure of the cleanness of the water source. Distilled water should have a colour of 0 HU.

The Indian Standard for drinking water holds that the acceptable limit is 5 Hazen Units, but in the absence of any other toxic substances or alternate source, this is relaxable upto 15 Hazen Units.
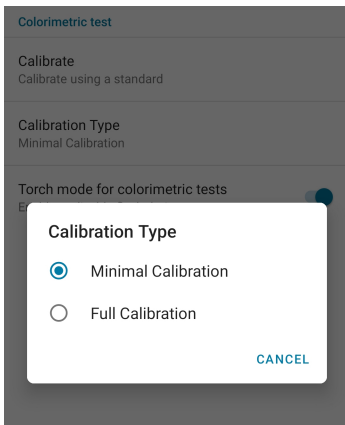
5.2 Calibration

To prepare calibration standards, take 20 ml of distilled water. Depending on if you chose minimal or full calibration, prepare standards as below.

Full Calibration

Standard	Drops
0 HU	0
25 HU	10
50 HU	20
100 HU	40

Minimal Calibration

Standard	Drops
0 HU	0
50 HU	20
100 HU	40

You do not need to add any reagent for this test.

- Take the 0 standard and fill it into the cuvette. In this case you will need to add the standard to the tall glass tube, and place it into the white cuvette.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness

- Place the phone over the stand

- Go to Settings >Colorimetric Test >Calibrate >Water and choose Hazen Units

- Select the calibration point, 0.00 HU in this case

- Click on Start Camera.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select Analyze

- You should have your first calibration point. Repeat similarly with the other calibration points.

5.3 Test

This test does not require a reagent.

- Collect 20 ml of sample water and place in cuvette. In this case you will need to add the standard to the tall glass tube, and place it into the white cuvette.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness.

- Place the phone over the stand.

- From the home screen choose `Colorimetric Test >Water >Hazen Units`.

- Choose No Dilution if this is the first test, you might have to dilute the sample and retry later if you get an error.

- Click on `Start Camera`.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`.

- After some time, the app will display a result

6 Turbidity

6.1 Principle

Turbidity, measured in NTU is a colorimetric test with no reagents. Turbidity is a measure of how clear water is. Distilled water should have turbidity of 0 NTU.

The Indian Standard for drinking water holds that the acceptable limit is 1 NTU, but in the absence of any other toxic substances or alternate source, this is relaxable upto 5 NTU.

6.2 Calibration

To prepare calibration standards, take 20 ml of distilled water. Depending on if you chose minimal or full calibration, prepare standards as below.

Full Calibration

Standard	Drops
0 NTU	0
10 NTU	10
20 HU	20
30 HU	30

Minimal Calibration

Standard	Drops
0 NTU	0
10 NTU	10
30 HU	30

You do not need to add any reagent for this test. **Shake the standard solutions dropper bottle thoroughly**

- Take the 0 standard and fill it into the glass cuvette provided. Place the glass cuvette inside the blue cuvette.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness

- Place the phone over the stand

- Go to `Settings >Colorimetric Test >Calibrate >Water` and choose `Turbidity`

- Select the calibration point, 0.00 NTU in this case

- Click on `Start Camera`

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`
- You should have your first calibration point. Repeat similarly with the other calibration points.

6.3 Test

This test does not require a reagent.

- Collect 20 ml of sample water and place in glass cuvette and in turn inside the blue cuvette.
- Place the cuvette under the light stand.
- Clip on the ring light over your phone and turn it on to maximum brightness
- Place the phone over the stand
- From the home screen choose `Colorimetric Test` >`Water` >`Turbidity`
- Choose `No Dilution` if this is the first test, you might have to dilute the sample and retry later if you get an error.
- Click on `Start Camera`.
- Position the cuvette so that the middle, most uniformly lit portion is within the circle.
- Select `Analyze`.
- After some time, the app will display a result.

7 pH

7.1 Principle

pH is a colorimeteric test. pH is a measure of how acidic or basic the water is.

Indian standards for drinking water specify it to be within 6.5 and 8.5 with no relaxation.

7.2 Calibration

pH standards based on buffer solutions should be supplied to you. You should have standards of pH 4, 5, 6, 7, 8, 9 and 10.

Take 5 ml of the pH standard, say 4, and add 1 drop of the pH indicator.

- Take the resulting coloured solution and fill it into the white cuvette provided.
- Place the cuvette under the light stand.
- Clip on the ring light over your phone and turn it on to maximum brightness.
- Place the phone over the stand.
- Go to `Settings` >`Colorimetric Test` >`Calibrate` and choose pH.
- Select the calibration point, 4 in this case.
- Click on `Start Camera`.
- Position the cuvette so that the middle, most uniformly lit portion is within the circle.
- Select `Analyze`.
- You should have your first calibration point. Repeat similarly with the other calibration points.

7.3 Test

This test uses the pH indicator.

- Collect 5 ml of sample water, add 1 drop of pH indicator and place in the white cuvette.
- Place the cuvette under the light stand.
- Clip on the ring light over your phone and turn it on to maximum brightness

- Place the phone over the stand

- From the home screen choose `Colorimetric Test >Water >pH`.

- Choose `No Dilution` if this is the first test, you might have to dilute the sample and retry later if you get an error.

- Click on `Start Camera`.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`.

- After some time, the app will display a result.

8 Fluoride

8.1 Principle

Fluoride is a colorimeteric test. This test uses a modified SPADNS reagent.

The Indian Standard for drinking water holds that the acceptable limit is 1 mg/l, but in the absence of any other toxic substances or alternate source, this is relaxable upto 1.5 mg/l.

8.2 Calibration

To prepare calibration standards, take 5 ml of distilled water. Depending on if you chose minimal or full calibration, prepare standards as below.

Full Calibration

Standard	Drops
0 mg/l	0
0.5 mg/l	1
1 mg/l	2
1.5 mg/l	3
2 mg/l	4

Minimal Calibration

Standard	Drops
0 mg/l	0
1 mg/l	2
2 mg/l	4

Take 5 ml of the 0 mg/l Fluoride standard, and add 5 drops of the Fluoride reagent.

- Take the resulting coloured solution and fill it into the white cuvette provided.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness

- Place the phone over the stand

- Go to `Settings >Colorimetric Test >Calibrate` and choose `Fluoride`.

- Select the calibration point, 0 mg/l in this case

- Click on `Start Camera`

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`.

- You should have your first calibration point. Repeat similarly with the other calibration points.

8.3 Test

This test uses the Fluoride reagent.

- Collect 5 ml of sample water, add 5 drops of Fluoride reagent and place in the white cuvette.
- Place the cuvette under the light stand.
- Clip on the ring light over your phone and turn it on to maximum brightness
- Place the phone over the stand
- From the home screen choose `Colorimetric Test` >`Water` >`Fluoride`.
- Choose `No Dilution` if this is the first test, you might have to dilute the sample and retry later if you get an error.
- Click on `Start Camera`.
- Position the cuvette so that the middle, most uniformly lit portion is within the circle.
- Select `Analyze`.
- After some time, the app will display a result.

9 Nitrate

9.1 Principle

Nitrate is a colorimeteric test. This test uses 2 reagents per test that are shipped in small packets.

The Indian Standard for drinking water holds that the acceptable limit is 45 mg/l with no relaxation.

9.2 Calibration

To prepare calibration standards, take 5 ml of distilled water. Depending on if you chose minimal or full calibration, prepare standards as below.

Full Calibration

Standard	Drops
0 mg/l	0
10 mg/l	2
25 mg/l	5
50 mg/l	10
75 mg/l	15

Minimal Calibration

Standard	Drops
0 mg/l	0
50 mg/l	10
75 mg/l	15

Take 5 ml of the 0 mg/l Nitrate standard, and add the contents of Reagent A and Reagent B. Shake till dissolved.

- Take the resulting coloured solution and fill it into the white cuvette provided.
- Place the cuvette under the light stand.
- Clip on the ring light over your phone and turn it on to maximum brightness
- Place the phone over the stand
- Go to `Settings` >`Colorimetric Test` >`Calibrate` and choose `Nitrate`.
- Select the calibration point, 0 mg/l in this case
- Click on `Start Camera`.
- Position the cuvette so that the middle, most uniformly lit portion is within the circle.
- Select `Analyze`.

- This test takes 6 minutes (360 seconds) to develop ideal colour. Click on `Start Timer` to start a timer, or you can `Skip Delay` if you have already waited 5 minutes.

- You should have your first calibration point. Repeat similarly with the other calibration points.

9.3 Test

This test uses the Nitrate reagents.

- Collect 5 ml of sample water, add the contents of Reagent A and Reagent B and place in the white cuvette.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness.

- Place the phone over the stand.

- From the home screen choose `Colorimetric Test` >`Water` >`Nitrate`.

- Choose No Dilution if this is the first test, you might have to dilute the sample and retry later if you get an error.

- Click on `Start Camera`.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`.

- This test takes 6 minutes (360 seconds) to develop ideal colour. Click on `Start Timer` to start a timer, or you can `Skip Delay` if you have already waited 5 minutes.

- After some time, the app will display a result.

10 Total Iron

10.1 Principle

Iron is a colorimeteric test. This test uses two liquid reagents.

The Indian Standard for drinking water holds that the acceptable limit is 0.3 mg/l with no relaxation.

10.2 Calibration

To prepare calibration standards, take 5 ml of distilled water. Depending on if you chose minimal or full calibration, prepare standards as below.

Full Calibration

Standard	Drops
0 mg/l	0
0.5 mg/l	1
1 mg/l	2
1.5 mg/l	3
2 mg/l	4

Minimal Calibration

Standard	Drops
0 mg/l	0
1 mg/l	2
2 mg/l	4

Take 5 ml of the 0 mg/l Iron standard, and add 3 drops of Reagent A, shake well, then add 20 drops of Reagent B and shake well.

- Take the resulting coloured solution and fill it into the white cuvette provided.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness.

- Place the phone over the stand.

- Go to `Settings` >`Colorimetric Test` >`Calibrate` and choose Total Iron.

- Select the calibration point, 0 mg/l in this case.

- Click on `Start Camera`.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- This test takes 5 minutes (300 seconds) to develop ideal colour. Click on `Start Timer` to start a timer, or you can `Skip Delay` if you have already waited 5 minutes.

- You should have your first calibration point. Repeat similarly with the other calibration points.

10.3 Test

This test uses the Iron Reagents.

- Collect 5 ml of sample water, add 3 drops of Reagent A, shake well, and add 20 drops of Reagent B, shake well, and place in the white cuvette.

- Place the cuvette under the light stand.

- Clip on the ring light over your phone and turn it on to maximum brightness.

- Place the phone over the stand.

- From the home screen choose `Colorimetric Test` >`Water` >`Total Iron`.

- Choose No Dilution if this is the first test, you might have to dilute the sample and retry later if you get an error.

- Click on `Start Camera`.

- Position the cuvette so that the middle, most uniformly lit portion is within the circle.

- Select `Analyze`.

- This test takes 5 minutes (300 seconds) to develop ideal colour. Click on `Start Timer` to start a timer, or you can `Skip Delay` if you have already waited 5 minutes.

- After some time, the app will display a result.

11 Total Hardness

11.1 Principle

Total Hardness is a titration test.

The Indian Standard for drinking water holds that the acceptable limit is 200 mg/l, but in the absence of any other toxic substances or alternate source, this is relaxable upto 600 mg/l.

11.2 Calibration

No calibration is needed for this test

11.3 Test

- Take 25 ml of water sample in 50 ml measuring tube, add 1 ml of Total Hardness Reagent A and add one small spoon of Total Hardness Reagent B.

- A wine red color develops if hardness is present. If the solution continues to remain colourless, hardness is 0.

- Titrate the red wine color solution till turns blue, by adding drops of the Total Hardness Titrant. Keep count of the number of drops till the solution turns blue. Shake the solution on addition of each drop.

- On the app, go to Titration Test ¿ Total Hardness and enter the number of drops.

- This should give you the result in mg/l.

12 Total Alkalinity

12.1 Principle

Total Alkalinity is a titration test.

The Indian Standard for drinking water holds that the acceptable limit is 200 mg/l, but in the absence of any other toxic substances or alternate source, this is relaxable upto 600 mg/l.

12.2 Calibration

No calibration is needed for this test

12.3 Test

Total Alkalinity is the sum of P and T Alkalinity.

P - Alkalinity

- Take 10 ml of sample in a measuring tube, and add 3 drops of P-Alkalinity Reagent A.
- If the solution turns pink, titrate it with P-Alkalinity Titrant by adding drops and keeping count of the number of drops till the colour changes from pink to colourless.
- If the solution does not turn pink P-Alkalinty is 0.
- On the app, go to Titration Test ¿ Total Alkalinity and enter the number of drops in the first textfield.
- This should give you the result in mg/l.

T - Alkalinity

- To the same measuring tube add 3 drops of T-Alkalinity Reagent, The colour should change to blue.
- Titrate it with T-Alkalinity Titrant till turns reddish by adding it dropwise. Keep count of the number of drops.
- On the app, go to Titration Test ¿ Total Alkalinity and enter the number of drops in the second textfield.
- This should give you the result in mg/l.