# Determination of Acid number and free fatty acids (FFA) in fats and oils

## Description

Free fatty acids (FFA) in plant oils and fats (e.g. edible oils and fats) are a quality feature for these fats. Fats with high levels of FFA are more susceptible to oxidative aging, they become rancid more quickly. The FFA should be removed during a refining process.
Determination of the FFA in Oils and fats is done by potentiometric titration in Ethanol / Diethyl ether as solvent with KOH in Isopropyl alcohol.
The method is suitable for edible fats and oils such as butter, olive, palm or sunflower oil. The acid number is the quantity of base, expressed in milligrams of potassium hydroxide, which is required to neutralize all acidic constituents present in 1 g of sample. The calculation of % FFA depends on the type of titrated sample and the fatty acid to which the result is to be calculated.

The result is calculated as mg $_{(KOH)}$ / g or as $\%_{fatty\ acid}$ (mainly as % oleic acid with $M_{oleic\ acid}$ = 282,47 g/mol).

## Instruments

| | |
|---|---|
| Titrator | TL 7000 or higher |
| Electrode | N 6480 eth |
| Cable | L 1 A |
| Stirrer | Magnetic stirrer TM 235 or similar |
| Lab accessory | glass beaker 150 ml |
| | Magnetic stirrer bar 30 mm |

## Reagents

| | |
|---|---|
| 1 | KOH 0,1 mol/l in Isopropylalcohol |
| 2 | Ethanol, absolute |
| 3 | Diethylether |
| 4 | Distilled water |
| All reagents should be of analytical grade or better. | |

## Titration procedure

### Reagents

**KOH in Isopropyl alcohol 0.1 mol/l**
It is recommended to use a ready 0.1 mol/l solution.
The solution must be protected against $CO_2$ with a $CO_2$ absorbent like soda lime.
The titer determination is done as described in the application note “Titer KOH”.

**Solvent mixture**
500 ml absolute Ethanol and 500 ml Diethyl ether are mixed in a bottle.

### Cleaning of the electrode

For cleaning and conditioning of the electrode 3 steps are necessary:
First the electrode is rinsed with the solvent mixture to remove residues of the sample.
Then it is conditioned in water.
After the conditioning step the electrode is rinsed with solvent mixture to remove the water.
The electrode is stored in a solution of 1.5 mol/l LiCl in Ethanol (or, if another electrolyte is used, in this electrolyte solution).

### Blank value

For blank titration 70 ml solvent are placed in a 150 ml beaker and titrated with 0.1 mol/l KOH. The Blank should be below 0.3 ml.

### Sample preparation

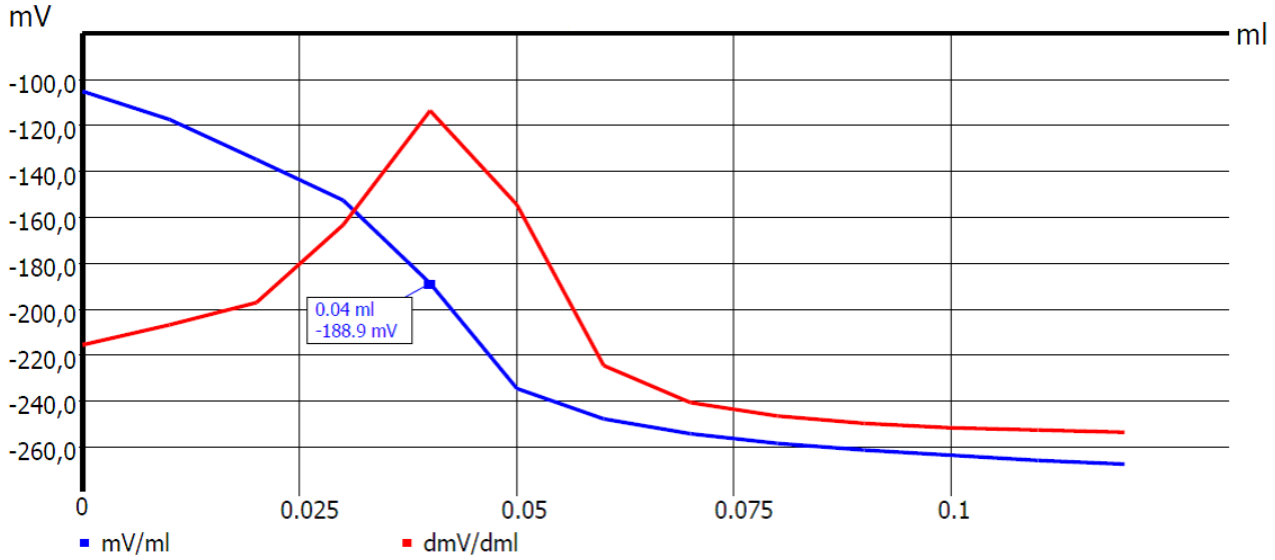
The sample is weighed into a 150 ml beaker and dissolved in 70 ml of the solvent. It can be necessary to heat the mixture to increase the solubility of the oil/fat, especially with solid fats (e.g. coconut fat). After a complete dissolution the sample is titrated with 0.1 mol/l KOH.

The sample weight should be selected that the titration amount is not more than 4-5 ml because of the long titration time. The required amount of sample depends on the expected Acid number ($mg_{KOH}/g$).

| Expected acid value ($mg_{KOH}/g$) | Sample amount [g] |
|---|---|
| 0.2 - 1 | 10 - 20 |
| 1 - 10 | 1 - 3 |

## Titration parameter

### Blank titration



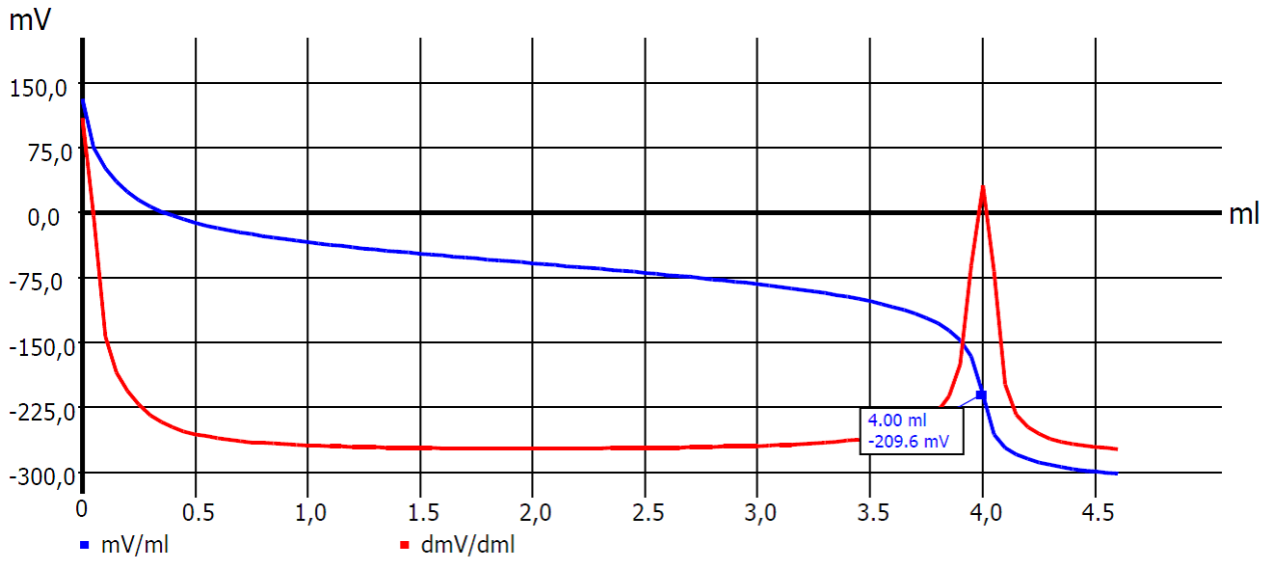

| | | | |
|---|---|---|---|
| Default method | Blank TAN-TBN | | |
| Method type | Automatic titration | | |
| Modus | linear | | |
| Measured value | mV | | |
| Measuring speed / drift | User defined | Fixed delax time | 12 s |
| Initial waiting time | 10 s | | |
| Linear Steps | 0.01 ml | | |
| Damping | strong | Titration direction | decrease |
| Pretitration | off | Delay time | 0 s |
| End value | off | | |
| EQ | On (1) | Slope value | 60 |
| Max. titration volume | 0.3 ml | | |
| Dosing speed | 100% | Filling speed | 30 s |

Calculation:

$$ml = EQ1$$

The result is saved in a global memory, e.g. M01. We recommend to use statistics = 3.

**Sample titration**




| | | | |
|---|---|---|---|
| Default method | -- | | |
| Method type | Automatic titration | | |
| Modus | linear | | |
| Measured value | mV | | |
| Measuring speed / drift | User defined | Minimum holding time | 7 s |
| | | Maximum holding time | 20 s |
| | | Measuring time | 4 s |
| | | Drift | 10 mV/min |
| Initial waiting time | 10 s | | |
| Linear Steps | 0.05 ml | | |
| Damping | strong | Titration direction | decrease |
| Pretitration | off | Delay time | 0 s |
| End value | off | | |
| EQ | On (1) | Slope value | 120 |
| Max. titration volume | 6 ml | | |
| Dosing speed | 100% | Filling speed | 30 s |

For samples with very low FFA values the linear steps can be reduced to 0.02 or 0.01 ml.

Calculation:

$$Acid\ number\ [mg(KOH)/g] = \frac{(EQ1 - B) * T * M * F1}{W * F2}$$

| | | |
|---|---|---|
| B | M01 | Blank value, saved in global Memory M01 |
| EQ1 | | Consumption of titrant at first Equivalence point |
| T | WA | concentration of the titrant |
| M | 56,11 | Molecular mass |
| W | man | Weight of the sample in g |
| F1 | 1 | Conversion factor |
| F2 | 1 | Conversion factor |

$$FFA\ [\%] = \frac{(EQ1 - B) * T * M * F1}{W * F2}$$

| | | |
|---|---|---|
| B | M01 | Blank value, saved in global Memory M01 |
| EQ1 | | Consumption of titrant at first Equivalence point |
| T | WA | concentration of the titrant |
| M | 282,47 | Molecular mass of oleic acid |
| W | man | Weight of the sample in g |
| F1 | 0.1 | Conversion factor |
| F2 | 1 | Conversion factor |

If the result is to be expressed as another fatty acid, M must be the molecular weight of this fatty acid.

Any questions? Please contact the application team:

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