Autotitrator

mpt-2

Technical Information and Specifications

detailed specification sheets from www.malvern.co.uk/autotitrator

MALVERN INSTRUMENTS

MPT-2 Autotitrator

Description

The MPT-2 autotitrator is an optional accessory compatible with all members of the Zetasizer Nano series. It is designed as a sample preparation station to automate changes in the sample conditions between measurements of size, intensity and zeta potential.

The sample conditions that can be changed are: pH, conductivity, the concentration of an additive and the sample concentration.

Features

- The minimum sample volume is as low as 2.5mL
- Three titrant syringes are built in that can each be assigned to acid, base, additive or different concentrations of the same titrant
- The titrant positions and software are colour coded to ensure the correct titrant is programmed
- All settings are integrated into the standard software operating procedure (SOP) for simplest operation and to ensure repeatability
- A software controlled magnetic stirrer is incorporated to ensure additives are mixed rapidly to ensure fast equilibration
- Multiple measurements of size, zeta potential and intensity can be made at each point as requested
- The sample tubing is replaceable
- The pump speed is variable and controlled through the software
- A disposable polypropylene sample container is used, which is also used for the titrants
- A fast response, liquid filled pH probe is supplied with buffer capsules and top-up fluid
- An optional sample filter can be fitted to improve repeatability with materials such as proteins
- Connection is through the Zetasizer optics unit, no extra connection to the PC is required
- An evolving plot of the titration trend is displayed during the titration
- A pre-scan option enables the system to ‘learn’ about the sample and this is used to shorten subsequent titrations
- Reports are included for all titration types

Modes of operation

pH titration

The system can be set up to measure at up to 100 points between the ranges 1pH to 13pH units, and to titrate with either acid or base.

A novel feature is that two or even three different concentrations of acid or base can be connected simultaneously. During a titration, the system will automatically select the appropriate concentration of titrant. This has a number of benefits. It allows a concentrated titrant to be used to reach the extremes of pH without having to add large quantities of titrant. It also enables an accurate pH to be achieved when close to pH 7 without overshooting the target pH.

The titration procedure takes sample buffering capacity into account. It does this by adding titrant in small quantities and measuring the actual effect on pH and comparing this with the expected effect. This ratio is incorporated into an efficiency algorithm that is used to predict the next addition. The effect of this is to shorten the time taken for the titration while minimising the risk of overshooting the target pH

Log additive titration (Conductivity)

This function automates the change of the concentration of an additive such as a salt. The usual purpose for this mode is for a conductivity titration. As the effect of a change in conductivity on the zeta potential is related to the log of the ionic strength for indifferent electrolytes, this titration mode spaces the points logarithmically. This means that the points are more evenly spaced in terms of the zeta potential.

Linear additive titration

This function enables the investigation of the effect of any additive such as surfactant or salt on the size and zeta potential of the sample. The points are linearly spaced, e.g. 1ppm additive, 2ppm, 3ppm etc.

Dilution titration

Typical use of this function is to investigate the effect of dilution on the size of the sample. This measurement procedure is required by ISO 13321 to ensure that the sample concentration is appropriate. The MPT-2 can automate this procedure.

Theory of operation

The MPT-2 is purpose designed as a sample preparation station for the Zetasizer Nano series. The three titrants can be used for conductivity and additive titrations as well as acid/base titrations. An external container of diluent can be used for dilution titrations.

A unique function is the ability to use different concentrations of the same titrant in the same titration, for example 0.25M acid and 0.01M acid. This enables a titration that uses little volume of titrant at the extremes of pH, and at the same time accurate pH adjustment close to pH 7.

The syringes are the displacement type, sealed using a Viton 'O' ring. One stroke of the piston is 84 microlitres in 300 steps, each of 0.28 microlitres. The valves directing the titrants are low dead volume valves, in a single manifold custom designed for this application.

The unit contains an integral peristaltic pump to circulate the sample from the sample container through the flow cell in the optics unit.

There are two flow cell options, the standard ZEN1060 folded capillary cell for measurement of both size and zeta potential, and the ZEN0023 quartz flow cell for size measurement. This quartz cell is recommended for dilute or poorly scattering samples such as proteins or nanoparticles less than 20nm in diameter.

The sample container uses a magnetic stirrer to mix the sample and titrants and to ensure pH equilibration in the shortest possible time.

The software controls all aspects of the titration and measurement. The protocol is stored as a standard operating procedure (SOP) to ensure repeatability.

The titration algorithm is designed to shorten the time for the titration and minimise the chance of overshoot of the target pH. This is necessary because the chemistry of many systems shows 'hysteresis'. Zeta potential in particular will depend on the history of the chemistry of the sample. This means that it is not usually possible to 'hunt' for the correct value using both acid and base. The target pH must be achieved by approaching from one direction, and the algorithm is designed to do this in a short a time as possible.

The pre-scan mode is a fast titration of a portion of the sample of interest, the results of which are stored in the SOP being used. This enables the system to learn about the buffering capacity of the sample. Subsequent titrations make use of this information to shorten the titration without overshooting the target pH points. For even moderately buffered samples, the total time taken for a pre-scan plus the actual titration can be shorter than the single titration without the pre-scan. Subsequent measurements of similar samples can use the stored pre-scan data.

Specifications

Compatibility	Zetasizer Nano S, Z, ZS, S90, ZS90
Number of titrants	Maximum of 3 connected simultaneously
Titrant volume	25mL for standard internal tubes, unlimited for external containers
Minimum dispense volume	0.28µL, 1.68µL during standard titration
Maximum dilution factor	15 (using 125ml beaker and insert)
Maximum sample flow rate	10mL/min
Minimum sample volume	2.5mL when using the size flow cell, 5.5mL when using pH probe, folded capillary cell and stirrer
Maximum sample volume	25mL in standard sample tube, 100mL in large volume container
pH probe	Liquid filled glass combination electrode
pH range	1 - 13
pH calibration	User definable. 2 point or greater
Exclusion of air from sample	Nitrogen purge facility
Sample stirrer	Magnetic follower, (supplied)
Materials in contact with sample	Silicone tubing, PTFE, Polycarbonate, Polypropylene
Materials in contact with titrants	Silicone tubing, PTFE, Polycarbonate, Viton, Polypropylene
Sample filter	In line disposable syringe type, 0.45µ supplied
Power requirements	100 – 240V 50 – 60Hz 45VA
Size	180,400, 260, (370) W x D x H (with pH probe fitted)
Weight	6kg (6.2kg including power supply)

The system includes:
3 titrant dispensing unit with universal power supply and cable, pH probe with pH4 and pH9 buffers, cable and top up liquid, stirrer magnet, 7.6m sample tubing, 5 sets of tube connectors, 20 sample bottles with caps, RS232 cable, software and manual. (Sample bottles are also used for titrants), 10 large volume sample containers of 125mL and container insert.

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