

RANK BROTHERS CHARGE ANALYSER II



FEATURES

COMPLETE SYSTEM SUPPLIED TO CARRY OUT FULLY AUTOMATIC TITRATION CONSISTING OF STREAMING CURRENT DETECTOR, CONTROL UNIT AND PRECISION METERING UNIT (requires only standard anionic and cationic polymers)

MICROPROCESSOR CONTROLLED GIVING USER FRIENDLY INTERFACE VIA FOUR FRONT PANEL KEYS AND A LIQUID CRYSTAL DISPLAY

HARD COPY OF THE TITRATION AVAILABLE VIA PARALLEL PRINTER INTERFACE

CUSTOM CARRYING/STORAGE CASE SUPPLIED TO ENABLE EASY TRANSPORTATION OF THE SYSTEM IN THE FIELD

MANY DIAGNOSTIC AND HELP MESSAGES DISPLAYED TO AID NOVICE OPERATORS

Scientific Instrument Division **RANK BROTHERS**

GENERAL

The Rank Brothers Charge Analyser II is a completely automatic polyelectrolytic titrator. The system is microprocessor controlled giving the operator a user friendly interface and has been designed to ensure that even 'novice' operators are quickly and easily able to carry out accurate titrations. Polyelectrolytic titration enables determination of ionic charges of polymers in solution and also surface charges of colloids. The cell has been designed to measure the charge of liquid samples or liquid samples containing only small particles, thus paper stock, for example, will need to be filtered to remove particles above 1 micron before a titration.

Applications include:

— Waste water treatment.

Optimising dosage of flocculants

— Paper manufacture.

Determination of charge density of unknown polymer (e.g. fixative, wet strength agent, or retention aid)

Determination of the concentration of a known ionic polymer in solution

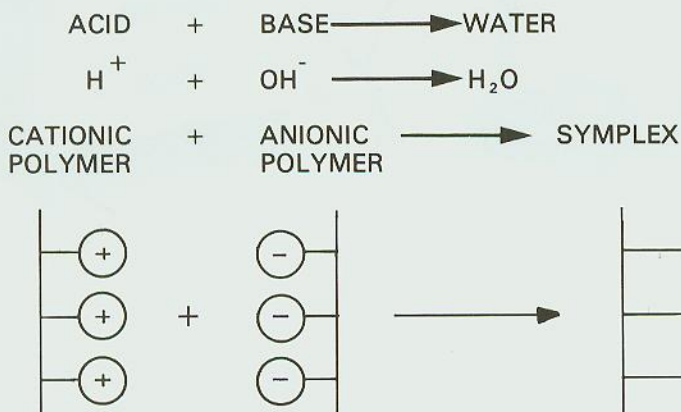
Determination of the concentration of anionic polymers (interfering substances in the water circuit)

Determination of the charge demand of paper stock or wire water by back titration

— Colloid science

PRINCIPLE OF POLYELECTROLYTE TITRATION

The principle of polyelectrolyte titration is based on the fact that the standard anionic and cationic polymers selected form 1:1 compounds with each other based on their charge, and is thus directly equivalent to an acid/base neutralisation.



The titration uses a standard anionic and/or a standard cationic polymer to determine the equivalent charge of the sample. Potassium polyvinyl sulphate (PVSK) is used as the anionic standard polymer and hexamethrine bromide (Polybrene) is used as the cationic standard polymer. The titration end point is determined using a streaming current detector cell.

The Rank Brothers Charge Analyser II (CAII) will perform a polyelectrolytic titration automatically and consists of three main parts: i) The streaming current detector cell unit, ii) the control unit, and iii) the precision metering unit. The three parts are described in more detail below.

Streaming current detector cell unit

The streaming current detector cell unit comprises of a stand, with incorporated drive motor and the measuring cell. The cell consists of a cylinder closed at one end with a pair of electrode rings, one at the closed end, and one in the middle of the cylinder. A piston oscillates axially inside the cylinder at a speed of approximately 250 rpm streaming sample past the 2 electrodes. Polymers have a tendency to adsorb onto interfaces and thus some become fixed to the piston and cylinder walls. The mobile counterions of the fixed electrolyte create an electric current due to the partial charge distribution which is measured between the two electrodes in the cylinder wall. A sinusoidal voltage of about 4Hz is thus produced by the cell.

The cell is easily detached from the stand assembly to enable cleaning of both the cell and the piston after every titration. The titration is carried out in disposable plastic cups, the cup being placed on the stirrer unit (supplied with the metering unit) and the cell is partly immersed in the sample to enable a titration to be carried out.



The control unit

The control unit houses the interface electronics and power supply for the cell, plus a microprocessor card to control the complete system. The front panel consists of a 2 line by 24 character Liquid Crystal Display (LCD), four keyboard switches, two LEDs, and a 'BNC' socket. The top line of the LCD shows current values of the charge of the sample and the total volume of polymer dosed (when this information is available). N.B. The value of the charge is not calibrated to any specific units, but is proportional to the value of the signal from the cell. The sign of the charge is also displayed so that the user immediately knows whether the sample is anionic or cationic.

The second line of the display indicates the status of the unit e.g. "Titrating" or displays useful help information e.g. "Press <TITRATE> to start". The four keys are labelled <MOTOR>, <TITRATE>, <PRINT>, and <STOP>, with the first three keys having built-in LEDs to indicate their status. The two main LEDs are used to indicate i) when the metering unit is dosing, and ii) when a titration has finished. The 'BNC' socket connects the unit to the cell and is on the front panel to enable easy connection during cell cleaning.

The rear panel has connections for the Power inlet lead, the cell motor, a parallel 'Centronics' printer, the metering unit, a Y/t recorder. The printer socket allows connection to a printer with a 'Centronics parallel interface' and will print the Charge value, the amount of polymer dosed, and the phase angle of the charge signal. This information is printed after every measurement cycle (10-30 times a minute depending on whether dosing occurs or not). The Y/t socket (for a chart recorder) has an output of 0-1 volt, this voltage being equivalent to the charge value, and is available at the socket during the titration.

The microprocessor has complete control of the system, including the cell motor and the metering unit. Once the operator has determined the correct standard polymer (anionic or cationic) to use, the system is able to carry out a fully automatic titration. The control unit determines the volume of polymer to dose into the sample from the magnitude of the charge and then proceeds to titrate until the phase of the streaming current has inverted. The end point dose will then be calculated from the minimum charge value during the titration and will be displayed on the LCD.

The microprocessor is monitoring various functions and will display diagnostic information relating to the printer and the cell connections, etc if problems occur during operation. It also has an internal buzzer to warn the operator of faults, invalid key presses, and the titration end.

The metering unit

The metering unit supplied is a 'Metrohm 665 Dosimat' complete with remote keypad, magnetic stirrer and stand, and two 10 ml exchange units complete with 1 litre reagent bottles. The Dosimat is connected to the control unit enabling the control to dose exact volumes and also to refill an exchange unit at the beginning and end of a titration. The 'Dosimat' is a versatile programmable metering unit and can be used completely independently from the CAII for other laboratory applications. For further information and full specification please refer to the Metrohm leaflet.

The carrying case

The CAII is supplied complete with a custom designed carrying case. The case has room for the complete system, enabling titrations to be carried out at particular sites in the field. The case has lockable catches and has an aluminium lined outer skin for extra strength and would be suitable to take as luggage on an aircraft. The inside of the case is foam lined with cut outs for individual parts of the system. The case can also be used for storage of the system, ensuring that parts do not become damaged or lost.

Exclusively distributed in North America by



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Specifications

General

Power supply (Control unit): 110-120V 25VA or 220-240V 30VA 50/60 Hz selectable via rear panel switch

Weight (complete system inc. case): 32 Kgs approx.

Size (carrying case inc. handle): H 690mm W 260mm D 840mm approx.

Control unit

Printer interface: 25 way D connector suitable for use with an 'IBM' compatible printer lead. The interface is a 'Parallel Centronics' type suitable for the majority of printers with a 'Parallel interface'.

Recorder output: BNC socket enabling connection to most Y/t chart recorders via BNC to 4 mm lead supplied. The output is 0 to 1V $\pm 5\%$. The voltage is proportional to the charge of the sample with 0V equivalent to an indicated charge of -205 and 1V equivalent to an indicated charge of 205. 0.5V is thus equivalent to a zero charge, i.e. the isoelectric point.

Metering unit

The metering unit supplied is the 'Metrohm Dosimat 665' complete with two 10 ml 'Exchange units' giving a 10 ml maximum dose and an accuracy of 20 microlitres. For further technical information please refer to the Metrohm' brochure.

Ordering information

The Rank Brothers Charge Analyser II is supplied complete with the following items:

- 1 off Streaming current detector cell complete with motor and stand.
- 1 off Control unit complete with connection leads for the cell, the cell motor, the metering unit, a Y/t recorder, and the power inlet lead, but **excluding** a printer lead.
- 1 off metering unit consisting of a 'Metrohm Dosimat 665' complete with magnetic stirrer and stand, remote keyboard for programmable functions, 2 off 10 ml 'exchange units' (for easy change over of standard polymers) plus 2 off 1 litre reagent bottles.
- 1 off Carrying/storage case, complete with custom made foam liner recessed to accommodate the individual units of the complete system.

Order Code: STRCA2

THE PHOTOMETER CELL

The photometer cell has been designed to enhance the Charge Analyser II (CAII) by offering an alternative method of performing the polyelectrolytic titration. The CAII originally used a streaming current cell to detect the isoelectric point of the titration, however it is now possible to carry out a photometric

titration using toluidine blue indicator to detect the end point. This method will be familiar to many people already carrying out manual titrations. The CAII will now be available with either the streaming current or the photometer cell, with the latest software controlling either cell, thus allowing the user to purchase the second cell at any time. Early CAIIs require modifications to the hardware as well as the software (see below for further information).

The cell

The cell is a stainless steel cylinder containing the optical components plus some associated electronics, measuring the relative transmission of light through the sample. It is thus able to detect when the indicator turns from blue to pink or vice versa. A new version of the software has been produced (version 4.00) to enable the cell to be used. The new software automatically detects which cell is connected during its initialisation routine, thus either cell can be used, simply by switching off the CAII and connecting whichever cell is required.

The titration

The CAII uses a different strategy for titrating with the photometer cell, than with the streaming current cell. Fixed doses of polymer ($20\text{ }\mu\text{l}$) are added to the sample until the unit has detected a significant colour change, and that the colour has become stable, thus the dosing typically continues for over 1ml after the colour change has occurred. The fully titration data is then scanned and processed to determine the end point of the titration.

Photometer cell Vs streaming current cell

There are advantages to both types of cell as listed below.

Photometer cell

Advantages

- Lighter and smaller than the streaming current cell i.e. more portable
- Easily cleaned.
- Uses the familiar manual technique.
- Titrates low molecular weight chemicals.

Disadvantages

- Less accurate than the streaming current cell.
- The indicator is cationic, thus allowance must be made.
- The toluidine blue indicator is affected by various metal ions, particularly calcium and aluminum.

Streaming current cell

Advantages

- Greater accuracy than photometer cell
- Not affected by calcium ions
- Titration not complicated by addition of cationic indicator

Disadvantages

- Needs careful cleaning for maximum accuracy
- Cannot cope with low molecular weight materials
- Heavier and larger than photometer cell.

Upgrades

All CAIIs currently being shipped (serial Nos. after 0033) are fully software and hardware compatible with both type of cell.

CAIIs (s/n 0014 and before)

These CAIIs require both the hardware and the software upgrading. When ordering the photometer cell it will be necessary to return the control unit for the hardware upgrade (free of charge).

CAIIs (s/n 0015 to 0032)

These CAIIs have compatible hardware but require version 4.00 software. The microprocessor card requires two EPROM sockets for version 4.00 software, some cards may require an additional socket soldering to the card. Version 4.00 software will include a spare socket to be fitted if required. We can also supply an exchange microprocessor card with the new software installed for anybody not confident in fitting the additional socket. Alternatively the control unit can be returned to us for the upgrade (free of charge).

Specifications

Material:	Stainless steel with glass optical window
Light source:	LED
Repeatability:	approx. 50µl PVSK vs Polybrene titration.
compatability:	Requires version 4.00 software and above