Annexure-1

SPECIFICATIONS FOR AUTOMATIC TITRATOR

The specifications are divided into: (i) Equipment features, (ii) Specific technical requirements, (iii) Data analysis requirements, and (iv) Safety features.

Equipment features

The automatic titrator should be capable of carrying out complete titration of various suspensions (mainly alkaline cementitious suspension). The analysis should comprise of Acid Neutralization Capacity (ANC) measurement, buffer capacity measurement, and should help in acid immersion study for more than 5 days by maintaining a constant specified acidic pH <2, during the immersion period through a single unit system, with automated titrant pumping and titration, with temperature sensor, pH sensor integrated into that single unit.

Specific Technical Requirements

The instrument should be 21 CFR Part 11 compliant. All the required accessories for performing the acid neutralization capacity application and 5-day acid immersion test should be provided along with the instrument.

NOTE: For each specification, please enter "YES" or "NO" in the second column of this table. **If a cell in the second column is left blank, then it will be assumed that the quotation does not comply with the respective specification/requirement.** Provide catalogues, data sheets and/or other documentation to support the compliance of your equipment to the given specifications.

1 General	**Yes / No**	**Remarks**
1.1 The automatic titrator should be capable of carrying out complete titration of various suspensions (mainly alkaline cementitious suspension) such as acid-base, non-aqueous, redox, sulfur determination, and precipitation titrations. The analysis should comprise of Acid Neutralization Capacity (ANC) measurement, buffer capacity measurement, and should help in acid immersion study of prism samples for more than 5 days by maintaining a constant specified acidic pH <2, during the immersion period through a single unit system, with automated titrant pumping and titration, with temperature sensor and pH sensor. Instrument should also have the facility to perform Karl Fischer Titration.		
2 pH		
2.1 Range: -13 to +20		
2.2 Resolution :0.001		
2.3 5-point pH calibration		
3 Temperature		
3.1 Measuring range −150 to +250 °C		

3.2	Resolution 0.1 °C		
4 Burette			
4.1	Burette sizes: at least 2,5,10 and 20ml should be available. Provide 20 ml with the system.		
4.2	Burette resolution 1/10000 of the burette volume.		
4.3	Motor driven Piston burette for accurate dosing and better control.		
4.4	The Burette piston should move from top to bottom of the burette, so that no problems due to the air bubble arise in the titrant.		
4.5	Fill and eject time 20 seconds.		
4.6	Automatic Burette Recognition feature wherein once connected instrument knows burette volume.		
4.7	Number of methods: at least 100		
4.8	Burette size should be automatically detected.		
4.9	Stirrer propeller type and stirrer speed and direction should be controlled by the instrument.		
4.10	Should have facility to connect magnetic stirrer, if required.		
4.11	Flow rate range 0.02 ml/ min to 3 x burette volume/ min.		
4.12	The Burette drive should be mounted on top of the Burette so that the electronics in the burette drive is not damaged due to reagent spill or leak.		
4.13	The instrument should have facility to connect two titrating burettes.		
5 Other specifications			
5.1	Real-time curve display for ongoing titration.		
5.2	Instrument should have facility for Method & Result storage without connecting to PC. Should be able to store at least about 100 Methods and about 1000 results within the system.		
5.3	Touch Screen display for complete control of the instrument.		
5.4	Live Keyboard for entries like sample weight, stop criteria should be possible even when the titration is in progress.		
5.5	Instrument should have the facility to save the reports in the PDF format.		
5.6	For ease of handling, automatic cleaning, and preparation of burette with a single command should be possible.		
5.7	All system components like Electrode, Stirrer, and Burette should be instantly recognized and ready to use automatically by the system. This for safety check operation.		
5.8	The instrument should have facility to connect Auto sampler expandable with minimum 12samples at a time.		
5.9	The Instrument should be able to manage samples and reagents automatically with the help of dosing devices in liquid handling mode, eliminating all errors related to human handling.		
5.10	The instrument should have facility of Ethernet access to save the methods and results directly in intranet.		
5.11	Possibility for direct connection of USB Keyboard, Printer, USB Mouse& Barcode reader for easy handling.		

5.12	Feature for Limit control for the results should be available.		
5.13	Last titration with curve and all sample data are stored, with recalculation possibilities with printout function.		
6	**Manufacturer experience, installation & training**		
6.1	The manufacturer must have at least 15 years of experience.		
6.2	Provide a list of IITs or government agencies, where similar equipment were supplied and their contact details.		
6.3	Automatic titrator should be installed and commissioned by the supplier at IIT Madras, Chennai at free of cost.		
6.4	Hands-on training on the testing, data acquisition and basic maintenance of the equipment to be provided for a period of at least two full working days at IIT Madras, Chennai.		
6.5	The manufacturer must have well-qualified technical support team.		
7	**Demo installation**		
7.1	Before the final purchase order is released, demonstration on acid neutralization capacity test on cement suspension provided from the lab.		
7.2	Before the final purchase order is released, demonstration on acid 5-day concrete-acid immersion test at constant pH should be performed.		

Data Analysis Requirements

The software should provide the following capabilities:

1) Plotting of acid consumed vs. pH
2) Plotting of time vs. pH/acid consumed
3) Calculate ANC of the suspension

Safety Features

All the safety related concerns must be stated, and details of functional access provided for safety related problems should be mentioned in detail.