**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**

1. The automatic titrator should be capable of carrying out complete titration of various suspensions (mainly alkaline cementitious suspension). The analysis should comprise of Acid Neutralisation Capacity (ANC) measurement, buffer capacity measurement, and should help in acid immersion study for more than 5 days by maintaining a constant pH during the immersion period through a single unit systemhaving automated titrant pumping. The instrument should have temperature and pH sensorsintegrated into single unit.
2. The titrator should be able to perform potentiometric (acid/base, redox, precipitation) titrations.

**Specific Technical Requirements**

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.

|  |  |  |
| --- | --- | --- |
| General | Yes / No | Remarks |
| The automatic titrator should be capable of carrying out complete titration of various suspensions (mainly alkaline cementitious suspension). The analysis should comprise of Acid Neutralisation Capacity (ANC) measurement, buffer capacity measurement, alkalinity measurement, hydroxyl value determination, quantification of ions present and should help in acid immersion study for more than 5 days by maintaining a constant pH during the immersion period through a single unit system with automated titrant pumping. The instrument should have temperature and pH sensors integrated into single unit.Single titration at a time should be sufficient. |  |  |
| pH |  |  |
| Range: -2.000 to 20.000 |  |  |
| Resolution:0.001 |  |  |
| Accuracy (@25 ⁰ C): ±0.001 pH |  |  |
| Measurement of ions |  |  |
| Should be able to measure anion/cation like sulphate, chloride sulphur, metal ions like sodium, potassium, calcium, magnesium with max. limit of 30000 ppm |  |  |
| Resolution ofsulphate, chloride measurement: 0.001 ppm |  |  |
| Voltage |  |  |
| Measuring range:± 2000 mV |  |  |
| Resolution: 0.1 mV |  |  |
| Error limit (@25 °C): 0.1 mV |  |  |
| Temperature |  |  |
| Measuring range: -20 to 130 °C |  |  |
| Resolution: 0.1 °C |  |  |
| Error limit: 0.1 °C |  |  |
| Burette |  |  |
| Burette sizes: at least 5 nos. between 5-50 ml |  |  |
| Burette resolution 1/40000 of the burette volume |  |  |
| Display resolution 1 μL |  |  |
| Error limit 0.1% of the burette volume |  |  |
| Fill and eject time 20 s |  |  |
| Display graphic LCD |  |  |
| Number of methods > 50 |  |  |
| Burette size should be automatically detected. |  |  |
| Programmable stirrer propeller type: speedof 100-2500 rpm and resolution of 100 rpm |  |  |
| Flow rate 0.1 ml/ min. to 2 × burette volume/min. |  |  |
| Other specifications |  |  |
| Titrator should perform direct pH/ mV measurement |  |  |
| Power 110 V/220 V |  |  |
| Should be able to titrate at least one suspension |  |  |
| Should be able to measure acid dissociation constant |  |  |
| Automatic titrator should have memory to store at least 100 titration data sets with date/time stamp, transferable to printer, computer, or USB drive. |  |  |
| Manufacturer Experience, Installation & Training |  |  |
| The manufacturer must have at least 15 years of experience. |  |  |
| Provide a list of IITs or government agencies, where similar equipment were supplied and their contact details. |  |  |
| Automatic titrator should be installed and commissioned by the supplier at IIT Madras, Chennai at free of cost. |  |  |
| Hands-on training on the testing, data acquisition and basic maintenance of the equipment offered to be provided for a period of at least two full working days at IIT Madras, Chennai. |  |  |
| The manufacturer must have well-qualified technical support team. |  |  |
| Should provide comprehensive warranty for 2 years and 5 years AMC after warranty. |  |  |
| Demo installation |  |  |
| Before the final purchase order is released, demonstration on acid neutralization capacity test on cement suspension provided from the lab should be done.Before the final purchase order is released, demonstration of 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
4. Should provide a tabulated form of corresponding pH, acid used, and time of acid addition to help in the manual plotting of titration curves and should be able to transfer through flashdrive or data cable.

**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.