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Colloidal systems — Methods for zeta-potential determination —

Part 1: Electroacoustic and electrokinetic phenomena

Systèmes colloïdaux — Méthodes de détermination du potentiel zêta — Partie 1: Phénomènes électroacoustiques et électrocinétiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13099 was prepared by Technical Committee ISO/TC 24, *Particle characterization including sieving*, Subcommittee SC 4, *Particle characterization*.

ISO 13099 consists of the following parts, under the general title *Colloidal systems — Methods for zeta-potential determination*:

— *Part 1: Electroacoustic and electrokinetic phenomena*

— *Part 2: Optical methods*

The following part is under preparation

— *Part 3: Acoustic methods*

Introduction

The basic theories and understanding of the electrokinetic and electroacoustic phenomena in a liquid suspension, an emulsion, or a porous body are presented within this part of ISO 13099 as an introduction to the subsequent parts, which are devoted to specific measurement techniques.

Many processes, from cleaning water, after either human or industrial fouling, to the creation of stable pharmaceutical suspensions, benefit from an understanding of the charged surfaces of particles. Also, causing the particles of a targeted mineral to have an affinity with respect to air bubbles, is a mechanism employed in the recovery of some minerals.

It should be noted that there are a number of situations where electrokinetic and electroacoustic measurements, without further interpretation, provide extremely useful and unequivocal information for technological purposes. The most important of these situations are:

a) identification of the isoelectric point (or point of zero zeta-potential) by electrokinetic titrations with a potential determining ion (e.g. pH titration);

b) identification of the isoelectric point by titrations with other reagents such as surfactants or polyelectrolytes;

c) identification of a saturation plateau in the adsorption indicating optimum dosage for a dispersing agent;

d) relative comparison of various systems with regard to their electric surface properties.

The determination of zeta-potential, which is not a directly measurable quantity, but one that is established by the use of an appropriate theory, can be interpreted to establish the region of stability for some suspensions. By determining the isoelectric point, conditions for the optimum coagulation of particles prior to either capture in a filter bed or settling out in a lagoon can be set to facilitate the clean-up of fouled water.

This document follows the IUPAC Technical Report on measurement and interpretation of electrokinetic phenomena (Reference [1]) and general References [2]–[5].

Colloidal systems — Methods for zeta-potential determination —

Part 1: Electroacoustic and electrokinetic phenomena

1 Scope

This part of ISO 13099 describes methods of zeta-potential determination, both electric and acoustic, in heterogeneous systems, such as dispersions, emulsions, porous bodies with liquid dispersion medium.

There is no restriction on the value of zeta-potential or the mass fraction of the dispersed phase; both diluted and concentrated systems are included. Particle size and pore size is assumed to be on the micrometre scale or smaller, without restriction on particle shape or pore geometry. The characterization of zeta-potential on flat surfaces is discussed separately.

The liquid of the dispersion medium can be either aqueous or non-aqueous with any liquid conductivity, electric permittivity or chemical composition. The material of particles can be electrically conducting or non-conducting. Double layers can be either isolated or overlapped with any thickness or other properties.

This part of ISO 13099 is restricted to linear effects on electric field strength phenomena. Surface charge is assumed to be homogeneously spread along the interfaces. Effects associated with the soft surface layers containing space distributed surface charge are beyond the scope.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1 Electric double layer

NOTE The electric double layer (EDL) is a spatial distribution of electric charges that appears on and at the vicinity of the surface of an object when it is placed in contact with a liquid.

2.1.1
Debye–Hückel approximation
model assuming small electric potentials in the electric double layer

2.1.2
Debye length
κ^{-1}
characteristic length of the electric double layer in an electrolyte solution

NOTE The Debye length is expressed in nanometres.

2.1.3
diffusion coefficient
D
mean squared displacement of a particle per unit time

2.1.4
Dukhin number
Du
dimensionless number which characterizes contribution of the surface conductivity in electrokinetic and electroacoustic phenomena, as well as in conductivity and dielectric permittivity of heterogeneous systems

