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Petroleum products and other liquids — Ethanol — Determination of electrical conductivity

Produits pétroliers et autres liquides — Éthanol — Détermination de la conductivité électrique

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Contents

Page

Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 7, *Liquid biofuels*.

Introduction

Conductivity is related to the electrical current which is achieved by the ions displacement into solution in an electrical field.

The importance of measuring conductivity is due to its role in corrosion processes which can harm metallic components and therefore cause bad engine functioning at long term.

Ethanol can be contaminated with ion solutions in many ways, such as water contamination, chemical treatment in industrial processes, addition of chemical additives, incorrect transportation and storage, generally related to the cleanliness of tanks.

The ascertainment of the conductivity is usually carried out through the measurement of the electrical conductance between two platinum electrodes, immersed in an electrolytic solution and connected to a source of alternating electromotive force of a typical frequency. The resulting current is directly proportional to the number of ions present in the solution, mobility and ionic valence, and temperature.

In the measuring of the conductance, it is essential to use an alternating current in order to eliminate the undesirable effects of faradaic currents. In the case of an alternating resultant current, an inversion of the polarization occurs every half cycle and, consequently, the inversion of the flow of the migration of the ions, leading to a non-faradaic process, which comprises the formation of a double electrical layer in the electrode-solution interface, called double electrical layer, with the potential decreasing linearly in the first part and exponentially in the second part.

In an alternating fashion, the surfaces of the electrodes act as capacitors; the capacitive current increases with the frequency and the size of the electrodes. The control of these variables is in order, so that the alternating current flows preferentially in the form of non-faradaic processes. With an alternating current, there is a reduction of the polarization effect and, as a consequence, an absence of faradaic currents.

In this sense, platinization, that is, covering the surface of the electrodes with a layer of platinum black, increases its surface area significantly and, consequently, its capacitance which causes a reduction in the faradaic current. Further, as a result of the increase in capacitance, there is a reduction in the capacitive reactance, favouring the flow of current in the cell.

For both a metallic or electrolytic conductors, the Ohm Law ($E = I{\cdot}R$) sets forth that the intensity of the current (I) which passes through an electrical conductor is inversely proportional to the resistance (R), where E represents the difference in potential and the inverse of the resistance is the conductance ($G = 1/R$).Further information is provided in Annex A.

Petroleum products and other liquids — Ethanol — Determination of electrical conductivity

WARNING — The use of this International Standard can involve hazardous materials. This International Standard does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a test method for the determination of the electrical conductivity in ethanol fuel and mixtures (including E85) in the range of 0,5 μS·cm^{-1} to 4 μS·cm^{-1} at a temperature of 25 °C. The electrical conductivity is determined from the measured electrical conductance.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3170, *Petroleum liquids — Manual sampling*

ISO 3171, *Petroleum liquids — Automatic pipeline sampling*

3 Terms and definitions

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

3.1
conductivity
electrical current which is achieved by the ions displacement into the solution in an electrical field

Note 1 to entry: The determination of the electrical conductivity is carried out by means of a direct conductivity meter (5.1) measurement, using a measuring cell (5.2) suitable for low conductivity measurements. The measurement is carried out at a sample temperature of (25,0 ± 0,1) °C.

4 Reagents

4.1 Analytical grade anhydrous ethanol, for cleaning and rinsing the conductivity cell and the sample vessel before undertaking the measurements.

4.2 KCl calibration solution, with 70 % de-ionized water and 30 % 1-propanol (99 %), approximately 5 μS·cm^{-1}, or certified reference material approximately 5 μS·cm^{-1}.

KCl solution with 70 % deionized water and 30 % 1-propanol 99 %, until 25 μS·cm^{-1} or less, Certified Reference Material until 25 μS·cm^{-1} or less, may also be used when it is not possible to carry out calibration using the above-mentioned solution.

4.3 De-ionized or distilled water, with a maximum conductivity of 0,5 μS·cm^{-1} or less for cleaning and rinsing the sample vessel and the measuring cell.

