THE DEFINITION OF ELECTROLYTE

Victor M.M. Lobo
Department of Chemistry, University of Coimbra
3000 Coimbra - PORTUGAL

Summary

A definition of electrolyte presented in an international standard is critically discussed.

Key words: electrolyte; solutions.

The terminology document CEN/TC 262/SC 1 N 95 rev, from the European Committee for Standardization (CEN) [1] presents the following definition of electrolyte:

"***Electrolyte:*** *A conducting medium in which the flow of current is accompanied by movement of matter. Most often an aqueous solution of acids, bases, or salts, ionized gases, some solids, etc. (ASTM term).*"

We do not agree and propose the following:

"***Electrolyte:*** *A substance when dissolved in a given solvent produces a solution with an electric conductivity higher than the solvent conductivity. May be a solid (e.g. sodium chloride), a liquid (e.g. sulphuric acid), or a gas (e.g. hydrochloric acid).*"

The proposed CEN definition (the document is still under discussion) is, in our opinion, inappropriate.

It seems to imply that the word "electrolyte" has the same meaning of "electrolytic solution" (or "electrolyte solution"). Actually, one thing is an "electrolyte" [e.g. solid sodium chloride, NaCl(s)], another quite different is the solution resulting from the addition of an electrolyte to a solvent: the electrolytic solution [e.g. an aqueous solution of sodium chloride, NaCl(aq)].

This kind of terminology has been in use since the pioneering work of Svante Arrhenius (1859 - 1927). In fact, W. Ostwald's famous book published last century says, in the English translation entitled "Solutions" [2], published in 1891, "... in their aqueous solutions the substances in questions, i.e. the *electrolytes*, are already separated for the most part into their ions. This

Portugaliæ Electrochimica Acta, 14 (1996) 27-29

conclusion was arrived at by Arrhenius (Zeitschr. f. physikal. Chemie, 1, p.631 [1887])".

Reference books in this field have titles such as: **The Physical Chemistry of Electrolytic Solutions**, by Harned and Owen [3]; **Electrolyte Solutions**, by Robinson and Stokes [4]; **Handbook of Electrolyte Solutions**, by Victor M.M. Lobo [5]; **Polyelectrolyte Solutions**, by Rice and Nagasawa [6]; **Aqueous Electrolyte Solutions**, by Horvath [7]; **Electrolyte Solutions Database**, at the Science and Engineering Research Council, U.K., organized by Victor M.M. Lobo [8]; etc. Thousands of papers from over a century use this terminology [9] as well as Ph.D. Thesis (e.g. [10]) and normal books in this field (e.g. [11]).

Text books in the field of chemistry also use the above concept. For example, Raymond Chang's well-known book entitled "Chemistry" [12] says: "All solutes in aqueous solution can be divided into two categories: electrolytes and nonelectrolytes. An **electrolyte** is a substance that, when dissolved in water, results in a solution that can conduct electricity. A **nonelectrolyte** does not conduct electricity when dissolved in water". Even non-scientific works such as Encyclopaedia Britannica distinguish between electrolyte (the pure substance, solid, liquid, or gas) and "the electrolyte solution". For example, Webster Dictionary (1974) has, for electrolyte, "A substance whose solutions are capable of conducting electric current; esp. a compound that decomposes by electrolysis".

If we use for "electrolytic solution" the word "electrolyte", then, which word do we use for the substance that gives rise to the electrolytic solution ? We certainly need one for that; otherwise it would be far more difficult to express ourselves in this field.

Concerning the wording of the CEN definition, we also think it is inappropriate to say "... *flow of current is accompanied by movement of matter*". When we measure the electrical conductivity of, say, an aqueous solution of NaCl, we apply an AC current (e.g. 1000 Hz). It is very difficult to imagine "movement of matter" in these circumstances but, no doubt we are dealing with electrolytes and electrolyte solutions. How could we reconcile the CEN definition with the above facts ?

We also think it is inappropriate to associate "movement of matter" with "flow of current". The reader might be led to think that the CEN definition is appealing to some model concerning the propagation of an electromagnetic field in a solution. It could be said that it is not the case, because CEN used the word "accompanied". However, we think it may give rise to misunderstandings. One may immediately ask "How do we see that ... is accompanied by movement of matter" ?

The CEN document is still under discussion and we certainly hope that such a definition of electrolyte will not be adopted. It would cause a lot of confusion in the scientific and technical world. Obviously, the definition 3.62 of "conducting salt" in the same document has to say "... added to an electrolyte solution ..." instead of just "... to an electrolyte ..." as it now stands.

References

[1] Revision of terminology document (CEN/TC 262/SC 1 N95 rev.), CEN - European Committee for Standardization, Secretariat of CEN/TC 262/SC 1: 389 Chiswick High Road London W4 4AL, England.

[2] W. Ostwald, Solutions, (Trans. by M.M.P. Muir), Longmans, Green, and Co, London (1891).

[3] H.S. Harned and B.B. Owen, The Physical Chemistry of Electrolytic Solutions, Reinhold Publishing Corporation, New York (1967).

[4] R.A. Robinson and R.H. Stokes, Electrolyte Solutions, Butterworths, London (1959).

[5] V.M.M. Lobo, Handbook of Electrolyte Solutions, Elsevier Science Publishers, Amsterdam (1989).

[6] S.A. Rice and M. Nagasawa, Polyelectrolyte Solutions, Academic Press, New York (1961).

[7] A.L. Horvath, Handbook of Aqueous Electrolyte Solutions, Ellis Horwood Limited (1985).

[8] V.M.M. Lobo, Electrolyte Solutions Database (ELYS), Science and Engineering Research Council, Daresbury Laboratory, Warrington, U.K. Released 1989.

[9] PAPES - Database on Papers in Electrolyte Solutions, V.M.M. Lobo, Department of Chemistry, University of Coimbra, 3000 Coimbra, Portugal.

[10] V.M.M. Lobo, Ph.D. Thesis, Cambridge, U.K. (1970).

[11] M.R. Wright, The Nature of Electrolyte Solutions, MacMillan Education, London (1988).

[12] R. Chang, Chemistry, McGraw-Hill, Inc., New York (1991).

(Received, December 6, 1995)