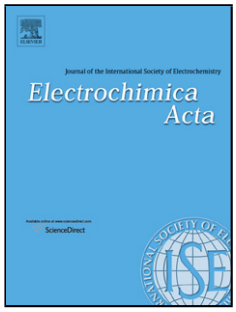

Title: Influence of soil moisture on the corrosion processes of carbon steel in artificial soil: Active area and differential aeration cells

Author: R. Akkouche C. Rémazeilles M. Jeannin M. Barbalat R. Sabot Ph. Refait

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<AT>Influence of soil moisture on the corrosion processes of carbon steel in artificial soil: active area and differential aeration cells

<AU>R. Akkouche[a,b], C. Rémazeilles, M. Jeannin[a], M. Barbalat[b], R. Sabot[a], Ph. Refait[a,*]
##Email##prefait@univ-lr.fr##/Email##
<AU>
<AFF>[a]Laboratoire des Sciences de l'Ingénieur pour l'Environnement (LaSIE), UMR 7356 CNRS-Univ. La Rochelle, Bât. Marie Curie, Av. Michel Crépeau, F-17042 La Rochelle cedex 01, France
<AFF>[b]AIR LIQUIDE Research & Development, 1 Chemin de la Porte des Loges, F-78350 Les Loges en Josas, France

<PA>Tel.: (33) 5 46 45 82 27; Fax: (33) 5 46 45 82 41.

<ABS-HEAD>Highlights► Variations of soil moisture induce variations of soil resistance measured by EIS. ► Soil resistance is inversely proportional to the area undergoing active dissolution. ► The corrected corrosion rate, related to the active area, is estimated. ► Differential aeration cells led to localized corrosion rates as high as 1.5 mm yr^{-1}.

<ABS-HEAD>Abstract

<ABS-P>Carbon steel coupons were buried for 4 months in an artificial silt loam soil initially set at 75% of saturation with a 0.01 M NaCl solution before to be subjected to wet/dry cycles. The corrosion process was monitored by electrochemical impedance spectroscopy and voltammetry around OCP. The evolutions of soil moisture and O_2 concentration at the vicinity of the coupons were also recorded. For high water contents (≥ 60%sat.) the corrosion rate was linked to the transport of O_2 and was maximal around 60-70%sat. because transport of O_2 was rapid in the soil pores partially filled with electrolyte. With further drying of the soil, the corrosion rate decreased while [O_2] remained constant. A concomitant increase of the electrolyte resistance R_s showed that both R_s and corrosion rate variations were due to the decrease of the active area of the electrode. Actually, for soil moistures below 60%sat., the corrected corrosion rate, expressed with respect to the active area, still increases while soil moisture decreases. Galvanic couplings between aerated and de-aerated zones led to localized corrosion processes with estimated rates up to 1.5 mm yr^{-1}.

<KWD>Keywords: *Voltammetry*; *Corrosion rate*; *Carbon steel*; *Buried steel pipelines*; *Oxygen reduction.*

<H1>1. Introduction