

Article

Study the effect of magnetic field on the corrosion of steel in sodium chloride solution (NaCl)

January 2010

Authors:

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Abstract

In this study we test the effect of magnetic field on the corrosion of Iron in NaCl – solution of different ratios. The samples of Iron were put in the NaCl solution of different ratios of concentration ranged between (1% , 2% , 3% , 4% and 5%). The magnetic field effect on the hydrogen reduction and on the activation –controlled iron dissolution reaction .Results show that the magnetic field effect on the corrosion of Iron in the NaCl-solutions and increased the corrosion. See the figures(1-7) that represent the corrosion of iron in NaCl solutions with applying magnetic field and without magnetic field. In control group fig(1), we show the highest loss in weight while in magnetic field group fig(2), we show the lowest weight loss. This can be ascribe to effect of magnetic field on the reduction and oxidation reactions of corrosion.

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... The table shows clearly that when a magnetic field is applied, the corrosion rate decreases below the zero -field value, $p 0$. This result is consistent with the findings of some previous research workers [5,6,11,[20][21][22][23][24][25][26]. Furthermore, as the applied magnetic field is increased, the corrosion rate further decreases to lower values. ...

... The first to mention is the electrical current that arises in the electrochemical system due to the movement of charged reactants, electrons and corrosion products. The second component consists of the movement of electrons released during the corrosion process and which move along metallic pathways from the

anodic to the cathodic sites [2, 22]. The effect of the applied magnetic field on the first component of the corrosion current has been extensively studied and the theories of magnetohydrodynamics (MHD) and gradient magnetic forces have been adequately applied in the studies [12,19]. ...

... As already pointed out, a corroding metal sample carries corrosion current on its surface. This consists of the flow of electrons from anodic to cathodic sites along metallic pathways [2, 22]. In the presence of a magnetic field applied perpendicularly to the sample surface, the electrical resistance of the metal sample increases leading to a further limiting of the corrosion currents. ...

The inhibitive effect of magnetic fields on mild steel corrosion in acidic media

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Mar 2023

Obi Jasper Tamadu · Mejeha Maurice · Okeoma Kelechukwu Bierechi

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... Follow up studies in which other metal systems were investigated have since confirmed the outcomes of the studies cited above [16,17]. It was not long before it came to light that some journal articles had earlier been published on the effect of magnetic fields on the corrosion of metals and metal alloys in corrosive environments [18][19][20][21] [22] [23]. These cited studies were done at single fixed values of applied magnetic fields. ...

... Costa and coworkers [19] show that the corrosion rate of a magnetized metal alloy is considerably larger than that of the same alloy when unmagnetized but which is immersed in identical corrosive environments. But Maatya co-workers [21, 22] obtained results similar to those obtained in the studies carried out in the FUTO laboratory, already cited. ...

... In their investigation of the effect of magnetic fields on the dissolution and passivation of iron in sulphuric, H_2SO_4 , acid solutions, Lu, and coworkers [18] used such electrochemical methods as scanning potentiodynamic polarization (PDP) and potentiostatic polarization (PSP) techniques to show that the presence of a magnetic field during the electrochemical process rendered the metal electrode (iron) prone to active dissolution in H_2SO_4 acid solutions. The results of the studies cited above [18][19][20][21] [22] [23] show that the presence of magnetic fields do indeed affect the corrosion behaviour of the metals and alloys in different corrosive environments. ...

The protective effect of magnetic fields on the corrosion of aluminium alloys in hydrochloric acid solutions

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Sep 2022

Mejeha Maurice · Okeoma Kelechukwu Bierechi · Uchechi Agoh · Obi Jasper Tamadu

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... It is known that magnetic field (B) can mitigate or aggravate metallic corrosion; nevertheless, the phenomenon is not fully understood [4][5][6][7][8][9][10] [11] [12]. Therefore, it is paramount to understand the apparent contradictory effect of B of permanent magnets, or electromagnets on the corrosion rate and pattern of metallic components to avoid premature failure of electrical motors, generators, transformers, sensors, actuators, which are widely used in everyday life appliances, as well as in medicine, industries, transportation, and electrical power systems. ...

... Many authors have studied the effects of magnetic field on the corrosion rate and observed that magnetic field decreases 4-8, increases [5][6][7][8][9][10] [11] [12], or even has no effect 9 on it. This ambiguous effect of the magnetic field observed on corrosion processes is attributed to differences in the corrosive medium 5,9, metal type 4, magnetic field strength 6,12, direction in relation to the metal surface 5,6, or the presence of gradients 7. ...

... This ambiguous effect of the magnetic field observed on corrosion processes is attributed to differences in the corrosive medium 5,9, metal type 4, magnetic field strength 6,12, direction in relation to the metal surface 5,6, or the presence of gradients 7. In these experiments, the magnetic field effect was detected by changes in the corrosion rate obtained by mass loss 5,8, 11 and change of the corrosion potential or corrosion current density at polarization curves [6][7][8]. The effect of magnetic field on the surface of corroded metals has been analyzed using scanning electron microscopy (SEM) 5,9 or optical images 8. ...

In-operando analysis of the corrosion patterns and rates under magnetic fields using metallic film

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Mar 2022

 Cirlei Nascimento · Giancarlo Tosin ·  Luiz Alberto Colnago

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... In recent times, the effect of direct magnetic fields on aqueous corrosion of different materials has been studied [32,36][37] [38]. Some authors reported that magnetic fields cause a decrease in the corrosion rates of metals such as Cu and

Fe in nitric acid [40], or pure iron in sulfate and chloride solutions [32], however other studies reported an increase in corrosion rate by applying magnetic fields, for example, AISI 303 in FeCl₃ solution [32]. ...

Study of the effect of magnetic fields on static degradation of Fe and Fe-12Mn-1.2C in balanced salts modified Hanks' solution

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Jun 2024

Irene Limón ·  M. Multigner ·  Carlo Paternoster ·  Joaquin Rams

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... It is well known a magnetic field, B, can affect charged particles, like those involved in corrosion processes. However, its effect is not well understood, and several authors have shown contradictory results, whereby B can reduce, accelerate, or even have no effect on the corrosion rate [17][18][19][20][21] [22] [23]. For this reason, more studies are needed to fully comprehend the effect of B on corrosion processes to assess whether it could be used as a tool to control or mitigate corrosion processes. ...

Use of Time Domain Nuclear Magnetic Resonance Relaxometry to Monitor the Effect of Magnetic Field on the Copper Corrosion Rate in Real Time

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Apr 2022

 Cirlei Nascimento ·  Bruna Ferreira Gomes · Elaine Paris ·  Luiz Alberto Colnago

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... The possible cathodic and anodic reactions occurring during the potentiodynamic polarization tests are given below [60][61] [62]. ...

Volume fraction effect of stainless steel on microstructure, interface, corrosion and wear behavior of stainless steel / aluminum bimetal composites

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May 2022 · MATER CHEM PHYS

 Ridvan Gecu ·  Ahmet Karaaslan

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... While FeOOH is formed by either the oxidation or the precipitation mechanisms in aqueous solutions containing Fe²⁺ or Fe³⁺ ions [42], for AlOOH formation, AlCl₃ must first be formed [43]. Anodic and cathodic reactions occurring throughout the immersion are listed below [44][45] [46]. ...

Casting temperature dependent wear and corrosion behavior of 304 stainless steel reinforced A356 aluminium matrix bimetal composites fabricated by vacuum-...

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Apr 2020 · WEAR

 Ridvan Gecu ·  Ahmet Karaaslan

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... While FeOOH is formed by either the oxidation or the precipitation mechanisms in aqueous solutions containing Fe²⁺ or Fe³⁺ ions [42], for AlOOH formation, AlCl₃ must first be formed [43]. Anodic and cathodic reactions occurring throughout the immersion are listed below [44][45] [46]. ...

Improving wear resistance of 304 stainless steel reinforced AA7075 aluminum matrix composite by micro-arc oxidation

[Article](#)

Apr 2019 · SURF COAT TECH

 Ridvan Gecu ·  Yakup Yurekturk ·  Emre Tekoğlu ·  Ahmet Karaaslan

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Effects of magnetic field on cable sheath corrosion

[Article](#)

Jul 2020 · ENG FAIL ANAL

Anton V. Korzhov

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The possible effect of high magnetic fields on the aqueous corrosion behaviour of Eurofer

Article

May 2018 · FUSION ENG DES

Robert Burrows ·  A. Baron-Wiechec · C. Harrington · E. Surrey

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Wasserstoff in Eisen und Stahl

November 1978 · Steel Research International

Ernst Riecke

Bericht über den Einfluß des Wasserstoffs auf das Bruchverhalten von Eisen und Stählen. Beschreibung der Wasserstoffaufnahme. Lösung des Wasserstoffs in Eisen und Wechselwirkung mit Gitterfehlern. Diffusions- und Transportvorgänge des Wasserstoffs in Eisen und Eisenlegierungen. Erörterung der Theorien zur wasserstoffinduzierten Rißbildung, Rißausbreitung und des Sprödbruchs. Survey of the ... [\[Show full abstract\]](#)

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Corrosion of Carbon Steels in Mechanically Stirred Solutions 2.0M H₂SO₄

July 1981 · CORROSION

Hanna Przewlocka ·  Hassan Bala

Increased rates with higher carbon content and decreased rates with lower carbon content are explained on the basis of the effect of stirring and carbon content on the cathodic evolution of hydrogen and the effect of the stirring rate on the anodic dissolution process.

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Effect of Stress Ratio and Loading Frequency on the Corrosion Fatigue Behavior of Smooth Steel Wire...

September 2016 · Materials

 Wang Songquan ·  Dekun Zhang · Ningning Hu · Jialu Zhang

In this work, the effects of loading condition and corrosion solution on the corrosion fatigue behavior of smooth steel wire were discussed. The results of polarization curves and weight loss curves showed that the corrosion of steel wire in acid solution was more severe than that in neutral and alkaline solutions. With the extension of immersion time in acid solution, the cathodic reaction of ... [\[Show full abstract\]](#)

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Article

Corrosion of iron archaeological artefacts in soil: Estimation of the average corrosion rates involv...

October 2006 · Corrosion Science

Delphine Neff ·  Philippe Dillmann ·  M. Descostes · G. Beranger

Archaeological artefacts have been analysed in order to determine the average corrosion rate of low carbon steel after long burial periods. The method adopted consists of two steps. The first one is based on the thickness measurement of the corrosion products, which after density correction and sample age consideration, provides a corrosion rate. As the obtained value is a minimum, another step ... [\[Show full abstract\]](#)

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Effect of calcium carbonate on low carbon steel corrosion behavior in saline CO₂ high pressure enviro...

October 2015 · Applied Surface Science

 Lisiane Morfeo Tavares ·  Eleani Costa ·  Jairo José de Oliveira Andrade · [...] ·  Bruno Huet

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Article

Hydrogen evolution on iron pyrite (FeS₂) in sodium chloride solution

April 1982 · Electrochimica Acta

A. I. Onuchukwu

The sulphur derivatives of iron rust and a mixed iron oxide from the co-precipitation of FeII-FeIII chlorides in 6M NaOH have been found to posses high hydrogen evolution in sodium chloride solution. The enhanced performance of these sulphides for hydrogen evolution is observed to depend on the sulphide constituents, prepared by the combinations of Fe1-x), α -Fe₂O₃ and Fe₃O₄ oxide mixtures, and ... [\[Show full abstract\]](#)

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Corrosion failure of 1Kh18N9T [1Cr18Ni9Ti] steel in liquid lithium

November 1972 · Soviet Materials Science

M. S. Goikhman · A. M. Datsishin · I. G. Shtykalo · [...] · M. I. Chaevskii

This article describes corrosion and mechanical tests on 1Kh18N9T[1Cr18Ni9Ti] steel specimens previously held in molten lithium (of various degrees of purity) at 700, 800, and 900° C both under isothermal conditions and in the presence of concentration- and heat-induced mass transfer. The results of gravimetric, spectrographic, and metallographic analyses showed that the corrosive action of ... [\[Show full abstract\]](#)

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Effect of NaF and CaO/SiO₂ on the hydrogen dissolution in the CaO-SiO₂-FeO_t based flux system

January 2013 · ISIJ International

Sung Hoon Chung ·  Jun Yong Park · Seo Jung Park · [...] ·  Il Sohn

The compositional effect of NaF and CaO/SiO₂ on the hydrogen solubility in the NaF–CaO–SiO₂–FeO_t welding flux system at 1 823 K is presented. At a CaO/SiO₂ of 1.3, higher NaF decreased the hydrogen solubility and at a CaO/SiO₂ of 1.5, higher NaF had relatively little effect on the hydrogen solubility in the flux. The hydrogen solubility with CaO/SiO₂ showed a parabolic behavior showing a minimum ... [\[Show full abstract\]](#)

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Liqui-solid reaction model and verification

July 2009 · Kung Cheng Je Wu Li Hsueh Pao/Journal of Engineering Thermophysics

 Qulan Zhou ·  Na Li ·  Qinxin Zhao · [...] · S.-E. Hui

When the reaction is controlled by the diffusion through liquid, the dissolution process of mono-sized particles was predicted based on the shrinking core model. The changing of particle's diameter satisfied the square-line law. Based on the dissolution of mono-sized particles, the model of solids overall conversion has been established, and the correlation between micro and macro model of ... [\[Show full abstract\]](#)

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Modeling and simulation of pit chemistry of 304 austenitic stainless steel under applied stress in s...

April 2013 · Nuclear Engineering and Design

 Yuhui Huang ·  Shan-Tung Tu ·  Fu-Zhen Xuan

A mathematical model for simulating the active dissolution of a pit on stressed metal surface had been developed. Based on active dissolution mechanism, dissolution current density on the pit surface was assumed and extended through accounting for the thermal activation energy and the multiaxial stress state in pit bottom. The influence of applied tensile stress, pit radius and temperature was ... [\[Show full abstract\]](#)

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On a passivating ability of low alkaline solutions in production of catalysts for oil cracking

March 1992

M.L. Medvedeva · G.D. Kurdgelaidze · G.M. Bashilova

To obtain the limits of carbon steel application for production of aluminosilicate cracking catalysts and zeolites, passivating capabilities of 0.05M Na₂SO₄ aqueous solution are studied at pH 7.0-12.5 (NaOH). The study indicates general corrosion in neutral solutions, pitting at pH 10.3-11.5 and total passivation of steel at pH >12. The most dangerous pH range is 10.3-11.0 within which an average ... [\[Show full abstract\]](#)

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The Role of Rust Layers on the Corrosion Process of Steels in the Atmosphere

February 1970 · Tetsu-to-Hagane

Hideya Okada · Yuzo Hosoi · Hiramitsu NAITO

An electrochemical investigation has been made of the corrosion process of the steels rusted in the atmosphere, in order to reveal the role of the rust in the atmospheric corrosion. The cathodic reaction of the rusted steel is found to be mainly consisted of the reduction of FeOOH (brownrust) to Fe₃O₄ rather than the reduction of dissolved oxygen, and the anodic reaction is the dissolution, of ... [\[Show full abstract\]](#)

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