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XLVIII. évfolyam 2008

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Studies about ageing of polyethylene insulating layers I. The evolution of corrosion and crossing resistance of pipelines covered with polyethylene layers
by J. Lingvay and C. Lingvay

The behavior of polyethylene (PE) isolations on metallic underground pipes was studied as a "basis anticorrosive isolation". As main parameters were measured both the anticorrosive isolation and crossing resistances, by measuring the protection cathodic current necessary in order to ensure the protection potential, and further, the volume resistivities were calculated. The experiments were achieved both on pipes isolated by hot covering using applied PE foils and on pipes isolated by extrusion of PE. The developed investigations have proven that the layers by hot covering using applied PE foils offer to the buried metallic pipes an efficient and durable anticorrosive isolation. Also, was established that the stability of PE layers exposed to UV radiations is limited, so that practically the pipes must be buried in less than a year after their isolation and during the storage they must be protected from UV radiations.

Use of Zn–Ni–Sn–Bi alloy in hot dip galvanization of high content silicon
by G. Mihăilă and E. Grünwald

The advantages of hot dip galvanizing with an alloy that can control the excessive steel reactivity induced by critical levels of Si and P in steels has been demonstrated by the ever increasing use of the Zn–Ni process in galvanizing plants. However, the Zn–Ni process has not provided the complete solution to the reactive steel problem since it does not control the hot dip galvanizing reactions of steels with very high Si and P levels.

Thus, in the Zn–Ni alloy has been introduced tin (Sn) and (Bi) bismuth, which has lead to obtaining the coatings with superior characteristics: reduced of the thickness of the zinc coating, bright appearance with large spangles on all kinds of steels, less zinc in residues, less galvanizing defects, less finishing work.

Characteristics of electroplated Zn–Ni alloy layers
by G. Vermeşan, C. Bulea, H. Vermeşan, E. Grünwald and C. Bumbuc

Possibilities of alloying zinc melt with nickel are known, so microalloying experiments had been done with bismuth and tin. Our purpose was hot-dip galvanization of reactive (Sandelin) and higher Si content steels. Seeing that, one of the disadvantages of the technology is to keeping the strict composition of the zinc melt, which specifies 0.05% Ni, 1.8% Sn and 0.5% Bi content. Increasing the amount of tin and bismuth causes layer thickness increase in case of non reactive steels. In case of reactive steels, it dramatically decreases. Amount of nickel has to be controlled. During our work, optimal nickel content had been determined.

Concrete corrosion, protection in planning
by M. Hunyadi

This communication is about protection of concrete bridge structures. What do the designers do for building permanent bridge structures. Regulations specify that every bridge structures have to last for at least 100 years. Renovation can be done every 20–25 years. The article discusses the types of the concrete damages, and the materials which can be used for concrete protection.

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Comprehensive study of uranium, transuranium and fission products accumulation on stainless steel surfaces II. Sorption studies in dynamic model system
by P. Kádár, K. Varga, B. Baja, Z. Németh, N. Vajda, Zs. Stefánka, L. Kövér, D. Varga, I. Cserny, J. Tóth, T. Pintér and J. Schunk

As a result of the breakdown on April 10, 2003 there was a significant contamination by uranium and transuranium (Pu, Am, Cm) nuclides in some technological units (such as reactor pit No.1, fuel-transfer pond) of the reactor block 2 of the Paks Nuclear Power Plant (PNPP). It is of special importance to know the contamination processes (adsorption-desorption) of uranium and transuranium (TRU) nuclides during the release of the damaged fuel assemblies. In the reactor pit No.1 uranium and TRU nuclides can be present in different chemical forms (molecular, colloidal and/or disperse) in the boric acid coolant. A reliable evaluation of the extent and kinetic of the above contamination phenomena on the constructional materials used in the fuel-transfer pond seemed to be fundamental to perform the safe release work of the damaged fuel, started in October 2006. However, there were only limited pieces of information about the extent, chemical forms and kinetic behaviors of the uranium and transuranium species accumulated on the surface of the main structural materials (stainless steels).

Within the frame of a joint project four domestic institutes have been cooperated in order to study the accumulation of uranium and transuranium (Pu, Am, Cm) species of construction materials (such as heat exchanger tube samples and stainless steel can material). The experiments were carried out in a dynamic model system. During the sorption experiments, boric acid coolants provided by the PNPP from pit No.1 of reactor block No.2 were circulated for a period of 30 hours at linear flow rate of 9 m/h. Solution and tube samples obtained in the course of above studies were analyzed by independent (α- and γ-spectrometry, ICP-MS, SEM-EDX, voltammetry and XPS) methods.

In the first article our two part paper by the virtue of literary data we gave a view of the main parameters influencing the extent and character of the surface contamination by uranium and transuranium products.

In the present (2^{nd}) paper we review the contamination-decontamination experiments, carried out on two types of steel sample, as well as summarize and interpret the measured surface analytical, solution chemical and radiochemical results.

During our work we studied the accumulation of uranium and transuranium (Pu, Cm) as well as fission products (Cs) on two types of construction material materials (such as heat exchanger tube samples and stainless steel can material). The experiments were carried out in a dynamic model system. During the sorption experiments, boric acid coolants provided by the PNPP from pit No.1 of reactor block No.2 were circulated for a period of 30 hours at linear flow rate of 9 m/h. Solution and tube samples obtained in the course of above studies were analyzed by independent (α- and γ-spectrometry, ICP-MS, SEM-EDX, voltammetry and XPS) methods.

Studies about ageing of polyethylene insulating layers II. The environmental impact on the ageing of PE insulating layer
by J. Lingvay and P. Budrugeac

The thermal analysis methods (TG, DTG, DSC) were used for the investigation of the thermo-oxidative degradation of the PE protection layer applied to underground steel tubes. The successive processes that occur at the progressive heating in air and in oxygen of these materials were put in evidence. The characteristic parameters of these processes have been correlated with the stocking duration of the tubes and the change of volume electrical resistance. The obtained results show that the thermal analysis methods are suitable for the quality control of the materials based on PE and the evaluation of the environmental impact on their properties.

C.S.A. (cold spray aluminium): a new generation of high temperature corrosion resistant coatings
by M. Fletcher

Corrosion of the externals of pipework and vessels which operate at higher temperatures including Corrosion Under Insulation (CUI) has long been a major problem for industry. Conventional Protective Coatings can be used to prevent corrosion of the surface, but their limitations must be recognised. The use of zinc silicates is not recommended by many including NACE if there is a possibility that the corrosion attack is expected to come from warm and wet conditions. Conventional corrosion protection coatings such as epoxy phenolics offer corrosion resistance at temperatures where corrosion occurs, but if they experience temperatures above 200 °C these coatings can be damaged and not offer corrosion protection after exposure to these higher temperatures. Other high temperature coatings such as aluminium silicones have resistance to higher temperatures, but do not offer long term corrosion protection.

A new generation of coatings, CSA (Cold Spray Aluminium) has been developed over the last ten years and recently become available that can offer long term corrosion protection up to continuous operating temperatures of 400 °C. This inorganic copolymer is pigmented with aluminium flake and has a unique flexibility after high temperature exposure which allows it to move with the metal substrate even during the most rapid of thermal cycling and still provide corrosion protection.

This paper will describe the characteristics of this new generation of coating with the use of standard test methods and new test methods designed to replicate corrosive cyclic temperature service conditions and environments where CUI can occur. Case histories showing field applications with major Oil & Gas companies will also be discussed demonstrating how this new generation of coating brings benefit to industry. CSA Coatings provide good corrosion protection in the range of service temperatures from –20 °C up to +400 °C (testing to –190 °C cryogenic/LNG service is currently in progress). CSA can be used to protect carbon, alloy and stainless steels. Its forecasted use would be both insulated and non insulated surfaces therefore providing a unique coating system for piping, valves and process vessels.

History of electrochemical protection in the Research Institute for Heavy Chemical Industries (NEVIKI)
by M. Horvátth

In this short communication, electrochemical protection researches in the Research Institute for Heavy Chemical Industries (NEVIKI) founded in 1949 are described until 1992 institute liquidation.

Effect of corrosion on the lifetime of spiral springs
by A. Bacskai

Spiral springs operate in many kinds of size and material quality and with various mechanical and corrosion expositions. Corrosion protection of static stress spiral springs is a well solved important task, because the springs are usually made of high-strength alloys which are inclined to hydrogen embrittlement. Corrosion of dynamic and alternate stress springs is riskful. Reason of spring breaks is usually the corrosion fatigue. This paper discusses a case history of a steel safety valve spring breaking and comparative spring material tests.

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The thermodynamics of welded seams and causes of its corrosion

by S. Szabó and I. Bakos

Because of the heating and cooling, energy changing takes palace in a welded seam. On the basis of the theoretical analysis of the energy changing, it can be stated that energy surplus is accumulated in a seam and this brings about its special character. Comparing of seam energy to the energy surplus of the amorphous or with other words glassy metals, an estimation of energy surplus has been made. Depending on the technology of welding and other circumstances it may vary from zero to about 6 kJ/mol. In corrosive environment the energy surplus in a seam results in an electrode potential difference between bulk metal and the seam. It may vary from 0 to about –30 mV, and for this reason the seam apt to corrosion.

Behavior of alloys is similar to the pure metals. For the estimation of the corrosion behavior of an alloy it is very important the knowledge of corrosion characteristics of its less noble component. It must always be count on dealloying processes when the leaching of the less noble component takes place. In this case catalytically active surfaces may form. It has to be mentioned here that in stainless steel the Cr is a very nonnoble component and if the passivity is destroyed then can be counted on a fast leaching of Cr.

Cleaning the welded seam with wire brush can cause even more corrosion danger, because the metal of brush may adsorb on the cleaned surface resulting in a multimetallic surface.

Chemical decontamination of steam generators used in nuclear power plants I. Antecedents and fundamental aspects of technology development

by K. Radó, E. Deák-Horváth, K. Varga, Z. Németh, I. Varga, D. Oravetz, P. Halmos, J. Borszéki, J. Schunk and G. Patek

Comprehensive investigations have revealed that the so called AP-CITROX (alkaline permanganate, citric acid + oxalic acid) technology is not an adequate method for the chemical decontamination of any reactor equipment having large stainless steel surfaces (e.g. steam generators), and has a detrimental effect on the morphology, chemical composition and mobility of the oxide layers grown on eg. heat exchanger tube surface. As a consequence of the lack of the appropriate decontamination method, an R&D project to develop a technology for decontamination and surface treatment of the inner surfaces of the steam generators at Paks NPP has been initiated. In this paper, we present some selected findings on the corrosion and surface chemical effects of the AP-CITROX technology as well as on the fundamental issues of the technology development. The second and third parts of the three-part series are scheduled to highlight some results obtained in the course of solution chemical calculations and laboratorial analysis of the efficiency of the technology to be developed.

Thought about history of corrosion and corrosion protection

by M. Horvátth

The author offers a brief survey of theories formed from idea of corrosion from the ancient times till the end of the 19th century. Consecutiveness of these theories is discussed. Evolution of protection against corrosion is also dealt with briefly. Based on available data, some former suppositions concerning application of protection are refuted.

Newly developed measuring devices for locale coating tests

by G. Mohácsi

In the years past, several technical innovations were appeared in the measuring technique of coating testing, in the field. There are many novelties in the field of computer based data recording and processing. In this review, some novelties which can be applied already in everyday practice are presented. New dew point meter, ultrasonic wall thickness meter, layer thickness measuring device, adhesion measuring set are described.

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Diagnostics of high temperature hydrogen damage of steels
by A. Bacskai

At high temperature, dissolution susceptibility of hydrogen into steel is grown. High temperature occurs during steel-making, welding and several industrial processes. The most well-known occurrences of high temperature hydrogen damage of steels are petroleum refineries, petrochemical plants and high steam pressure power stations. The aim of the diagnostics is to disclose these damages in time, otherwise material structure damages in steel can be formed unobserved which decreases mechanical strength of pressure device with dangerous degree. The author presents difficulties of identification of this kind of corrosion and the significance of danger with examples of his many decades practice.

Test methods of hydrogen corrosion susceptibility of steels
by M. Horvátth and N. Mátravölgyi

Hydrogen dissolved in steel is the most troublesome contamination which touches the wildest user area. The authors expound mechanism, type and danger of hydrogen corrosion. Using their own three decades experiences and test results, mostly standardized laboratory test methods, its practice and pitfalls are presented.

Introduction of industrial application of measuring with auxiliary electrode
by M. Tompa

The underground and underwater metal structures suffer surface or structure damage due to electrochemical corrosion. The corrosion condition can be characterized with direction and volume of current density which steps over electrolyte/metal surface. Since this quantity can not be measured in practical structures without essential interference of corrosion systems, the corrosion condition is characterized with current density, analogue potential change, polarization, and IR-free potential (is analogue to polarization). In practice, corrosion relations of individual coating failures can not be measured commonly, only resultant properties of total coating failures on higher surface can be determined. More than half century ago, it is realized that condition of protected metal structure can be modeled with known size and material sample plate. The theory of this measuring method is a suppose. If an auxiliary electrode (piece of steel) made of the pipe's material is connected to the pipe, then the potential of this auxiliary electrode demonstrates the effective functioning of the protection at a given point. The stray current can be ended if we disconnect the metal connection between the pipe and the auxiliary electrode, thus the switch-off potential of the electrode can be measured. The author shows, how this measuring method is introduced in Hungarian practice.

Knowledge about metals in the first century
by V. Kaptay-Bozsó

In corrosion professional literature the name of the scientist who lived in the first century appears from time to time. Although considerable part of his works was lost, with his huge remained natural sciences encyclopedia in 37 volumes Historia Naturalis rightly achieves wonder and respect of posterity. Mainly 33rd and 34th volume deals with metals. We can get to know mining of ores, winning methods of pure metals, metallic compounds known at that time, application of alloys. And of course the phenomenon of corrosion and primitive protection methods.

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Complex cathodic protection of over ground storage tanks

by L. Halász, S. Kanala and I. Zachar

In the second part of the 90's, Slovakian petrol company thought that the cathodic protection of tanks have to be plan in such a way that it would be ready for operation during the planned lifetime of tanks. In such case only complex cathodic protection can comes up. Our company was asked for this work. Fist we had done complex evaluation of the already working tank protection system. We had mapped the pipelines, tanks and other technological infrastructures. After we have planned and built the cathodic protection system which is still operating properly. This article shows the structure of the cathodic protection system.

Aluminium bridge structures as solution of corrosion problems

by I. Zalavári

The paper introduces features and corrosion behavior of aluminium and aluminium alloys. Presents examples, where aluminium was used for bridge structures for the first times and tells the history of the first Hungarian aluminium bridge. Then introduces pml company and its Hungarian affiliated company which manufactures modern aluminium structures for wide-ranging applications.

Painting in practice, experience of an environmental management system auditor

by L. Fortuna

Through an environmental management system auditor's eye, this review shows, which regulations we have to know to do the corrosion protection and surface pretreatment works safely. Deals with safety engineering, safety data sheets, fire and environmental protection, dangerous materials, waste management.

Short history of GYŐRLAKK paint manufacturing company

The history of GYŐRLAKK paint manufacturing company is presented in this short communication from the foundation till now days.