

# KORROZIÓS TUDÁS

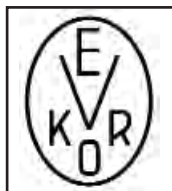
XLVII. évfolyam

2007

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## SYNOPSIS OF THE PAPERS IN THIS ISSUE

### *Water treatment of primary and secondary circuit of nuclear power plant Paks during the extended operating time*

by Á. Doma, J. Schunk, G. Patek, T. Pintér,  
J. Ósz and T. Salamon

In 2005, revision of water chemistry of the blocks of nuclear power plant Paks had been done after 18–23 years operating. After the working up of huge water chemistry database, we can unanimously state, there is no water chemistry obstacles of performance increase and operation time elongation.

In 2006, preparation for operation time elongation and working out of new water treatment technology had been made. In connection of this work, some change is proposed in the so far applied water chemistry.

For the moment, there is no elaborated uniform start up and shut down water treatment technology for the VVER-440 blocks. Now as we have elaborated it, we will apply it during the main services in 2007, although, before introduction, the technology will be expertized by international jury.

### *The degradations by corrosion of ground plates from the three phased power system*

by J. Lingvaj and C. Lingvaj

Degradation by corrosion of ground plates for three phased energetic system had theoretical and experimental studied. From the studies and investigations effectuate in the ground, it results that metallic structures for the ground plates, specially of those from the agglomerate urban centers, it is liable to

accelerated degradation by corrosion, caused by the simultaneous action of the disequibred currents from the three phased electro energetic system and the D.C. stray currents, with the origin in the urban electrical traction (transportation system – trams, metro).

### *Contact corrosion tests of aluminium and stainless steel*

by B. Lengyel and É. Fekete

With electrochemical test methods, corrosion chance and range of a construction was examined. The structure consists of a rectangular stainless steel connected to an anodized alloyed aluminium rail with stainless pin. The construction is painted, and is periodically in contact with salty solution or salty mist. In the paper, the following questions were answered:

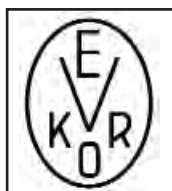
- Is contact corrosion expected?
- If yes, what is the range of the corrosion?
- What should be done to avoid the corrosion?

### *Paints can redye within a short time*

by B. Ludányi

This short paper summarizes the properties and the benefits of the paints which can redye within a short time in contrast with traditional paints. These benefits are the followings:

- shorter redye time
- lower application temperature
- amine and epoxy subsidiary reactions are pushed into the background
- less sensitiveness to humidity
- higher safety for the applicators
- smaller pot life



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**SYNOPSIS OF THE PAPERS IN THIS ISSUE*****The maximum protective potential for epoxy coated steel pipelines***

by Z. Angelovski

A study was undertaken to determine the limiting potential criteria for cathodic protection of coated metallic underground facilities to avoid damage from hydrogen evolution. Twenty eight day tests were performed in tap water on the fusion bonded epoxy coated structure. Accelerated tests were used in order to estimate the resistance of the coating to cathodic disbandment with the additional requirement that the length of the separated area should be less than 0,5 mm. Series of tests were carried out keeping the value of the applied potential (ON potential) between the values  $-1,05$  and  $-1,25$  V compared to a saturated copper/coppersulphate reference electrode, and changing it in steps of 10 mV. The tests proved that at a maximum protective potential (instant OFF)  $-1,097$  V the separation of the epoxy coating from the structure begins.

***Why does a coating system flexible? Thought-provoking analysis from formularization till application***

by J. Bognár and L. Nagy-Molnár

The coating is flexible, if it able to follow the dimension and shape changing of carrier without cracking or flaking, and able to tolerate deformation caused by external effect without permanent damage. In this article, we try to summarize how the flexibility of paints (as coatings) depends its composition, application method, application environments and way of layer construction.

***VOC Forum***

There was a forum about the new regulation of VOC containing paints and lacquers at the second Vekor-conference in Balatonfüred. This extract is based on the tape recording of the discussion.

***Corrosion tests of auto parts, risk of bio ethanol application***

by M. Horvátth

Several corrosion phenomena can be occurred in vehicles. Most of these problems had been solved in modern vehicles, and the companies give surprisingly long guarantee period, mainly for the excellent painting of the car body. Many researchers try to change the traditional fuels to environmental friendly ones. However, new materials mean new corrosion problems. One of the promising new fuel is the agricultural ethanol. But the water content of ethanol can cause corrosion on the way to the engine.

***Problems on planning of bridge coatings***

by M. Horvátth and V. Zanathy

In the corrosion protection plan of the building M0 Budapest ring north motorway bridge, criterion had been determined for flexibility of bridge coating due to client's request. Based on laboratory experiments, 2.5 mm deep-drawing flexibility value had been given. After finishing the plan, the expected dilatation of the bridge coating had been examined by structural engineers. Because of the determined value, flexibility of coating had to be changed to the value which is measured with bending.



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## SYNOPSIS OF THE PAPERS IN THIS ISSUE

### *Some practical experiences of bright electroplating of wires*

by C.-C. Bulea and E. Grünwald

The application of organic brightening additions in electroplating of wires meet with more or less success. In its presence, roughness, smoothness and structure can be optionally set. Also the burn zones can be reduced and the deposition domain can be widened. With the adequate analytical test and electrolyte control methods the disadvantage of application of organic additives can be prevented. Only the French one-component brightening addition SR-509 stayed stable over 40 A/dm<sup>2</sup> current density among the other tried ones. During our experiments we have not found an adequate features addition material yet, which satisfies the claim of customers and strict industrial specifications.

### *Comparative analysis of Zinc-cobalt alloy coatings deposited from chloride based electrolytes with direct and pulsating current*

by C.-C. Bulea and E. Grünwald

Corrosion resistance of electroplated zinc coatings can be considerably increased with cobalt alloying, if the cobalt content is larger than 0.2%. Comparative corrosion tests were shown, that the protective effect of 0.1–0.2% cobalt contained alloy coatings is similar to unalloyed zinc coating. The protective effect of Zn-Co coatings deposited from chloride based electrolytes is better than alloy layers obtained from sulphate based electrolytes. Application of pulsating current increases the corrosion resistance of Zn-Co layers, results solidier coatings and makes more evenly dispersion of cobalt possible.

### *Long-term effects of the ap-citrox decontamination procedure on the protective oxide-layer formed on stainless steel*

by B. Baja, Z. Németh, P. Kádár,  
K. Varga, A. Szabó-Nagy, D. Oravetz,  
Z. Homonnay, E. Kuzmann, L. Kövér,  
D. Varga, I. Cserny,  
J. Tóth, J. Schunk and G. Patek

Our previous studies have revealed that a "hybrid" structure of the amorphous and crystalline phases is formed in the outermost surface region of the austenitic stainless steel tubes of steam generators

(SGs) as an undesired consequence of the *industrial application* of the AP-CITROX decontamination technology. The formation of this mobile oxide-layer increased the amount of the corrosion products in the primary circuit significantly (~80 kg/block), resulting in magnetite deposition on fuel assemblies. As deposits blocked the cooling channels, the flow rate of water coolant through the reactor core decreased. Consequently, the power capacity of three nuclear reactor units had to be reduced, and full core fuel replacement became necessary.

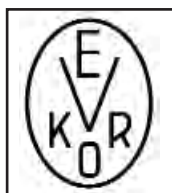
In the light of the above events, the present work gives a brief overview on the general corrosion state of the heat exchanger tubes of SGs, concerning *the long-term effects of the AP-CITROX procedure* on the chemical composition and structure of the protective oxide-layer. Owing to the fact that there is no investigation method available for the in-situ monitoring of the inner surfaces of heat exchanger tubes, a research project based on sampling as well as on ex-situ electrochemical and surface analytical measurements was elaborated. Within the frame of this project, comprehensive investigation of the general corrosion state and metallographic features of 36 stainless steel specimens, cut out from various locations of the four steam generators of the Paks NPP has been performed. Electrochemical (voltammetric) and surface analytical (SEM-EDX, CEMS, and XRD) results reveal that some beneficial changes in the corrosion properties, morphology and chemical composition of the inner surfaces of heat exchanger tubes can be observed in the time period of 2000–2006.

### *Corrosion protection of bridge structures with HELIOS coatings*

by B. Vežočník and M. Sáfrány

HELIOS is the biggest coating manufacturer in Slovenia, has got more than 80 years producing experience. The HELIOS industrial paints have been present in the Hungarian market for 15 years as ZEN-TAX-HELIOS Kft. Recently, the company, as a paint deliverer, takes part in bridge renovations and new bridge constructions. In Croatia, two new bridges had been built. At these bridges, corrosion protection of the steel structures was with HELIOS coating systems. This article describes the applied coating systems, and the course of the protection works. Also deals with developing of new VOC free two component coating systems of the future.





# KORRÓZIÓS FIGYELŐ

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4. szám

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**SYNOPSIS OF THE PAPERS IN THIS ISSUE*****Electroplating of zinc–nickel alloy layers from weakly acid electrolytes***

by C.-C. Bulea, Cs. Várhelyi jr.,  
E. Grünwald and Cs. Várhelyi sr.

In industrial practice, zinc–nickel alloy layers are deposited using 3 kind of technique. From weakly acid electrolytes and from alkaline electrolytes with or without ammonium salts. All three of these techniques results both bright and half bright coatings, and the characteristics of the layers are partially different. In this paper the features of the electrolytes has been examined, and conclusions have been drawn.

***Practicable application of nanotechnology in the field of corrosion protection***

by E. Kálmán

Three surface modification technologies: self-assembly, LB and sol-gel are applied for corrosion protection. These nanosized and/or nanostructured coatings supply not only temporary protection but also help by the adsorption of lacquer and paint coatings.

***Standards of cathodic protection and soil corrosion***

by M. Horvátth

Standards make comparing the measuring results possible, helps the planning work and entering into a contract. In Hungary, lately, standardization is regressing in the area of corrosion protection because

of lack of financial assistance. Introduction of several standards can be only in English language version. Such standards help to evaluate the corrosion aggressiveness of soil, and planning, building and operating of corrosion protections. In this article the valid standards are listed, and the most important ones are compared with the old standards.

***One solution of cathodic protection of tank plants***

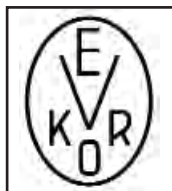
by M. Tompa

In the last year, cathodic protection of tank bottoms and buried metal structures has been made on more tank plant of the MOL Company. These protections are now in quite bad condition. The company decided that new cathodic protections have to be built, and the old ones have to be renovated. More enterprises took part in the task, and have successfully solved the protection of each tank plant. In this paper, one solution is described.

***Evaluation of 15 reference coating systems after 10 years exposition***

by L. Fortuna and V. Zanathy

10 years ago, 15 kind of reference coating systems had been made near to Tiszapalkonya on behalf of MOL Nyrt. Examination of reference surfaces had been done then, and 10 years later, now. In this article, evaluation of test results and comparison of coating systems are presented.



# KORRÓZIÓS TÍJYELO

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5. szám

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by P. Kádár, K. Varga, Z. Németh, N. Vajda,  
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 ( $\alpha$ - and  $\gamma$ -spectrometry, ICP-MS, SEM-EDX, voltammetry) methods.

Based on literary data in our first article we give view of the main parameters influencing the extent and character of the surface contamination by uranium and transuranium products.

***The kinetics and the mechanism of formation zinc layers at hot dip galvanization of high content silicon***

by G. Mihăilă and E. Grünwald

With the growth of demand for high-strength steels, silicon-killed, the problem of reactive steels hot dip galvanization came back in actuality. The unpredictability of high reaction rates and the less coherent nature of the coating formed can lead to a detrimental effect on the coating quality. The increase in reactivity results in high zinc consumption as the coatings are thicker. The thick coatings are often brittle and have a dark, lusterless appearance if

the alloy layer has grown through to the coating surface. Should the steel surface silicon content, the outward galvanized appearance can be nonuniform, with dull areas being evident in an otherwise shiny coating. This section deals with the effect with normal galvanizing baths, trying find an answer of this problem.

***Morphological and corrosion examinations of galvanized steel plates treated by cerium and lanthanum saline solution***

by Sz. Kőszegi, A. Paszternák,  
I. Felhősi and E. Kálmán

On the surface of low-alloy steels galvanized by different processes, environmental friendly rare-earth metal content layers had been deposited with different immersion times, in order to provide temporary corrosion protection. The morphology of formed conversion layers had been examined with atomic force microscope and the chemical structure had been examined by photoelectron spectroscopy. It had been stated, that the  $\text{CeCl}_3$  treating was the best among of the applied  $\text{Ce}(\text{NO}_3)_3$ ,  $\text{CeCl}_3$  and  $\text{LaCl}_3$  saline solutions for all type of galvanized steel plates.

Corrosion protection properties of conversion layers had been examined by electrochemical methods (polarization measurements, impedance spectroscopy). It had been stated that the best long life protection can be reached on continuous hot dip galvanized steel plate with 40 minutes  $\text{CeCl}_3$  treatment.

***Inside and outside corrosion of tank bottoms***

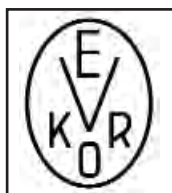
by Zs. Rónafalvi

In oil, gas and chemical industry, one of the most important tasks is the safe and continuous operation. Within this, pitting-free operation of large tanks is prominently notable. According to the statistical data, most of the failures and environmental damages are caused by corrosion processes. Corrosion processes can be inside or outside origin, depend on corrosion aggressiveness of stored material or the soil. The purpose of this short work is to present the corrosion processes of tank bottoms, and to offer practical solution for safe and pitting-free operation

***Renovation painting of industrial monument Lakihegy radio tower***

by K. Gráfel, L. Gálfi and V. Zanathy

Antenna of Lakihegy radio station was built in the year of 1933 based on American plans redrafted by Hungarian experts. The 314 m high, 280 t weight tower was the highest steel structure in the world at the age of the construction. In 2006, renovation paint of the steel structure was made. In this short communication, an account of troubles of painting and surface cleaning and experiences of coating quality control is given.



# KORRÓZIÓS TUDÁS

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**SYNOPSIS OF THE PAPERS IN THIS ISSUE*****Analyses of brass heavy metal migration and corrosion***  
by D. van Loyen, I. Schubert and W. Nissing

Analyses of brass specimen installation units in combination with not rusting steel pipes showed that critical neutral salt concentrations according to the Turner-Diagram are not generally causing an increment of lead, nickel and arsenic delivery from brass by using pilot plants according to DIN 50931-1. Lead migration can be increased in dezincification resistant brass qualities. Dosing o-phosphate is a possibility to reduce the lead concentration in drinking water home installations by using dezincification resistant brass. This is not necessary connected to a corrosion deceleration. The total equivalent of neutral salt concentration consisting of chloride and sulphate is a main influence coefficient for evaluating dezincification probability of standard brass. An application recommendation could be given for armature consisting of dezincification resistant brass in drinking water installations.

***Corrosion in connection with welding***  
by M. Horvátth

Welding usually damages the metal structures. For decreasing the risk, cautious choice of welding technology and material of welding rod is necessary. The effect of welding on the corrosion processes can be attributable to 4 reasons. Change of phase relations, contact effects, residual stress and avoidable aper-

tures. The author takes this parameters and troubles one by one, and demonstrates the solutions with examples.

***Materials and technologies for prevention of reinforced concrete corrosion and for structure repairing***  
by D. Valtinyi

Results of construction chemistry researches and practical experiences showed that concrete and reinforced concrete is not so resistant and permanent construction material as we believed in the beginning of the last century. Among given conditions, not only reinforcing bars are seem willing to electrochemical corrosion, but due to physical and chemical effects, cement and concrete aggregate also suffer corrosion damages. It is important to know that all corrosion processes are connected with water. TECHNO-WATO Ltd. is committed to concrete and reinforced concrete repairing and prevention with application of self developed materials. The application of these materials is showed in this short communication through a renovation process of a historical water tower.

***Law interpretation forum about environment protection controlling orders***

There was a law interpretation forum about environment protection controlling orders at the second Vekor-conference in Balatonfüred. This extract is based on the tape recording of the discussion.