# ABSTRACTS

## (A) General

**1. Development of corrosion resistant alloys—**

B. R. Nijhawan (J. Sci. & Ind. Research, **23**, 144, 1964). Introduction, high tensile low alloy steels, low alloy steels resistant to sulphide cracking, stainless steels, heat resistant alloys.

**2. Studies of lead alloy anodes for cathodic protection IX. Studies on corrosion resistance of lead-silver alloy anodes—**

E. Sato (J. Electrochem. Soc., Japan, **31**, 105, 1963). Lead-silver-antimony and lead-silver alloys were used as anodes for cathodic protection of gas condensers using sea water and iron-steel structures submerged in sea water. Potential-time / current curves. An anode containing about 3 per cent silver is the best. Nine figures and 11 references.

**3. Corrosion theory and accelerated testing procedures—**

L. Schlossberg (Metal Finishing, **62**, No. 4, 57; No. 5, 93, 1964). Generalized discussion on the mechanism of corrosion and description of various investigations of accelerated corrosion tests, six tables, 9 figures; salt spray test results, four tables, 9 figures, 26 references.

**4. Why metals fail—I-**

C. L. Lewis (Chem. Engg., **71**, No. 8, 214, 1964). Basic metallurgy that is essential to the understanding of metal structure.

**5. Statistical analysis of formation and dissolution of anodic oxide films on aluminium—**

S. Tajima and M. Shimura (Electroplating and Metal Finishing, **17**, 144, 1964). Empirical equations for the aluminium loss, dissolution rate, film weight gain, rate of thickening of the film, coating ratio, etc., have been derived as a function of bath temperature and time of formation.

**6. Laboratory methods of corrosion testing—**

J. D. Hayton (Australasian Corrosion Engineering, **8**, No. 4, 9, 1964). Environment, production testing, consumer testing, methods of testing, interpretation of corrosion tests, methods for cleaning corrosion test specimens after exposure.

**7. Corrosion of stainless steel by liquid metals—**

B. C. Agrawal (Trans. Indian Inst. Metals, **16**, 186, 1963). The use of liquid metals as a means of heat transfer fluids in nuclear power reactors is discussed. The results of investigations of the action of liquid lead and bismuth on the 18/8 type of stainless steel is given. The interaction of liquid bismuth is attributed to the leaching of nickel and of liquid lead to both nickel and chromium from the steel.

**8. Corrosion case histories (3)—**

(Corrosion Technology, **11**, No. 5, 38, 1964). The route of an all-welded steel pipeline buried for 10 years connects two pumping stations. The problem is to eliminate the leaks.

**9. Corrosion behaviour of cast aluminium bronzes—**

L. Piotti and E. Fot (Werkstoffe u. Korrosion, **15**, 27, 1964). The authors point out that the corrosion resistance of different types of aluminium bronzes—containing manganese, iron, nickel, is dependent on their ability to form an adherent protective surface film during exposure to the corrosive medium. The experimental data are then discussed with reference to the behaviour in hydrochloric, sulphuric and phosphoric acids, and sodium hydroxide.

**10. The analysis of corrosion products by physical methods—**

Y. Aoyama (Sci. Papers, Inst. Phys. and Chem. Research, Tokyo, **57**, 176, 1964). As a result of application of physical analysis methods to the corrosion products in salt water or to the electrolytic corrosion products of various metals —iron, copper, lead, zinc and magnesium, the formation of the basic chlorides of the metals was confirmed. The application of infrared absorption, electron diffraction and flourescent x-ray analysis is discussed. Twelve tables, 19 figures and 46 references.

**11. Corrosion case histories (4)—**

(Corrosion Technology, **11**, No. 6, 19, 1964). This report deals with the corrosion of the steel window frames of a neglected laundry. The 3 layers of paint on the frames have blistered. The problem is to clean and treat them in situ to stop them being attacked in this way again.

**12. Corrosion of lead by alternating current—**

C. E. Galimberti (Corrosion, **20**, 150t, 1964). From laboratory tests it appears that corrosion of buried lead-sheathed cables by alternating current is due to current leakage through breaks in the insulating coating. Even though the current flow in the sheathing may be small, it becomes concentrated i.e., its density increases considerably at small openings through which the current is grounded into the soil. In tests in which d.c. was superimposed on a.c. flowing to lead electrodes immersed in tap water, the corrosion of the electrode acting as anode was increased and that of the cathode decreased. Lead may also be cathodically protected with metals like iron, zinc or magne ium.

**13. Electrodeposition of paint—**

(Industrial Finishing, **16**, No. 190, 28, 1964). A summary of production line and experimental work carried out to date by paint suppliers, equipment manufacturers and users.

**14. Nickel-cobalt-copper ternary alloy deposition from the pyrophosphate bath—**

(Miss) M. Sarojamma and T. L. Rama Char (Chemistry and Industry, 620, 1964). The pyrophosphate bath has been shown to be suitable for the production of satisfactory electrodeposits of ternary alloys of nickel-cobalt-copper containing 1-68 per cent nickel, 2-52 per cent cobalt and 4-99 per cent copper by a variation in the experimental conditions. One table giving effect of variables on deposit composition, cathode efficiency and potential.

**15. Heavy nickel plating — 1, 3—**

J. D. Greenwood (Metal Finishing J. **10**, No. 112, 151; No. 114, 243, 1964). Introduction, properties of the deposit, plant for deposition, plating solutions; finishing heavy nickel deposits, industrial applications.

**16. Gold plating by chemical reduction—**

D. J. Levy (Metal Finishing J, **10**, No. 112, 157, 1964). The process, properties of deposit, substrate materials, applications.

**17. Alloy deposition — theory, practice and current applications—**

N. V. Korovin (Electroplating and Metal Finishing, **17**, 117, 151, 1964). General, theoretical aspects; alloys for protective and/or decorative applications.

**18. Deposition of nickel-tungsten alloys. Acid peroxide solutions —**

L. Domnikov (Metal Finishing, **62**, No. 4, 68, 1964). Effect of nickel and tungsten concentration, pH, peroxide, boric acid, temperature and current density. Under the best conditions an alloy containing 19 per cent tungsten is deposited at 88 per cent current efficiency. Three tables, 4 figures and 7 references.

**19. Science for electroplaters 87. Chromium-ion exchange. 88. Chromium: rinse waste—**

L. Serota (Metal Finishing, **62**, No. 4, 72; No. 5, 103, 1964). Pollution, drag-out. ion exchange, concentration, industrial unit, sulphate concentration, oxidation, purificaton, exchange capacity; cost, capacity, stability, evaporation method, evaporation equipment.

**20. Electroplating on plastics: adherent deposits claimed—**

(Products Finishing, **28**, No. 7, 146, 1964). Plastics producer introduces new plastic which is said to "chemically bond" to electroplated metals applied after special chemical treatment.

**21. Plating components for semi-conductor devices, Part II. Process Control—**

J. E. Weaver (Products Finishing, **28**, No. 7, 50, 1964). The new techniques a plater mu t learn to meet the high standards for plating semi-conductor parts.

**22. The development of the electroplating industry in the Argentine Republic—**

P. A. Weinberg (Metal Finishing, **62**, No. 5, 80, 1964). Introduction, from past to present, modern installations.

**23. Recent trends and developments in the metal finishing industry—**

R. T. Hill (Corrosion Technology, **11**, No. 5, 19, 1964). Pretreatment, conversion coatings, nickel and chromium coatings, automated

plant, electroforming and non-metal on metal coatings, precious metal coatings, new base metal coatings, electrophoretic paint coatings, new drying techniques.

24. **Nickel gives plating quality—**

(Inco-Mond Magazine, No. 24, 18, 1964). This article gives some idea of the far-ranging and ever increasing use of nickel in finishes of many types: plain nickel plating, nickel/chromium plating and modern developments, nickel as an underlay for other metals, nickel alloy plated coatings.

25. **Electrodeposition of iron-cobalt alloys from the sulphamate bath—**

S. S. Misra and T. L. Rama Char (Plating, **51,** 423, 1964). Iron has been codeposited with cobalt from the sulphamate bath, and detailed studies made of the effect of the variables on alloy composition, cathode efficiency and cathode potential. It is possible to obtain alloys in the range 3 to 96 per cent iron with 65 to 95 per cent cathode efficiency up to 10 amp/dm$^2$. X-ray patterns of the deposits show the existence of the b.c.c. structure. Four tables, 11 figures and 17 references.

26. **Quality control in architectural anodizing—**

P. W. R. Smith and J. C. Bailey (Trans. Inst. Metal Finishing, **41,** part 2, 90, 1964). Introduction, control of materials, precautions to avoid surface damage, control during pretreatment, control of the anodizing process, control after anodizing, quality control related to performance specifications, conclusion. Three tables including one on national specifications, 2 figures and 4 references.

27. **Recent practices in anodic polishing—**

R. Weiner (Galvanotechnik, **55,** 155, 1964). Anodic polishing is not suitable for brasses containing less than 63 per cent copper, or leaded brasses. A pickling pre-treatment has been devised for electropolished brass so that bright plated metal coatings can be deposited on to it. The effect of electropolishing on surface roughness is shown.

28. **Codeposition of cadmium and iron from the sulphamate bath—**

S. S. Misra and T. L. Rama Char (Metalloberflache, **18,** 164, 1964). The optimum conditions have been established for the codeposition of cadmium with iron from the sulphamate bath. Deposits containing up to 93 per cent iron can be obtained. The effect of current density on plate composition was quite marked. X-ray studies reveal a mechanical mixture of the two metals with h.c.p. and b.c.c. structures. Four tables, 12 figures and 12 references.

29. **Research and development of nuclear graphite in Japan—**

Review: introduction; research and development in industries — impervious graphite, graphite — carbon dioxide reaction under gamma radiation, diffusion of fission gases, dispersion type fuels; studies in research organizations; 37 references.

30. **Coated-particle fuels for gas-coated reactors**

R. W. Dayton (Battelle Tech. Review, **13,** No. 5, 5, 1964). A recent development — small nuclear fuel particles coated with ceramic materials — promises a highly effective fuel for gas-cooled reactors. Discussed here are possible coatings materials and their performance, and problems associated with design, fabrication, and evaluation of such fuels; figures, tables and 11 references.

31. **Chlorate reduction in diaphragm-cell caustic liquor—**

O. P. Purohit and S. K. Raman (Chem. and Process Engg., **45,** 312, 1964). Experiments were conducted on reduction of chlorate in a typical 50 per cent diaphragm-cell caustic solution with sodium formate and sulphite, sucrose and iron. Results show that, on the basis of ease of operation, economy and contamination of the product, sulphite is the best reducing agent while formate and sucrose come next in order of desirability.

32. **Recent advances in polarography—**

H. M. Davis (J. Royal Inst. Chemistry, **88,** 104, 1964). Cathode-ray, differential cathode-ray and pulse polarography. Five figures and 12 references.

33. **Electrodics—**

J. O'M. Bockris and B. E. Conway (Record of Chemical Progress, **25,** No. 1, 31, 1964). Electrodics is the name proposed for the study of processes which occur at surfaces in electric contact with ionic liquids or solutions. The approach to research in this field is similar to that made to heterogeneous reaction kinetics, but with the rate constant exponentially de-

pendent upon the potential difference across the metal-solution boundary. This topic and its applications are discussed under: definition, basic concepts, present structure, recent advances, directions of future research, applications. One table, 9 figures and 23 references.

—T.L.R.

## (B) Batteries and Fuel Cells

### 1. Electrode phenomena of silver-silver oxide system in alkaline battery—

S. Yoshizawa and Z. Takehara (J. Electrochem. Soc., Japan, **31**, No. 3, 91, 1963). Electrolytic behaviour of the silver-silver oxide system in an alkaline battery and effects of addition of various metals to the silver electrode were studied by utilizing electron-microscope and x-ray diffraction methods and oscilloscopic technique for the determinations of decay and growth of overpotential and current-potential relations. It was shown that during charge, silver oxide, and silver peroxide were successively found followed by the expansion of silver crystal owing to a diffusion of oxygen ion; on discharge, the reverse process should be occurred.

### 2. Electrochemical oxidation of methane in phosphoric acid fuel cells at 150° C—

W. T. Grubb and C. J. Michalske (Nature, **201**, 287, 1964). In fuel cells operating below 100°, methane was inert. In fuel cells at 150°, with porous platinum electrodes, methane was quite reactive when the electrolyte was orthophosphoric acid 14.6 molar or 85 weight per cent. At current density less than or equal to 20 mA/cm² the cell performance with methane was better than with propane. Gas chromatographic determination from methane-oxygen cell showed a carbon dioxide yield 98 ± 4 per cent that required by the anode reaction. The methane platinum black anode in orthophosphoric acid at 150° sustains a steady state current density of 48 mA/cm² only, 0.5 v. from the reversible hydrogen potential in the same electrolyte.

### 3. Thermally activated power cells—

B. W. King et al. (American Ceramic Society Bulletin, **43**, 117, 1964). Austin cells consisting of layers of dissimilar etals with an intermediate layer of glass were investigated and found to be galvanic cells. They are thermally activated in the sense that as the temperature is raised the internal resistance decreases rapidly and the (power) output increases. The cells investigated generated power by the oxidation of one metal layer. The other metal served essentially as an electrode. Glass or porcelain enamel served as an electrolyte, or ionic conductor. The cell potential was closely related to the energy of oxidation of the metal consumed. Several type of cells were prepared and their characteristics measured.

### 4. Fuel cells, a state-of-the-art report—

R. J. Jasinski and T. G. Kirkland (Mech. Engg., **86**, No. 4, 121, 1964). Various applications — space, terrestral are discussed. Further the article deals with the efforts abroad, together with research efforts regarding catalysts and electrode structures.

### 5. Further studies on plante plate formation using nitrate as forming agent—

Miss R. Vijayavalli, P. V. Vasudeva Rao and H. V. K. Udupa (J. Electrochem. Soc., India, **13**, 7, 1964). Plante plate formation for stationery lead-acid batteries using nitrate as forming agent has been described. The role of formic acid and urea were re-examined and their addition was found to be having no special advantage. Formation using only nitrate as addition agent could give plates which gave capacity as per IS specification. Shedding was observed to be low during cycling. 30 A.H. plates were formed, and their capacities determined. The performance characteristics conformed to the IS: specification for these plates.

### 6. On the use of gold reference electrodes in fuel cell studies—

R. Thacker and J. P. Hoare (Electrochemical Technology, **2**, 61, 1964). It has been shown that a small anodized gold bead at the end of a gold wire may be used as a micro-reference electrode in single-electrode fuel cell studies. In basic solution, a potential between 950 and 1100 mv vs platinum/hydrogen in the same solution is obtained. The potential of such an electrode must be calibrated periodically against a saturated calomel electrode. In acid solution, a very stable and highly reproducible electrode having a potential of 1.360 ± 5 mv./vs normal hydrogen electrode may be from a slurry of the auric oxide in the acid solution. The polarization data obtained on a fuel cell air electrode in 8N potassium hydroxide using a gold bead micro-reference electrode are presented. The oxygen overvoltage measurements agreed with similar data in the literature.