Abstracts

Metal Finishing, Volume 75 No. 12, Dec. '77 :

The Coated Abrasive Belt : A Production Tool by Robert Leggett. Improved Technique of Electroless Copper Coating of Alumina Substrates by L.G. Bhatgadde and S. Mahapatra, Radar Project Centre, Indian Institute of Technology, Bombay, India.

Finishing Industries : Vol. 1 No. 10, Oct. '77 :

Sheet Metal Precoating and Recoating—By Eric Sharp, Merritts (Industrial Finishings) Ltd.

Continuous Anodising—By R.A. Clark, Ano-Coil Ltd.

Early Electroplating—Part 3 by Dr. C.A. Smith, Principal lecturer, Stevenage College — This is the third in a series of four articles reviewing the development of electroplating in the 19th Century. The first and second articles covered the period up to the introduction of magneto-electric machines for electrodeposition.

Electroless Copper Plating—Part 1 by Mrs. Malathy Pushpavanam and B.A. Shenoi.—Electroless copper plating finds application in printed circuits, reinforced shielding of dielectrics, copper plated plastic wave guides cavities, chasis shielding as a basis for electroplating non-conductors and in electronic components. Tremendous improvements have taken place in recent years to produce thick copper coatings by this method, This review deals with the different baths available, and the factors affecting deposition.

Vol. 1 No. 11, Nov. 1977 :

Testing Sealing Quality of Anodic Coatings—Part 1 by J.M. Kapex, Pennwalt Chemicals Ltd.—A comprehensive survey of the methods for testing the sealing of anodic coatings.

Anodised Instrument and Control Panels for Industry—By G. Cull and R. Stubbs R.H. Nameplates Ltd.

Electroless Copper Plating—Part 2 by Mrs. Malathy Pushpavanam and B.A. Shenoi—Electroless copper plating finds application in printed circuits, reinforced shielding of dielectrics, copper plated plastic wave guides cavities, chasis shielding as a basis for electroplating non-conductors and in electronic components. Tremendous improvements have taken place in recent years to produce thick copper coatings by this method. This review deals with the principal causes of instability, remedy and mechanical properties of the coating obtained.

Electrolytic Magnetic Cobalt-Zinc Alloy—By M. Bratoeva—The research work reported refers to obtaining electrolytic cobalt-zinc alloys including phosphorus. The alloy is intended for computer technique. Different relationships are examined and the optimum conditions and coating composition selected, the latter ensuring optimum magnetic properties.

Vol. 1 No. 12, Dec. '77 :

Modern Wood Finishing—A comparative review of election beam and ultra violet curing systems

Flatboard coating—Paint companies have grown and adapted to the technological demands, of the flat board finishing industry. One such company is International Paint and in his article we analyse this company's involvement in flat board finishing.

All Nickels Bright and Beautiful? By C.E. Hatzel —A critical review of the various categories of bright nickels taken particularly from the automatic plater's view who is working to BS 1224.

Premature leaking of galvanising baths—By F. Sjoukes Ing., Banmens Group B.V. — The factors affecting the corrosion rate of steel galvanising baths are discussed and the principal causes of premature leakage suggested.

Testing Sealing Quality of Anodic Coatings — Part 2 by J.M. Kape, Pennwalt Chemicals Ltd., —A comprehensive survey of the methods of testing the sealing of anodic coatings. In part 1 published last month the author defined sealing and described the methods in commercial use.

Early Electroplating - Part 4—Dr. C A. Smith, Principal Lecturer, Stevenage College - This the final article in a series of four reviewing the development of electroplating in the 19th Century. In the latter half of the century the dynamo supplemented and superseded the primary cell.

Vol. 2 No. 1. January 1978 :

Recovery Makes Sense by Salim Bhatia and Robert Jump, Corning Process Systems. — Process industries, including the electroplating industry, are constantly considering the question of what to do with their waste products, particularly waste fluids. Usually, the answer is found in one of the two alternatives or a combination of both—destroy the contaminating or toxic elements of the waste, or recover them for reuse.

Initially, the idea of recovering and reusing materials would seem the most attractive answer. However, recovery is seldom the first approach seriously considered in solving total waste problems because industrial waste usually takes several forms, and available recovery processes are usually limited to particular materials, to certain processes or to steps within a process.

Transport Coatings by W.F. Dabbs, Staff director, Forward Facilities Planning, British Leyland UK Ltd.— The first in a series of papers read at the Paint Research Association's Golden Jubilee Conference.

It is hoped to publicise most of the papers during the year.

Galvanotechnik Vol. : 68 No: 8 August 1977 :

Rinsing Operations and their importance in Effluent Treatment — Fundamental Principles and Practical Applications. — P. Winkel — Calvanotechnik (Saulgau/Wurtt.) 68 (1977) 8. S. 692-699, 8 Abb, 3 Tab. — The subjects discussed include the importance of rinsing operations, rinsing systems (running water rinsing, spray rinsing, static rinsing, drag-out tanks) the quality of rinse water, and the control of rinse water consumption. Materials dragged out of rinse tanks not only constitute a loss, but also increase the cost of effluent treatment. Practical methods of economic operation are described.

Treatment of Effluents and Degassing with Electrochemically Active Catalysts by W. Faul/B. Kastening — S.699-704, 4 Abb., 11 —The use of air-oxygen as an oxidising medium, or of hydrogen as a reducing medium in the presence of electrochemically active catalysts without employing current is described. In this way no sallnation takes place, whilst dilute solutions can be treated. Two examples are given to show how air-oxygen treatment enables cyanids to be converted to cyanate, and sulphur dioxide to sulphate, and how chromate can be reduced to trivalent chromium, and nitrite to ammonia, by means of hydrogen.

Residual Metal Removal by Ion Exchange after Electrolysis — S. 705-709, 4 Abb — Metals can be removed from rinse waters by electrolysis, which enables them to be recovered in solid form. The residual metal content which is left behind in aqueous solution can be removed by selective ion exchange. In this manner 1) water and 2) metal in compact form, can be recovered from rinse waters. The sludges produced during effluent treatment can be maintained free from metal hydroxides, so that there are no heavy precipitates.

Vol. 68 No. 9, September 1977 :

Behaviour of Anodes in Cyanide Silver Baths Part - II By — K.P. Binanzer/A.V. Krusenstjern — 9. S. 796-799, 16 Abb. — In Part I of this article (Vol. No. 7/1977) the methods of manufacture of silver anodes were discussed. Defects caused by impurities were illustrated. The second part of the article depicts many examples of the condition and characteristics of the anodes which influence the electrodeposition process.

The Electroplating of various plastics — F. Hasko/C. Merenyi — S. 800-803, 13 Abb. — Some practical experiences with epoxy resins and high impact polystyrene are assembled.

Vol. 68 No. 10, October 1977 :

Method of Measuring the Thicknesses of very thin Deposits — W. Pattsch — S. 865-868, 5 Abb — Although many methods are known for the determination of the thickness of deposits over 1 m, this is not the case in the thickness range below 1 m. These are primarily met within preciousmetal deposits in electronic and semi-conductor technology, as well as in the tinplate industris. The available methods for the measurement of very light deposit thickness, with the exception of the beta-backscatter process, are discussed in this article.

Recovery, Quality and Disposal of Effluents and Sludges in Electroplating — K. Beyer — S. 869–873, 5 Tab. — The author estimates that about 7,000 industrial organisations carryout chemical and electrochemical surface treatment operations in the German Federal Republic. A table provides an outline of the present position. Further tables give an indication of electrolyte losses and the water and metal contents of the sludges produced by electroplating processes. In nickel–Chromium plating there is a higher proportion of chromium than of nickel in the hydroxide sludges.

Weak Acid Bright Zinc Plating Processes — Gunter K. Schwarz — S. 874–881, 28 — Weak acid bright zinc baths are preferred for the plating of cast iron malleable iron castings. In the case of articles of complicated shape, on the other hand, alkaline electrolytes are recommended. The object in the further development of these weak acid bright zinc solutions is to reduce their ammonia and chloride contents in order to enable cyanide–free baths to be employed with advantage.

Electropolishing in place of Mechanical Polishing — K. Bendt — S. 887–892, 4 Abb — The differences between mechanical polishing and electropolishing are explained. Practical experiences with plants, racks, and the electropolishing of articles in bulk are reported and the polishing electrolytes are discussed. The article deals with the many fields of application of the processes.

Vol. 68, No. 11, November 1977 :

The PD–R–Process for the Production of Printed Circuits — J.F. Mansveld — S. 989–992, 4 Abb — The subtractive, semi-additive and additive processes are reviewed and schematically illustrated. The PD–R–Process developed by Philips is then described; this is based on the photo-mechanical properties of titanium dioxide. The conducting paltern is formed by the reduction of palladium ions to metallic palladium in the presence of titanium dioxide by the action of ultraviolet light, after which it is chemically copper plated. This is a variant of the additive process.

Electrodeposition of Gold Coatings — K.G. Schwarz — S. 948–952, 2 Abb., 4 Tab. – Modern gold electrolytes for technical applications are based on potassium gold cyanide. The alloying metals mostly used are cobalt and nickel, and sometimes also Iron and Cadmium. Developments have enabled greater current efficiency and uniform coating thickness distribution to be obtained. Spray gold plating enables cost savings to be achieved. The selective deposition of gold on functional surfaces only results in considerable economies. A wide variety of colour tones are available for decorative gold plating.

Possibilities of Functional Precious Metal Coatings based on Examples from Modern Practice — W. Saxer — S. 953 959, 12 Abb. — Numerous special characteristics are demanded of electrodeposited coatings in modern technology. The technique is referred to as 'Functional Electrodeposition'. The requirements come mainly from the electronics industry, electrotechniques, and by no means least important, space applications. The extensive possibilities of electrodeposition are described and illustrated by means of examples of functional precious metal coatings.

Modern Aspects of Chemical Copper Plating for the Production of Printed Circuit — H.J. Ehrich — S. 960–969, 7 Abb — A provisional balance of the technical status is drawn. From this it is shown that theoretical deductions with regard to the mode of operation of the most important constituents of the bath can be employed as a guide to future lines of development. The effects of stabilizers, complexing agents and surfactants are discussed. Practical aspects and problems yet to be resolved in the additive technique for the production of printed circuits are dealt with.

Vol. 68 No. 12, December 1977 :

Controlling the Deposit Formation in Electrolytic Processes — W. Baranowski — S. 1038–1041, 4 Abb — In the mechanisation and automation of electrolytic processes, it is necessary to plate within definite intervals of time in order to obtain the specified coating thicknesses. The methods available for maintaining constant current density on the workload to produce uniform deposit thicknesses are described.

Practical Experiences with the Reduction of Emissions and Drag–out Losses in the Electroplating of Chromium — H.G Klein/J.N. MeuBdoerffer/H. Niederprum — S. 1045–1051, 3 Abb, 2 Tab — The

use of fluorine surfactants in chromium plating baths has disadvantages as well as advantages when thicker coatings are to be deposited. Practical experiences of the use of a new fluorine surfactant which has been developed by Bayer AG, Leverkusen and marketed under the name FT 248 are described. Drag-out losses are minimised by the reduction of the surface tension A foam layer is produced on the chromium plating bath which the liberation of chromic acid spray mist.

Anti Corrosion — Vol. 24 No. 10 Oct. 1977 :

Review of Shotblast Developments

The Corrosion Story — Part : 7 Alloys of Steel by Dr. C.A. Smith.

Cathodic Protection — Anode Developments by D.J. Mullard.

Vol. 24 No. 11, November 1977 :

Light alloy motors in Corrosive Environments, by Tom Porteous — The results of an investigation of the effects of corrosion on a total of 50,000 cast-iron and light-alloy motors in the Swedish pulp and paper industry are reported. Only five seriously corroded light-alloy motors have been found.

Corrosion Inhibition of Copper-Cadmium Alloy Electroplates in Nitric Acid Solutions — By Ram D. Srivastava and Anil K. Agarwal, Chemical Laboratories, University of Lucknow, India — Urea and thiourea have been investigated as corrosion inhibitors for 94/6 and 80/20 copper-cadmium alloy electroplates in nitric acid solutions by weight-loss and polarisation measurements. Both inhibitors are found to be quite effective for shorter duration of immersion. Potential and polarisation data indicates a predominant role of local cathodic areas in corrosion protection.

An assessment of External Coatings and Coating requirements for Steel Pipelines — by Dr. Gray, British Gas Corporation. UK.

Vol. 24 No. 12 : December 1977 :

Corrosion and Safety aspects of Steel diving cylinders — by G. Bombara, M. Cavallini, Instituto di Metallurgia, University of Rome — Aqueous internal corrosion of Steel Scuba tanks is critically considered as a cause of explosive accidents during charging, storage and use of air cylinders. More restrictive safety regulations are shown to be needed in relation to the extremely high corrosion rates induced by high oxygen pressures. Accidental sea water entries are particularly dangerous because of tubular type localized attacks occuring in the presence of chlorides. Consideration is given to possible protective measures by phosphate conversion treatments and coatings.

The Corrosion Story — Part 8 (conclusion) : Sherardizing — by Dr. C.A. Smith.

Vol. 25 No. 1, January 1978 :

Diffusion Coatings on Steel — A.N. Mukherji and P. Prabhakaran.

Metal Sprayers Guide to B.S. 5493 — In connection with the launching as a new British Standard of the revised "Code of Prictice for Protective Coating of Iron and Steel Structures Against Corrosion", the Association of Metal Sprayers published a "Plain Guide to BS 5493 : 1977".

Australasian Corrosion Engineering : Vol 21 No. 6/7 June/July 1977 :

In Factory Welding Quality Control and NDT— K. Davis.

Vol. 21, No. 8 August 1977 :

Non-Destructive Control Methods — Recent Developments of Ultrasonic systems and their potential applications in petrochemical installations.

Vol. 21, September 1977 :

Magnetic Rubber Inspection — D.T. Murrell

Zinc Coating Mass Measurement and Control on a Continuous Galvanising Line — R. F. Evans.

Australian Chemical Engineering — Vol. 21, May/June, 1977 :

The Detection of Lamellar Tearing by Ultrasonic Testing — C.W. Pope and K.J. Card — The increasing

application of ultrasonic inspection to structural welds and the increasing incidence of lamellar tearing have been major features of heavy steel fabrication over the past decade. The features of the ultrasonic method are well matched to the characteristics of lamellar tearing. Ultrasonics also provides some future hope for fabricators in the development of techniques for assessing tearing suceptibility.

Vol. 21, August/September 1977 :

The Possibilities of New Techniques in Industrial Radiology — R. Halmshaw — Three new developments in radiological methods are described : 1. The X-ray flying-spot system, 2. Television fluoroscopic methods, 3. Image processing, image enhancement, image restoration.

Reliability Versus Reproducibility — C.E. Lautzenhiesher — Defect detection and reproducibility of results are two separate but closely related subjects. It is axiomatic that a defect must be detected from examination to examination or reproducibility of results is very poor. On the other hand, a defect can be detected on each of subsequent examinations for higher reliability and still have poor reproducibility of results.

Australian Chemical Engineering — July 1977 :

Specifications for Non-Destructive Testing — R.R. Malcolm.

Korrozios Figyelo.

Vol. 17, No. 5, 1977 :

Stainless Steels in Sweden : A Research Report of Jernkontoret — One of the defects of the known stainless steels is their sensitivity to certain types of local corrosion, like pitting and crevice corrosion, another is the stress corrosion of austentic steels. The tensile strength of austentic steels and the toughness of ferritic steels should be improved.

Looking at the choice of standardized and special steels produced in Sweden it is evident that important steps forward were made in the last 10 years. An economic production of low carbon steels became possible only recently. Alloying of nitrogen makes the production of austentic steels with increased tensile strength far less expensive.

The developments of the past years indicate the future trends in the field of special stainless steels; and increase in the resistance of both austentic and ferritic steels can be expected from an increased Cr and Mo content. A definite breakthrough can be expected in the field of standardized steels — in the direction of high N austentic steels, and on the long run the replacement of part of the Ni by N is also foreseen.

Cathodic Protection in Sweden : Linder B : As a consequence of the shipbuilding traditions of Sweden the cathodic protection is used mainly for the protection of ships and port installations, using both forms of it, the sacrifical anode and the outside source of current. On the mainland this method is used for the protection of underground storage tanks, pipelines and cables. Minor applications, e.g., in case of water-towards, tanks boilers etc., are also mentioned. In the actual realization of the cathodic protection co-operation of all the operators of the networks of public utilities of built-in areas is of utmost importance.

Rust Preventives based on Corrosion Inhibitors and Film-Builders — Linder, B — Persson, H : — A summary is presented of the structures and fields of application of materials used for temporary protection against corrosion. This is followed by a description of procedures suitable for the protection of behicles and for the protection of holes.

Vol. 17, No. 6, 1977 :

Some Aspects of the Electrochemical Theory of Metal Corrosion — Part II Kiss L. : — In connection with the discussion of the electrochemical theory of metal corrosion, the following data are given for some characteristic limiting cases : the mixed potential of the metal undergoing dissolution, the rate of dissolution, the polarization curves measured on the metal during this process and the relationships calculated from the polarization resistance. The presented relationships are valid if the diffusion of components taking part in the reaction experts influence on the mechanism of the reaction.

A Study of the Kinetics of the Formation of a Coating of Electrolytic Sn-Ni Alloys and of its Corrosion Characteristics — Hartai, J. Lohonyai N: In this study of the kinetics of the deposition of highly resistant Sn-Ni alloys it was found that if the overvoltage is not high, then the deposition of the

metal on the cathode follows the Tafel-plot. At higher over voltages, however, a three-dimensional formation of seeds becomes the rate-determining step, according to the theory of Erdey-Cruz. A metallographic study of the deposited alloy indicates that contrary to statements found in several papers, the electrodeposited Sn-Ni alloy is not completely hemogeneous.

Electrostatic Powder – Coating Applied in the Polish Industry—Smieszek, E.—Pisula Mandziej, A—The study of electrostatic powder-coating has begun in 1972 at the Research Institute of Paints and Lacquers at Gilwice. After testing different foreign coating materials, the production of an epoxy powder-coating meterial named Faproxyd was started. It is used widely, e.g., for the coating of tube saws and drill pipes, petrol tanks of cars, for the painting of fire extinguishers and metal furniture. The characteristics of Faproxyd and its other perspective uses are described.

Large Scale use in Surface Protection of an Oxide-Layer Produced in a Thermic Process – Vaszko, T: Based on the findings in his laboratories, K. Valenik has called the attention to the temporary corrosion protection properties of oxide layers produced in a thermic process on iron. The Hungarian Factory of Driving Motors and Dyeing Machineries has tested this principle and used it on an industrial scale. In 1976 in the Estonian SSR an electro-dipping dyeing machinery of 1 million m^2/year capacity was put into operation. This is being used – efficiently – for the painting of cast iron engine-cases protected by a 8–12 m thick oxide-layer. The layer of scale on the die-cast engine cases has a very homogeneous structure and its adherence is excellent. The layer of scale has semiconducting properties assuring the proper conditions for the electrophoretic formation of film during dyeing by electrodipping. The process used and the Hungarian machinery applied are also described.

Gold Bulletin Vol. 11, No. 1 January 1978 :

High Speed Selective Brush Plating of Gold — Advantages over conventional plating in Specific Applications—Marv Rubinstein—The major proportion of all gold plating will always be carried out in a conventional bath, but for a substantial number of industrial applications selective brush plating offers considerable savings.

Low Melting Carat Gold Brazing Alloys for Jewellery Manufacture — A Study Of Ag–Au-Ge-Si Alloys — G. Zwingmann — The Au-Ag-Ge-Si system has been investigated as a source of cadmium-free low melting carat gold hard solders but alloys of this type have been found to have restricted applicability. In particular, when applied to copper containing alloys, brittle copper germanides and silicides are formed.

Grain Coarsening Effects of Chromium and Iron in Au-Ag-Cu Alloys—D. Ott and Ch. J. Raub—Chromium and iron in concentrations as low as 0.30-0.5 per cent have been found to cause a marked coarsening of the microstructure of 18 carat Au-Ag-Cu alloys on annealing. Where minimum grain growth during annealing is required, as in the fabrication of rings and chains, the concentration of these metals should therefore be kept at a low level.

Vol. 10, No. 4, October 1977 :

Soldering to Gold Films—The Importance of Lead–Indium Alloys—Frederick G. Yost—Reliable solder joints can be made on gold metallised microcircuits using lead–indium solders providing certain important conditions are understood and carefully controlled. This paper reviews the three fundamental concepts of scavenging, wetting, and ageing, which are relevant when soldering to gold films.

Improving the Residual Resistivity of Pure Gold—Manfred Poniatowski and Axel Wirths — The achievement of exceptionally high purity in gold necessitates extreme care not only in refining but also in subsequent rolling and drawing. This paper described the precautions adopted to produce extremely high purity gold, as measured by its residual resistivity ratio.

Platinum Metals Review – Vol. 21, No. 4, October 1977 :

Platinum Provides Protection for Steel Structures —An Economic way to prevent corrosion—By Lionel L. Shreir—Increasing concern at the taste caused by corrosion has focused attention on the need to utilise the most advanced methods for preventing, or controlling, this expensive phenomenon. The use of platinum for the cathodic protection of ships and marine structures is by no means new but the high cost of such structures, the aggressive environmental conditions to which they are subjected in service, and the need for maximum reliability over long periods of time all tend to make platinum cathodic protection an economic alternative to other methods. This

review, which outlines the many factors that have to be considered when utilising this method and described some of the most recent applications.

Fused Salt Platinum Plating for Industrial Applications—A Useful Production Process—By J.H.F. Notton, Group Research Centre, Johnson Matthey and Co. Ltd.,—Fused salt platinum electroplating has been successfully applied to the continuous cladding of molybdenum wire. The deposit obtained is ductile and has many other attractive features when compared to aqueous platinum plating, such as good adhesion and high purity. The process is equally suitable for thin coatings of a few microns or for electroforming components more than a milimeter thick.

Vol 22, No. 1, January 1978.

Machining Properties of Platinum — Superior Process Results from Wear Investigations—By R.W.E. Rushforth—Group Research Centre, Johnson Matthey and Co. Ltd.—Platinum is usually considered to be a ductile workable metal readily fabricated by all the usual processes ; it is therefore somewhat surprising to discover that the machining of platinum by conventional techniques results in rapid and extensive tool wear, with consequent deterioration of the surface finish imparted to the platinum article. This paper reports the results of an investigation into the behaviour of platinum during machining and the mechanisms by which the tool becomes worn. In addition the techniques devised to alleviate these phenomena, such as preferred tool materials and configurations, are described.

Platinum Provides Protection for Steel Structures—Part II—Performance in Service—By Lionel L. Shreir, Department of Metallurgy and Materials, City of London Polytechnic, London—The first part of this article considered the principles of cathodic protection and described ways in which platinum could be utilised economically as an electrode material. This article examines how such electrodes perform in service, in a variety of applications and under differing conditions.

Order-Disorder Transformations in some Iron-Nickel-Platinum Alloys—by D Skinner and A. P. Miodownik — Dept. of Metallurgy and Materials Technology, University of Surrey, Guildford.

Tin and Its Uses : No. 114, 1977 :

Hot Tinned Wire for the Electronics Industry—P. M. Dinsdale, I.T.R.I.

Modern Automatic Soldering of Printed Circuit Boards by Walter Plattner, Zevatron GmbH, Arolsen, W. Germany.

Continuous Casting of Bronze-Part 2—C.J. Evans, I.T.R.I.,—The first part of this article, in Tin and its Uses No. 113, described the vertical continuous casting process developed at the Institute and also the Wertli system for horizontal continuous casting of strip. This second part looks at some other processes which are used for continuous casting of bronzes and other alloys.

Tin in the Ceramics Industry — Commercial Experience—R R. Dean and C. J. Evans, I.T.R.I.—In Tin and its Uses No. 113, the characteristics of ceramic colours based on stannic oxide were described. These colours play a significant part in the modern ceramics industry and their use by a number of leading companies is described in this article.

Two-Part Connectors For Printed Circuit Board Applications—R. R. Dean, I.T.R.I.

Minerals Science and Engineering—Vol. 9, No. 4, October 1977 :

The Role of Dithiolates in the Flotation of Sulphide Minerals—A critical review is made of published work concerned with the role that alkyl dithiolates play in flotation systems and an attempt is made to settle points of disagreement and controversy. The work on the subject is unbalanced in that very much more attention has been paid to dixanthogen and galena than to other dithiolates, and to other sulphide minerals. Accordingly the picture of the chemistry that emerges is heavily influenced by what is known about dixanthogen/galena and by the theories that have been developed for that system.

It is concluded that whether or not a thiol is converted to the dithiolate at the surface of a particular mineral depends on the rest potential of the surface under the particular conditions. However, once formed or if added to the system in excess, the dithiolate can persist at the surface even when the rest potential indicates that it is not stable. The formation of dithiolates at the surface is not essential to the collecting action of thiols, although it does give increased flotability.

No reference has been found to the addition of dithiolates as collectors in any flotation operation on an industrial scale.

Proto-Plate Tectonics Controlling the Precambrian Deformations and Metallogenetic Epochs of North-Western Peninsular India.

Circuit World, Vol. 4 No. 1, October 1977 :

Some Facts and Figures on India's Printed Circuit Industry — V. Mitter.



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