creasingly aggressive hot water storage tank environments now encountered.

Summary

Advances in electronics and materials technologies have led to the development of miniaturised impressed current protection systems. The system described here was developed for the protection of glass-lined steel hot water storage tanks. It consists of a platinum clad niobium anode strip which extends the full length of the tank, and an electronic control unit. The stability of platinum clad niobium has been well documented such that the design of the anode for long life is ensured. The control unit was designed to provide optimum cathodic protection current for the tank in all water conditions. Service performance of the Mini-ICCP system has shown that problems encountered with other protection methods are overcome with this device. The system has applicability in other environments including water pumps, valves, water cooled devices and a wide range of plant equipment where small protection currents and inexpensive miniaturised circuitry is necessary.

References

1 R. H. Stevens, *U.S. Patent* 1,077,920; 1913

2 J. B. Cotton, *Platinum Metals Rev.*, 1958, **2**, (2), 45

3 R. M. Skomoroski, R. Baboian, R. G. Zobbi and E. K. Camp, *Plating*, 1973, **60**, 1115

4 R. Baboian, Chlorine Bicentennial, The Electrochemical Society, Princeton, N.J., 1974, p. 158

5 R. Baboian, Proceedings of the 4th International Congress on Marine Corrosion and Fouling, 1976, p. 51

6 M. A. Warne and P. C. S. Hayfield. *Mater. Perform.*, 1976, **15**, (3), 39

7 R. Baboian, *Mater. Perform.*, 1977, **16**, (3), 20

8 L. L. Shreir, *Platinum Metals Rev.*, 1977, **21**, (4), 110 and 1978, **22**, (1), 14

9 R. Baboian, *Mater. Perform.*, 1979, **18**, (1), 9

10 R. Baboian, *Mater. Perform.*, 1983, **22**, (12), 15

11 R. Baboian, *Mater. Perform.*, 1984, **23**, (9), 31

12 R. Baboian and G. Haynes, *U.S. Patent* 4,407, 711; 1983 and *Mater Perform.*, 1983, **22**, (10), 15

13 R. Baboian, L. McBride, R. Langlais and G. Haynes, *Mater. Perform.*, 1979, **18**, (12), 40

14 H. H. Uhlig, "Corrosion and Corrosion Control", 2nd Edn., Wiley, New York, 1971, p. 218

Palladium-Copper Composite Contacts

Electrical contacts form a necessary part of a very wide variety of components used, for example, by the telecommunications and automotive industries. Essential requirements of such contacts are that, on activation, they will consistently close the circuit, carry the current and then break the circuit, for at least the specified number of operations. The reliability of performance depends upon the electrical and mechanical operating conditions, and also upon the chemical and physical properties of the contact.

Although copper-palladium alloys containing 15 or 40 weight per cent copper have been used successfully for electrical contacts for many years, none-the-less work continues to develop materials that combine the different properties in more advantageous ways. A recently published communication from the laboratory of R. Rau G.m.b.H., Pforsheim, and the Institute for Materials Technology of the Technical University Berlin deals with the manufacture of copper/palladium composites, and compares the properties of these new materials with those of conventional copper-palladium contact alloys, (K. Müller, D. Stöckel and H. Claus, *Metall*, 1986, **40**, (1), 33–37).

As the palladium content of a copper-palladium alloy is increased to improve resistance to tarnishing, so the electrical conductivity is decreased and the hardness increased due to solid solution effects. However composite materials can be made from these two metals in ways that hinder solid solution formation. One of the three methods suggested is to draw down bundles of copper-clad palladium wire. By repeated bundling and drawing as many as 5000 wires may be reduced to a diameter of 0.5 to 2mm.

These ductile composite materials can be fabricated in a cost effective manner into bimetallic rivet-headed contacts. Electrical conductivity may be higher by a factor of ten, and contact resistance lower than that of conventional alloy contacts of the same overall composition.