



**US Army Corps
of Engineers®**

Engineer Research and
Development Center

Ceramic Anodes for Corrosion Prevention

Technology

The ceramic-coated (“durable”) anode is a cost-effective method for combating corrosion in the high-volume, low-cost materials such as those used in military and civil works applications. The ceramic-coated anode is a much improved alternative to the traditional silicon-iron and graphite impressed current anodes. The advantages of ceramic anodes are their: (1) light weight, (2) dimensional stability (i.e., they do not change shape.), and (3) long life. Cathodic protection designs using ceramic anodes are available for lock and dam gates, elevated water storage tanks, buried pipe, buried storage tank, and also in systems using electro-osmotic pulse (EOP) technology (an emerging technology that mitigates “wet basement” problems without the cost of excavation).

Problem

Corrosion of metallic structures buried in soil or immersed in water can be stopped by using cathodic protection devices that involve applying a small electrical current from an outside source to the corroding structure. The current is applied through an anode that eventually is consumed by the electrical current. The anode is the positive terminal in the corrosion battery and the structure is the negative terminal, as in a flashlight battery where the center of the battery is positive and the casing is negative. The silicon-iron and graphite materials used over the past 30 years in cathodic-protection anodes are brittle and have consumption rates of approximately 1 pound per ampere year. Consequently, structures required large anodes, which were vulnerable to debris and ice damage and field installation problems, which in turn caused numerous electrical shorts in the system.

Expected Cost To Implement

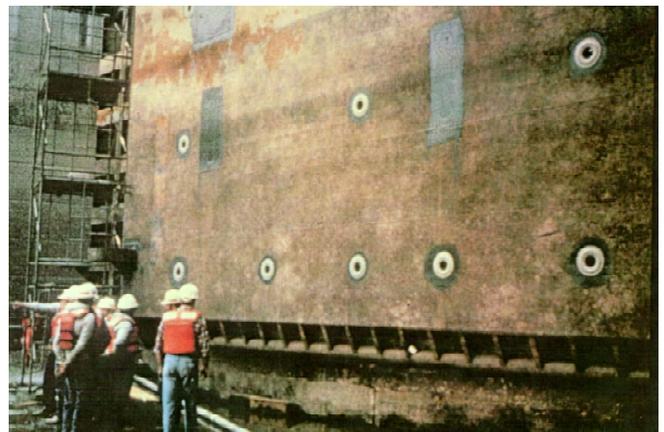
The cost to implement ceramic anode technology will vary depending on the number, size, and type of anode to be used; individual user requirements; and the size and scope of the application. Questions regarding application cost for a specific project should be referred to APS Materials, Inc. (the exclusively licensed Distribution Source listed below).

Benefits/Savings

The consumption rate of conducting ceramic materials such as mixed metal oxides is 500 times less than the silicon-iron and graphite anodes. This resulted in a smaller, (up to 150 times) lighter anode with the same life span. The ceramic coated anode also has a factory fabricated and tested redundant electrical connection. This eliminates installation problems associated with silicon-iron and graphite anodes and results in positive electrical isolation between the anode and the structure. In addition, the ceramic-coated anode is resistant to mechanical damage caused by floating debris due to the tough anode substrate and protective design features. These factors significantly increase the cathodic protection system reliability from an average of 20 percent to a potential 90 percent.

Status

Technology transfer of ceramic anode technology is complete. The use of ceramic anodes is prescribed in Corps of Engineers Engineer Manual (EM) 1110-2-2704. The ceramic coated anode won the 1985 IR-100 Award,



Ceramic anodes are successfully applied to Civil Works dam projects.

presented by Research and Development Magazine to recognize the 100 most significant products. The ceramic-coated anode also won the Army Research and Development Achievement Award in 1984, the Army Science Conference Award for Outstanding Achievement in 1984, and the Technology Transfer Excellence Award in 1991 from the Federal Laboratory Consortium.

ERDC POC

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Documentation

Engineer Manual (EM) 1110-2-2704, *Cathodic Protection Systems for Civil Works Structures (Department of the Army [DA], Washington, DC, 1 January 1999)*, available through URL:

<http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-2-2704/entire.pdf>

Engineer Technical Letter, ETL-1110-9-10, *Engineering and Design – Cathodic Protection System Using Ceramic Anodes*, 5 January 1991, available through URL:

<http://www.usace.army.mil/inet/usace-docs/eng-tech-ltrs/etl1110-9-10/toc.html>

Vincent F. Hock, Richard Ruzga, and Ashok Kumar, Technical Report (TR) FM-95/05, *Field Evaluation of Cathodic Protection Systems Using Ceramic-Coated Anodes for Lock and Dam Gates* (CERL, September 1994).

Distribution Source

The exclusive license for the Construction Engineering Research Laboratory (CERL) ceramic anode patent was awarded to APS Materials, Inc., of Dayton, OH, in May 1984. APS Materials (“CerAnode Division”) manufactures, markets, and provides user support for the ceramic-coated anode. Further contact information is available through URL:

http://www.apsmaterials.com/common/corp_main.htmhttp://www.apsmaterials.com/common/corp_main.htm