

DEEP WELL CATHODIC PROTECTION SYSTEM

PRODUCT OVERVIEW

The **EnvirAnode®** CP System* for impressed current cathodic protection (CP) is a premium product aimed at applications that demand high performance, long life and environmental compliance. The **EnvirAnode®** offers the following value proposition:

1. An Environmentally Neutral Solution
2. Longest Lasting Performance
3. Most Efficient Performance and
4. Best overall value for money (lowest CAPEX on a NPV Basis)

PRODUCT FEATURES

The **EnvirAnode®** is the world's first molecular bonded tertiary energy transfer technology developed expressly for CP applications, and is behind its stunning performance as a fully operational, environmentally-neutral cathodic protection anode. Notable features include:

- The conductive **Conducrete®** backfill sets up to form a solid, impermeable column that stops water migration and aquifer cross-contamination, a major issue with coke breeze type anode beds;
- The combined volume of the three energy transfer materials, with their inherent protection against water penetration and corrosion give the **EnvirAnode®** its phenomenal operational lifespan of 2 to 3 times that of traditional CP anode beds;
- Two carbon and one mixed metal oxide (MMO) energy transfer materials, molecularly bonded together into a single CP anodic column;
- The molecular bonding process that ties the active energy materials together results in a highly efficient electronic energy transfer to the soil that provides a stable and predictable electrical performance throughout its operational life;
- The large surface area of the **EnvirAnode®** lowers the surface energy density, and efficiently manages the normal gas byproducts produced that out-gassing vent pipes are not required;
- The **EnvirAnode®** even ages differently. The “shelving off” and “end effect” phenomenon associated with traditional anode beds is effectively eliminated, as the CP process slowly depletes carbon from within the energy transfer materials, leaving the column itself intact and impermeable, thus eliminating abandonment costs and environmental pollution risks.

These features add up to unparalleled operational and environmental performance, which creates a compelling business case for **EnvirAnode®** CP solution even before considering the significantly lower total cost of ownership.



EnvirAnode® installation at an oil refinery

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How ENVIRANODE® WORKS

The **EnvirAnode®** CPS is first and foremost an effective impressed current cathodic protection solution — familiar, but different:

- Familiar in that an **EnvirAnode®** CP system is installed using the same tools and techniques as those used in traditional anode beds, though simpler as the vent pipe and anode centering rings are not required;
- Different in that an **EnvirAnode®** CP system is constructed from robust SAE extended-life AEL Anodes® embedded in a conductive impermeable column made from specially formulated Conducrete® backfill material (see diagram);



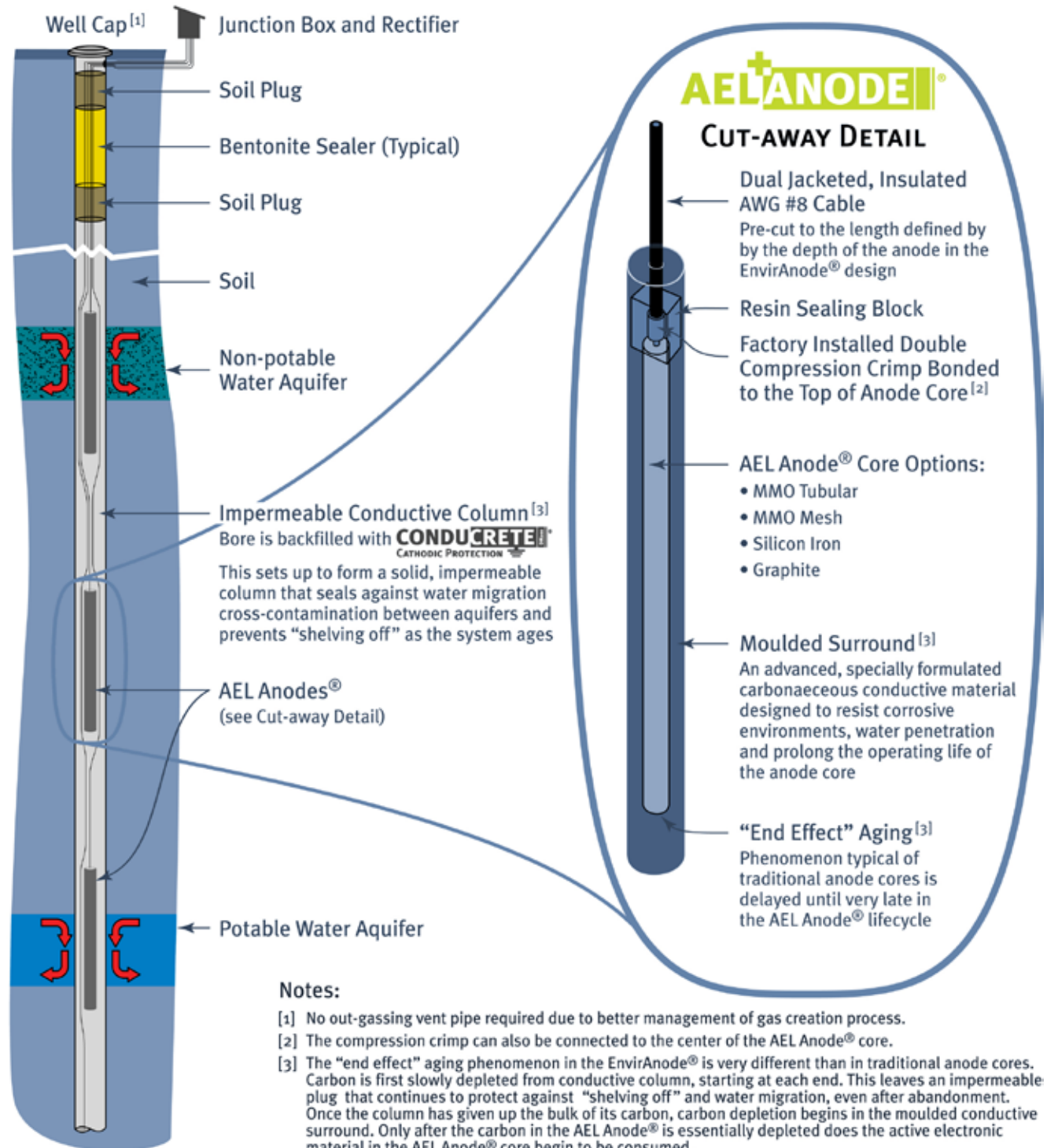
EnvirAnode® installation using familiar drilling, mixing and pumping tools and techniques

- Installed, this configuration transforms into a molecularly bonded tertiary electronic energy transfer system with a very large active surface area over which the CP energy is effectively dissipated into the soil. This results in the ionic reaction boundary being shifted away from the surface of the anode core to the interface between the column and soil, where the large surface area reduces the circumferential energy density, thereby reducing carbon consumption/depletion by nearly half, and extending the life of the anode bed;
- The electronic energy transfer mechanism of the **EnvirAnode®** gives extremely stable electrical operating behaviour in use, especially when compared to the electrolytic energy transfer utilized in traditional anode beds (see Performance section);
- The large active, low energy density surface area of the **EnvirAnode®** column causes minute bubbles of gas to be formed over the entire surface of the column, where it is easily absorbed into the soil before it can collect into concentrated pockets. Thus, by better managing the production and dissipation of out-gassing, vent pipes are not required in **EnvirAnode®** installations and the overall efficiency of the anode bed is increased;
- Once the **EnvirAnode®** column has set up, it provides an impenetrable barrier to the migration of water, eliminating aquifer cross contamination to help maintain the quality of critical water resources. This impermeable characteristic continues even after the carbon has been depleted from the active areas of the column, eliminating expensive abandonment issues and costs;
- The solid **EnvirAnode®** column also eliminates the “shelving off” phenomenon inside the bore that degrades the anode bed efficiency and shortens operational lifetimes in traditional coke breeze systems;
- In addition to being an energy transfer material, Conducrete® backfill provides excellent anti-corrosion benefits, protecting the AEL Anode® against water penetration and corrosion and further extending the operational lifetime of the anode bed. The pre-cast carbonaceous surround material used in the AEL Anode® in turn provides additional anti-corrosion protection for the anode core — typically a mixed metal oxide (MMO) tube — and offers the additional benefit of delaying the onset of the aging “end effect” at the core;
- With superior CP energy transfer efficiency, three layers of energy transfer materials (the tertiary design), corrosion, “shelving off” and “end effects” either eliminated or delayed, and out-gassing very effectively managed, it’s no surprise that the cathodic protection performance and operational life of an **EnvirAnode®** CPS far exceeds any other solution in the market.

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A CP SYSTEM THAT CAN BE SAFELY INSTALLED THROUGH UNDERGROUND AQUIFERS

EnvirANODE® CROSS-SECTION



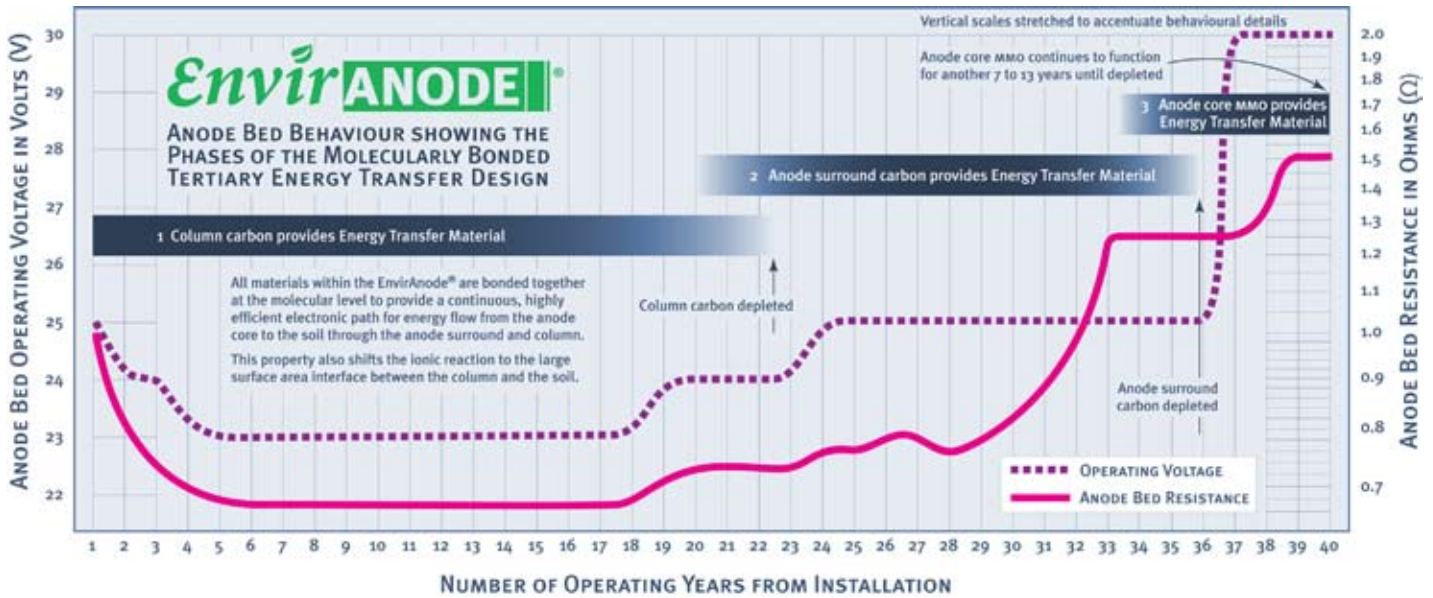
Notes:

- [1] No out-gassing vent pipe required due to better management of gas creation process.
- [2] The compression crimp can also be connected to the center of the AEL Anode® core.
- [3] The "end effect" aging phenomenon in the EnvirAnode® is very different than in traditional anode cores. Carbon is first slowly depleted from conductive column, starting at each end. This leaves an impermeable plug that continues to protect against "shelving off" and water migration, even after abandonment. Once the column has given up the bulk of its carbon, carbon depletion begins in the moulded conductive surround. Only after the carbon in the AEL Anode® is essentially depleted does the active electronic material in the AEL Anode® core begin to be consumed.

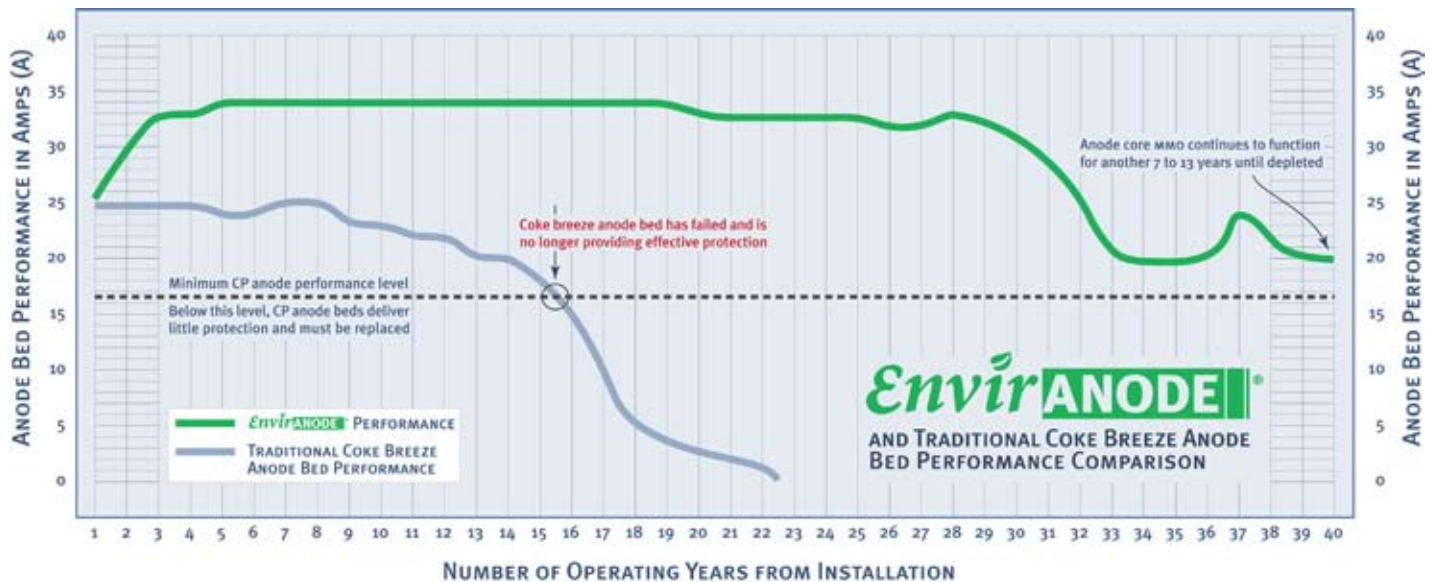
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ENVIRANODE® OPERATIONAL PERFORMANCE

The **EnvirAnode®** solution offers more reliable and stable electrical performance (and cathodic protective value) over a longer operational lifetime than any other impressed current cathodic protection solutions currently available. The charts below illustrate the behaviour characteristics of a typical 25A **EnvirAnode®** deep well anode bed, and show its expected performance and lifecycle as compared to a traditional 25A coke breeze anode bed.



EnvirAnode® operating characteristics showing the properties of the Molecularly Bonded Tertiary Energy Transfer Design over time



*Comparison of 25A anode bed performance between an **EnvirAnode®** CP system and a traditional coke breeze system*

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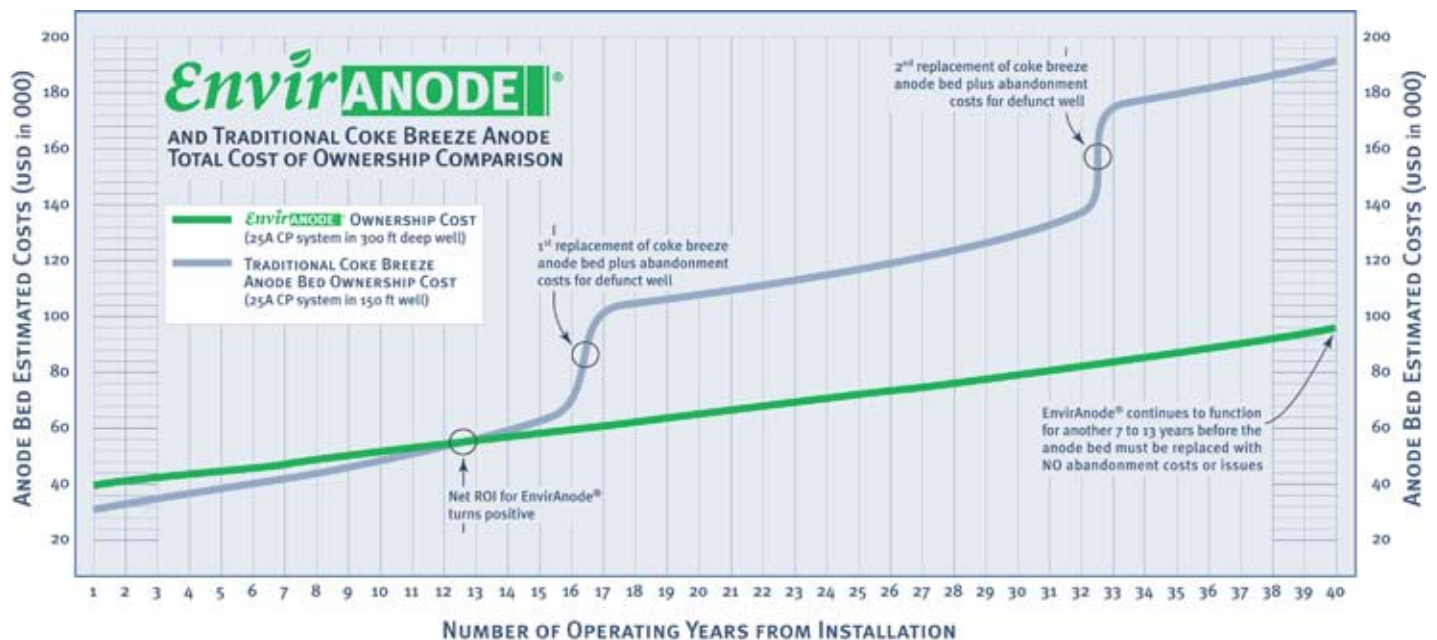
THE BUSINESS CASE FOR ENVIRANODE®

The **EnvirAnode®** solution offers a compelling business case at several distinct levels: as an individual anode bed, as a system-wide CP deployment and as a viable response to increasing stringent environmental regulations and control.

- At the level of individual anode beds, the **EnvirAnode®** offers a Total Cost of Ownership (TCO) that is less than half the TCO of traditional anode beds (see chart below). When abandonment bond requirements are considered in the financial model (typically USD 50,000 per anode bed), the **EnvirAnode®** TCO is one third of traditional anode beds, with positive ROI on day one! This financial benefit stems primarily from the longer operating life of the **EnvirAnode®** and its reduced maintenance costs.
- In a system-wide deployment, the unique operational characteristics and performance of the **EnvirAnode®** offer a significant reduction in system CAPEX, as fewer **EnvirAnode®** anode beds are required. For example, along a 150 mile (240 km) pipeline, CP protection can be obtained with three (3) x 300 ft **EnvirAnode®** anode beds producing a more stable current output, compared with the five (5) x 150 ft traditional coke breeze anode beds required to provide a similar level of CP protection. The CAPEX advantages are even more profound given the fact that virtually no abandonment costs are required with the **EnvirAnode®** solution.
- Where strict environmental regulations are in force, the **EnvirAnode®** is often the only deep well technology which can be deployed, since the **EnvirAnode®** technology has been approved for use in environmentally sensitive areas by regulatory agencies.



*Environmental regulatory agencies that have approved the use of the **EnvirAnode®** in environmentally sensitive areas*



Total Cost of Ownership (TCO) comparison between a 25A, 300 ft **EnvirAnode®** CP system and a 25A, 150 ft traditional coke breeze system

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ENVIRANODE® PRODUCT ORDERING OPTIONS

EnvirAnode® CP solutions are available in either as predefined kits built for typical cathodic protection applications, or as custom designed systems tailored to specific client requirements (see www.saeinc.com website for details).

The kits are available for a variety of impressed current capacities. Use the product ordering option codes in the tables below to specify the EKT EnvirAnode® CP kit that meets your technical requirements.

ENVIRANODE® CP KIT CODE (see Current Rating Options in Table A)		PHYSICAL GEOMETRY OPTIONS CODE (see Applications Options in Table B)
EKT	cc	ggg

TABLE A: ENVIRANODE® KIT – CURRENT RATING OPTIONS

OPTION CODE (cc)	TOTAL IMPRESSED CURRENT RATING (AMPS)
25	25
50	50

TABLE B: ENVIRANODE® KIT – PHYSICAL GEOMETRY OPTIONS

OPTION CODE (ggg)	N° OF AEL ANODES®	AEL ANODE® WIRE LENGTHS				BORE HOLE GEOMETRY		
		METRES		FEET		DIAMETER (INCHES)	DEPTH (METRES)	DEPTH (FEET)
101	10	46.0	68.9	151	226	10	91.4	300
		50.6	73.5	166	241			
		55.2	78.0	181	256			
		59.7	82.6	196	271			
102		64.3	87.2	211	286	12		
301	20	64.3	110.0	211	361	10	152.4	500
		68.9	114.6	226	376			
		73.5	119.2	241	391			
		78.0	123.7	256	406			
		82.6	128.3	271	421			
302		87.2	132.9	286	436	12		
		91.7	137.5	301	451			
		96.3	142.0	316	466			
		100.9	146.6	331	481			
		105.5	151.2	346	496			

For more information about our environmentally neutral cathodic protection solutions, products and services, please contact us at:

Toll Free: 1.877.234.2502 eMail: sales@saeinc.com Website: www.saeinc.com