

# EnvirAnode®

## 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 carbons 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.

## TECHNICAL DESCRIPTION

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

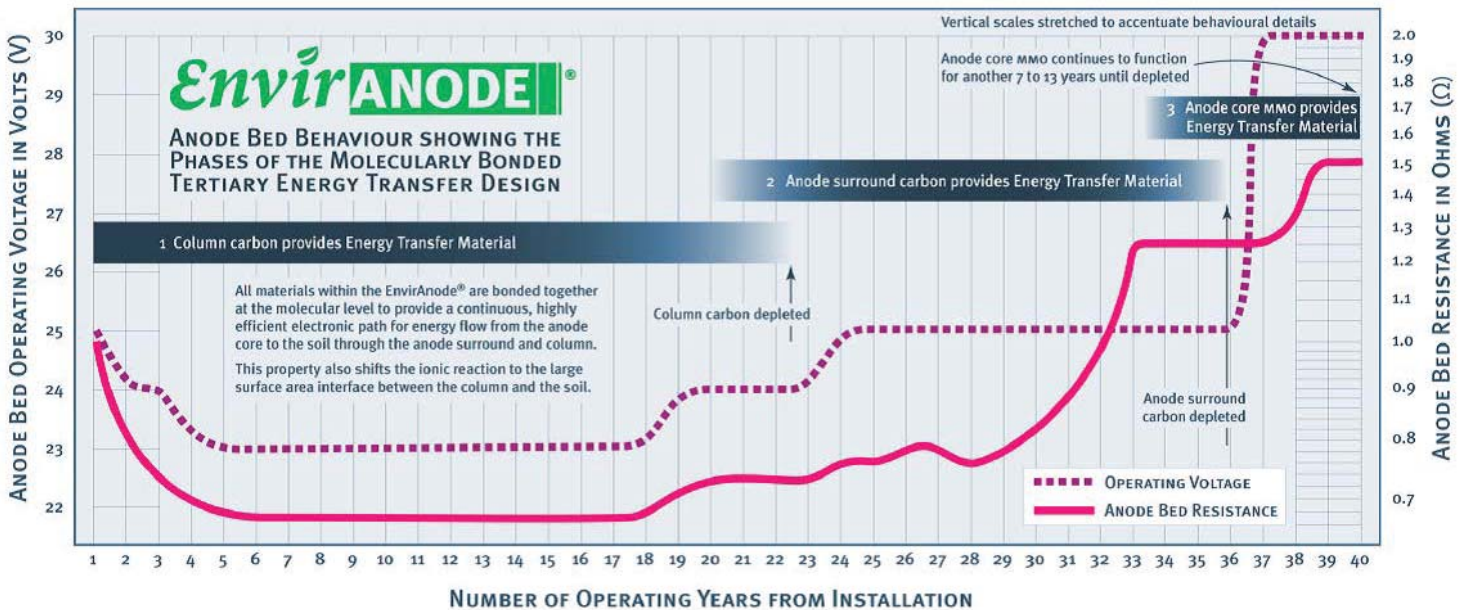
- Familiar in that an EnvirAnode® CP system is installed using the same tools and techniques as those used in traditional anode beds, though simpler as the vent pipe and anode centering rings are not required.
- Different in that an EnvirAnode® CP system is constructed from robust SAE extended life AEL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

# EnvirAnode®

- 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.

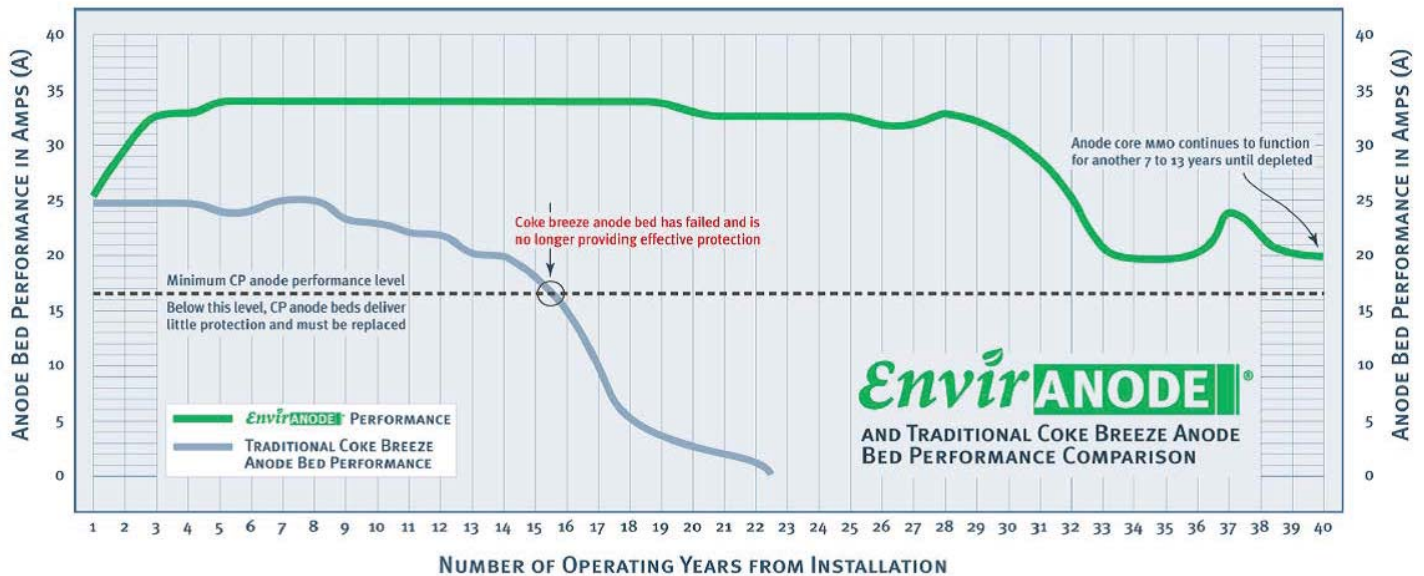
## ENVIRANODE® OPERATIONAL PERFORMANCE

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.



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

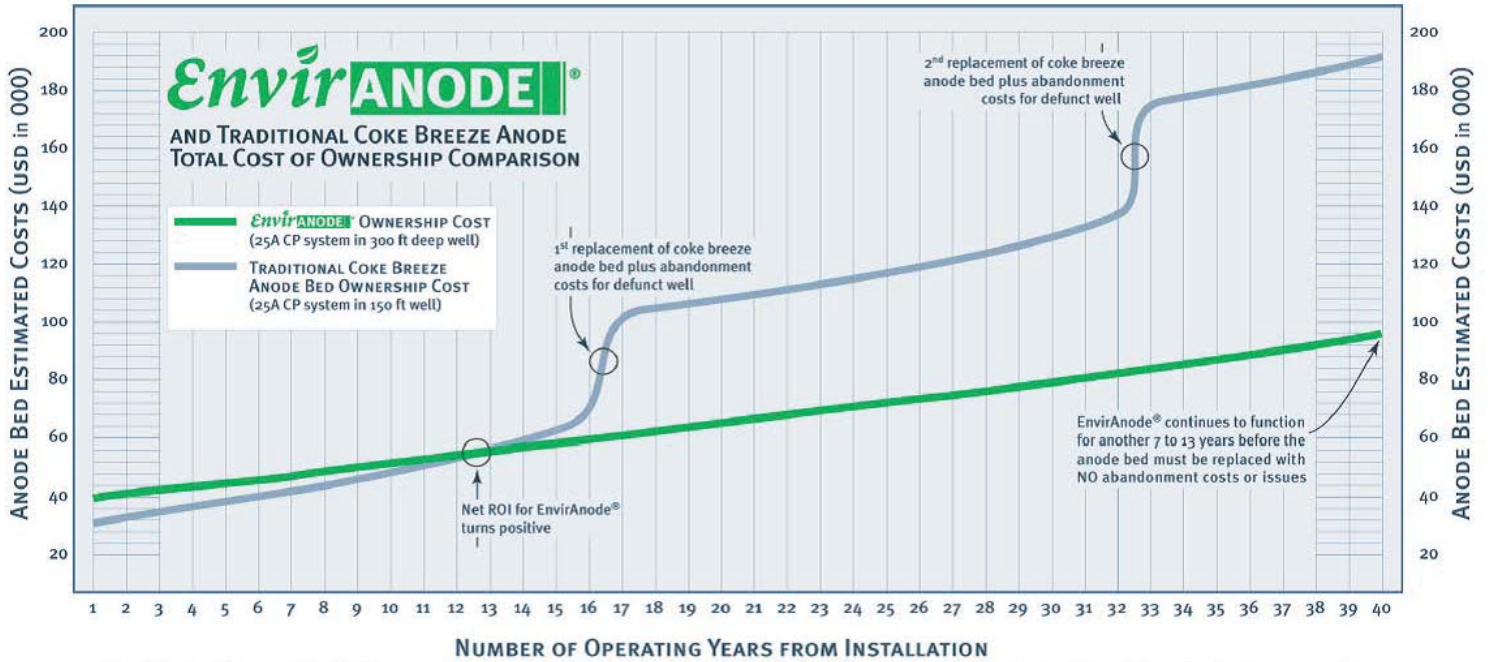


Comparison of 25A anode bed performance between an EnvirAnode® CP system and a traditional coke breeze system

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 used 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.

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