BADGERCOMP®

American Carbon developed and manufactures a graphite anode quite different from any other graphite anodes out there. The density and impregnation process of our anodes allows them to be both more durable during handling and longer lasting once placed in service than other graphite anodes.

APPLICATIONS:

Graphite anodes were the first inert cathodic protection anodes commercially available. Originally, graphite anodes had a relatively narrow application base, but with new denser graphite, and wax and resin impregnation, graphite anodes of today are much more durable and versatile.

Graphite anodes that have not been impregnated with a wax or resin treated (ACC products 10-301 and 10-401) are not suitable for most installation methods as sold. The high porosity of these anodes can allow water to infiltrate the anode interior, causing sloughing and excessive loss of material or disconnection from the power source. This reaction often will cause damage to grain boundaries and physical damage due to gas generation. In any case, these problems will likely cause an increase in consumption rate or electrical connector corrosion and failure. American Carbon does not recommend installing these bare, non-impregnated anodes without a treatment method - these anodes should be treated by the customer with some method before installation.

Anodes treated with either wax or phenolic resin are much less susceptible to the pitfalls of moist conditions. In fact, in chloride containing waters the consumption rate of wax treated graphite anodes (ACC products 10-302, 10-304, 10-305, 10-402, 10-404, and 10-405) is significantly less than in dry or fresh water applications.

From both a practical and cost effective standpoint, wax treated graphite anodes are the most commonly installed anode type. Their performance characteristics in most common installation environments are listed below. As always these rates of consumption vary with current density, environment, and method of installation.

Installation Environment	Current Density (Amps/SF)	Consumption Rate (lb/Amp/Year)
Fresh Water (Not Recommended)	0.23 - 0.27	0.22 - 0.66
Sea Water	0.9	0.66 - 1.1
Carbonaceous Backfill (Recommended Installation)	1.0	0.22 - 0.66

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MANUFACTURING PROCESS:

Graphite anodes are made with synthetic graphite. Synthetic graphite starts with calcined petroleum coke. Calcined petroleum coke is a waste by-product of oil refineries. It is primarily made from solids that have precipitated out of the oil during the cracking process. The coke that is originally removed must be cleaned, or calcined, before it can be used for synthetic graphite. Not all coke is created equal, just as crude oil is not created equal. To manufacture a high quality graphite, only the best quality, most crystalline calcined petroleum coke is selected for the manufacture of synthetic graphite.

At this stage the calcined petroleum coke (petcoke) is a gravelly substance with a defined grain distribution of large particles to very fine particles. Much like adding water to Portland cement to make concrete, a liquid substance must be used to bind the particles together. Since this material must also be graphitic (able to turn into graphite) in nature, the only acceptable binder material is coal tar pitch (CTP). By applying heat to make the CTP more fluid, the petcoke is fully coated with CTP.

The ensuing mixture is then extruded into an oversize round for anodes. The extruded round is then slowly baked at a temperature of approximately 1,000oC for a period of 2-3 weeks (including cooling). The speed at which the extrusion is heated is critical to prevent deformations created by off-gassing and any possible melt flow from the CTP. A result of this baking process is a more homogeneous material, however the porosity of the material is increased. To ensure the proper density is met, the rounds are then impregnated with CTP again, this time using a less viscous material that fills the smaller pores of the round. After another round of baking (again 2-3 weeks), a rod is produced with the correct porosity for graphite anodes, but it is not yet graphite. At this point it is only pure carbon, and has almost no conductive properties.

The next production step is graphitization. Graphitization is a process also described as longitudinal or magnetic induction. The now carbon rods are laid end to end in a furnace and covered with loose petroleum coke. A low voltage, high amperage DC charge is applied to the furnace and the natural resistance of the petcoke and carbon rounds creates huge amounts of heat – in the range of 2,300 oC. This heating causes the grain structure of the carbon rods to change dramatically. The grains in the carbon rod are quite random in their orientation, but the heat and electrical resistance in the furnace cause the grains

to form parallel structures that slide easily against one another. This is where the slippery feeling of graphite comes from. After a 3-4 week heating and cooling process, the carbon rods have been fully converted to a graphite rod.

The next step is machining the rods to tolerance, for American Carbon's graphite anodes these tolerances are +1/4", -0" on diameter and +1", -0" on length. Some anodes are also predrilled for center connections.

The final step most rods undergo is impregnation by either wax or phenolic resin. Currently wax treatment is much more cost effective and more commonly used. Using a the correct grade of paraffin wax, American Carbon impregnates the graphite anodes to 100% wax impregnation with the use of a vacuum pressure tank which impregnates quicker and more evenly than traditional hot wax open air tanks. This paraffin wax is an excellent barrier to moisture and premature deterioration of the anode due to water infiltration.

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