



TECH 2023S6: Industrial Graphite Electrodes

Industrial Graphite Electrodes is one in a series of reports published as part of NexantECA’s 2023 Technoeconomics – Energy & Chemicals (TECH) program.

Overview

Industrial graphite electrodes are of great importance to steel and aluminum production, in the former sector mainly for electric arc furnaces (EAFs) and in the latter as a consumable anode. The sector is small but high value, and is subject to a series of short- and long-term trends that have placed the strategic outlook of the sector into flux:

- Chinese initiatives to convert blast furnace processing of steel scrap to EAFs in the near term
- Decarbonization initiatives driving replacement of blast furnaces for processing of virgin iron ore to direct reduced iron-arc furnace (DRI-EAF) options
- Major competition for synthetic graphite used in electrodes with those used for battery applications
- The availability of short- and medium-term subsidies for high-quality industrial graphite production

These trends have positioned industrial graphite electrodes as key materials for carbon intensity reduction and have dramatically affected supply and demand dynamics. Moreover, the sector is in the process of consolidating and specializing by application, and has been riven by trade disputes even as markets have grown.

This report covers the industrial graphite electrode sector from a techno-economic perspective. More than ever, it is an indispensable piece of the world’s critical manufacturing technologies.

Commercial Technologies

This report covers the production and use of graphitic and semi-graphitic electrodes used as functional products in industry, focusing on major applications of electric arc furnace electrodes, prebaked consumable carbon anodes, and Söderberg electrodes. While these technologies are widely known, their manufacturing and uses have rapidly evolved as their functional applications have become more demanding. Within the last 10 years, major changes in scale, technological improvements and market requirements for steel and aluminum have caused corresponding changes in graphite electrodes.

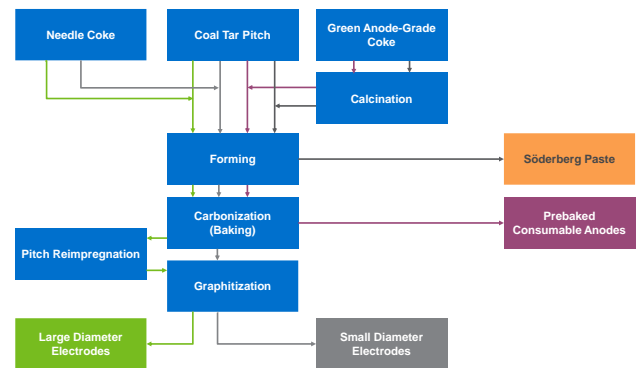
The report also provides a detailed overview of the functional uses of graphitic and semi-graphitic electrodes in current best-in-class applications in electric arc furnaces (especially for steel production) and in the Hall-Héroult process used for aluminum smelting.

Process Economics

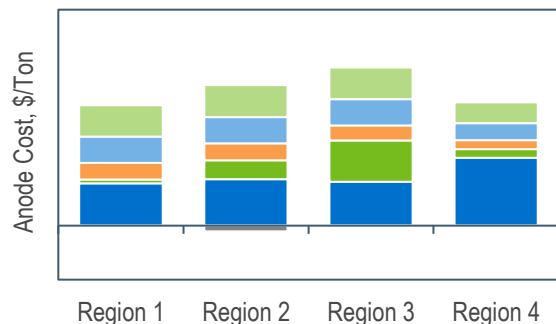
This report models the cost of production of HP/UHP large format electric arc furnace electrodes and for producing prebaked consumable carbon anodes, both serving current leader applications in steel manufacturing and aluminum refining, respectively. The facilities modeled cover integrated manufacturing as practiced by the world’s leading players. Cost estimates are provided for the U.S. Gulf Coast, Coastal China, Western Europe, and Middle East regions on a Q1 2023 pricing basis.

Included in the manufacturing cost analysis is an estimate of Greenhouse Gas Protocol Scope 1 & 2 emissions.

Industrial Graphite Electrode Value Chain



Regional Comparison of Cost of Production for Prebaked Consumable Carbon Anodes





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- Strategic/business overviews
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- Chemistry
- Process flow diagrams and descriptions of established/conventional, new and emerging processes
- Process economics – comparative costs of production estimates for different technologies across various geographic regions
- Overview of product applications and markets for new as well as established products
- Regional supply and demand balances for product, including capacity tables of plants in each region
- Regulatory and environmental issues where relevant

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- Cost of production tables in spreadsheet format
- Consultation time with the project team

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

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