TDA
Research



Developing cutting edge chemical processes and materials for customers in the defense, aerospace, energy and chemical industries.

TDA is a leader in developing cutting edge advanced materials (polymers, carbons and ceramics), catalytic and sorbent-based chemical processes, and military and aerospace hardware. This development has led to licensing of three major processes and manufacture of ton quantities of sorbents, resulting in multi-million dollars of sales.



TDA combines the creativity, drive, speed and flexibility of a small entrepreneurial company with the business acumen that comes from turning concepts into products. We benefit greatly from the diverse skills of our staff and draw upon their wide variety of skills to move a project forward from idea to product.

CORE ADVANTAGE

TDA develops and brings to market new chemicals and materials to solve our customers' problems.

- TDA has extensive analytical and materials characterization equipment, as well as a wide variety of automated equipment for testing of catalysts and sorbents.
- TDA is a privately held U.S. small business. All employees are either U.S. Citizens or permanent residents. TDA is fully compliant with U.S. export control regulations and has an approved Technology Control Plan (TCP) for handling export-controlled items.
- TDA's two facilities in Colorado provide the machining and electronic facilities needed to build up and support development.

INTELLECTUAL PROPERTY

TDA actively pursues protection of our inventions, and has 37 issued U.S. patents, 13 foreign patents, and 14 pending U.S. and foreign patents. Our IP protection is assisted by having a registered patent agent on staff.

MARKETS AND APPLICATIONS

MILITARY & AEROSPACE
- Life Support Technologies
- Personal Protective Equipment
- Chemical and Biological Defense
- Surface Decontamination
- Fuel Processing Technologies
- Protective Paints and Coatings
- Battery Technologies

ENERGY TECHNOLOGIES
- Liquid Fuel & Syngas Clean-up
- Flue Gas Clean-up
- Carbon Capture

CHEMICAL TECHNOLOGIES
- Conducting Polymers
- Electronic Grade Carbons

ADVANCED MATERIAL RESEARCH

New material research includes catalysts and sorbents, fullerenes, carbons, polymers and polymer additives and ceramics. These materials in turn often form the basis for new and unique chemical processes or devices.

TDA CATALYSTS remove pollutants (such as sulfur compounds and nitrogen compounds, hydrocarbons and carbon monoxide) or enable new or more efficient chemical processes (such as the production of hydrogen, syngas, aldehydes or nitrogenated compounds).

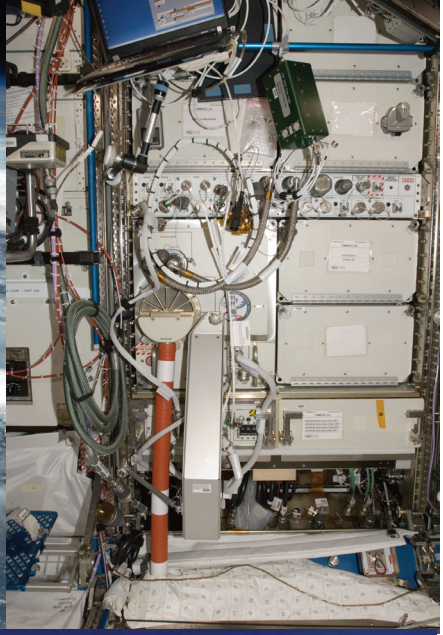
TDA SORBENTS remove pollutants such as sulfur and nitrogen compounds or metals such as mercury and arsenic from power plant streams or exhausts, including at elevated temperatures where normal sorbents simply don't function.

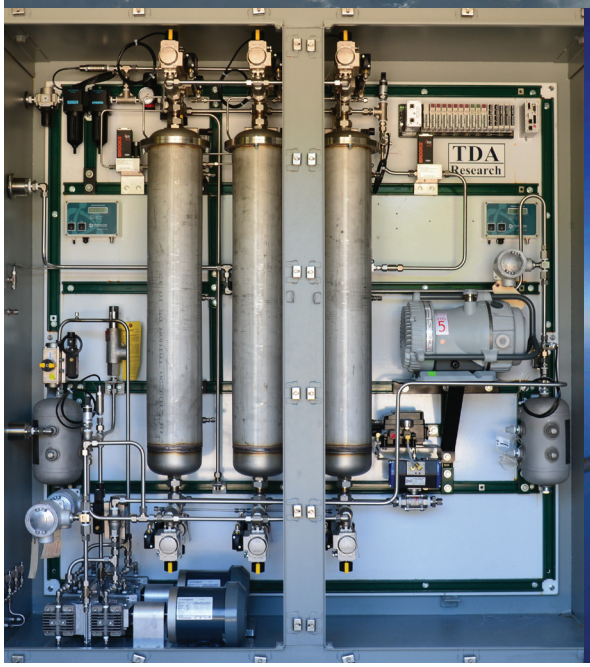
TDA is a leader in CARBON-BASED MATERIALS, with strengths in the production and use of fullerenes (C_{60}) and conductive carbons for use in ultracapacitors, batteries and water clean-up.

TDA POLYMER work focuses on conducting polymers, self-assembling materials with nanoscale features and additives that improve the physical properties bulk polymer or impart useful characteristics such as corrosion resistance.

TDA has just the right combination of experience and small-company flexibility to solve cutting edge chemical and engineering problems.









HARDWARE DEVELOPMENT

TDA develops and builds hardware for a wide range of systems, including components and standalone devices:

- Custom chemical and catalytic reactor systems for testing or operation of laboratory and pilot scale chemical processes.
- A field-portable CO_2 generator for military entomology units to use in surveillance of mosquito disease vectors.
- Chemical and biological defense decontamination equipment that is active against both chemical warfare (CW) and biological warfare (BW) agents.
- Life Support Technologies that sustain pilots, astronauts, submariners and firefighters with flight qualified backup oxygen systems, as well as catalytic and sorbent-based trace contaminant control systems.



COMMERCIAL PRODUCTS

A majority of the products developed by TDA are not sold by us, but by our manufacturing partners. Last year alone, our partners sold over $3.4 million of products developed at TDA.

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SULFUR SORBENTS

SulfaTrap LLC (www.sulfatrap.com), the largest U.S. supplier of sulfur removal sorbents for the fuel-cell industry, was spun off from TDA in January 2013.

SulfaTrap manufactures a complete line of sorbents and sulfur removal systems that capture all types of sulfur contaminants from natural gas, biogas and hot reformer gas. These sorbents remove inorganic species such as H_2S and COS (prevalent in European gas) and hard to remove organics such as thiophenes, mercaptans and organic sulfides.

SulfaTrap sells specialized sorbents for high and low moisture feeds. Major users include fuel cell manufacturers (FuelCell Energy, Delphi, Acumentrics and others) and major chemical companies.

FULLERENES

TDA developed the world's first large-scale fullerene manufacturing process, the material that ushered in the nanotechnology era.

In 1991 TDA started developing a combustion-based fullerene production process and in 2001, a complete 3-ton/year system was built and licensed for Frontier Carbon (a joint venture of Mitsubishi and Nanotech Partners); at the time the world's largest facility. By 2003, TDA built and licensed all of the reactors for Frontier Carbon's 30-ton/year plants.

More than 90% of the fullerenes ever made have been produced in TDA's reactors, their use is growing since fullerene derivatives are then-type semiconductors in organic photovoltaics.









DIRECT OXIDATION

In 1995, TDA began developing catalysts that partially oxidize hydrogen sulfide (H_2S) to form sulfur and water.

Removing H_2S from natural gas costs U.S. industry roughly $2 billion per year. For small plants with capacities of 1-10 tons per day our process reduced the cost of sulfur removal by 40%.

The first full-scale demonstration of our process at an EOR facility in Plains, TX was completed in 2003 and the first two commercial units have been installed in Southern California with sales exceeding $8 million. The process is licensed to GTC Technologies (Houston, TX) and URS Corp. (San Francisco, CA).

AIRCRAFT CLEANER AND DECON SOLUTION

TDA's SSDX-12™ aircraft cleaner is qualified for routine aircraft cleaning per MIL-PRF-87937D "Cleaning Compound, Aerospace Equipment". Through a collaboration with Proctor & Gamble, SSDX-12™ was developed as a decontamination detergent product for aircraft use, and is optimized for removal of chemical warfare agents.

CONDUCTING POLYMERS

TDA manufactures and sells specialty chemicals through Sigma-Aldrich and introduced two families of product, the Oligotron™ line of printable (polymerizable) oligomers and the Aedotron™ line of processable, transparent, conducting polymers.

By selling our materials through Sigma-Aldrich we put our chemicals in the hands of hundreds of researchers worldwide that are developing new products.

AUTOMATED CATALYST TESTING EQUIPMENT

As an outgrowth of expertise, TDA's Automated Systems Division has long sold automated catalyst and sorbent testing equipment to large chemical companies and national laboratories. This equipment provides fully automated control and data handling, as well as redundant safety features.



OUR PARTNERS

Virtually all of our projects establish partnerships in which we work together to bring our products and processes to market.

In addition to the work that we carry out in house, our partners make significant investments in taking our technology from the development and demonstration phase to full-scale manufacturing.

OUR PARTNERS INCLUDE:

Aldrich, Air Products, Akzo Nobel, Batelle, Colorado School of Mines, Conoco Philips, Fuel Cell Energy, Georgia Tech., Gas Technology Institute, GTC Technologies, Hamilton-Sunstrand, Jacobs, National Renewable Energy Laboratory, Proctor & Gamble, Sherwin-Williams, PPG, University of Colorado, Southern Company, Southwest Research Institute, UC Irvine, URS Corp., etc.



COMPANY PROFILE

TDA Research was formed in 1987 by two staff from the Solar Energy Research Institute (now the National Renewable Energy Laboratory) in Golden, CO. Since that time, TDA has grown to a staff of 80 with annual revenues of approximately $14 million. TDA is a privately held R&D company that develops new materials (polymers, carbons and ceramics), catalytic and sorbent-based chemical processes and military and aerospace components. We bring them to market either by forming internal business units, or more frequently, in partnership with larger Global 2000 manufacturing companies.

TDA is located just west of Denver. We occupy two facilities with a total area of 50,000 $ft^{2.}$