Altex Technologies Corporation

Power and Energy System Innovators

Altex Technologies Corporation

Innovating Power Technologies

Mission

Altex Technologies Corporation leverages staff creativity, expertise and available tools to define, develop, test, demonstrate and deploy innovative energy technology solutions that improve energy security at lower volume, weight, emissions and cost.

Vision

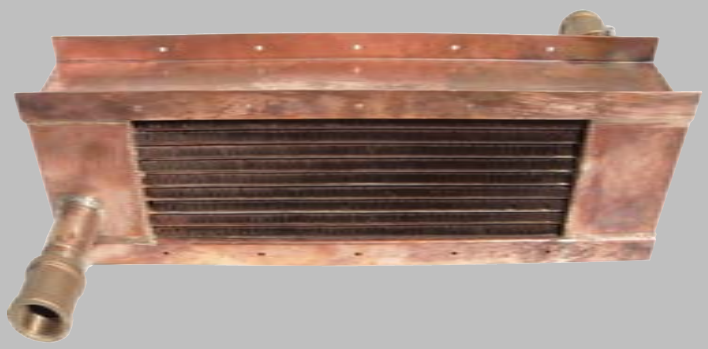
Our goal as a company is to create energy innovations for industry and the public, which are compact, lightweight, efficient, and clean, at a lower cost.

Value

The world of energy is changing forever as a result of geopolitical and climate changes Efficient and clean energy innovations are needed to attain energy security and address climate change. Altex delivers these needed innovations.

Core Competencies

Altex core competencies include a strong fundamental understanding of flow and reaction associated with energy production and utilization that can be translated into solutions for challenging fuels production and utilization problems. This competency is supported by a proven track record with many federal, state and commercial company customers, and the ability to cover a range of activities from research and development to demonstration and deployment. Special test facilities are available to support heat exchanger, fuel cell and microturbine systems, biomass densification and conversion to liquid fuels and low emissions burners. Using unique knowledge, Altex has developed proprietary models in support of systems development



High performance low cost non-isotropic structures for heat exchanger with 100%COP

Biomass densification (40lb/ft^3) for low-cost transport to biofuels plant

5-10kWe Fuel Cell and Cogen Systems that operate on Mil Spec JP-8 and similar fuels

Lower-cost conversion of biomass to, energy, power or drop-in fuels

Ultralow NOx burners to meet sub 5ppm NOx emissions

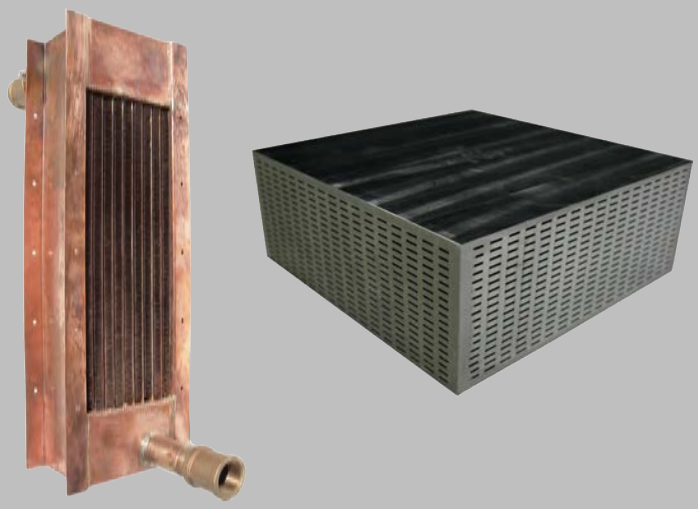
Combined heat and power system that meets boiler's thermal needs with added 100 kWe

Altex Product Development Areas

Altex's unique knowledge base, and analysis and experimental tools have supported the development and test of new thermal management, fuel-processing, combustion and power-system technologies. Several fully instrumented test facilities are available at Altex covering capacities from 20 watts to 3MW. These are complemented by models addressing chemical kinetics, chemical equilibrium, fuel transformation, combustion, fluid dynamics, heat transfer, and pollution formation. Using these resources, Altex has supported technology development and demonstration in several key areas of expertise.

High Performance, Low-Cost Thermal Management Systems

Altex has discovered and is testing an innovative three-dimensional heat exchanger construct that reduces fan power needs by over 50% for the same heat transfer, compared to state-of-art heat exchangers. Importantly, this innovation, called the Non-Isotropic Structures for Heat Exchange (NISHEX), is constructed of readily available materials and uses common fabrication techniques, which reduces fin cost by 50% versus conventional heat exchangers. Lastly, NISHEX exchangers are 60% lower in fin volume and weight than conventional heat exchangers. The concept is general and flexible, and can be adapted to many important residential, commercial, industrial and vehicle heat management applications. The picture on the near right shows the NISHEX application to a radiator.



Altex has also developed a low cost manufacturing method for micro-channel heat exchangers. By avoiding micro-machining and chemical etching, which is the current approach used to manufacture micro channel heat exchangers, fabrication costs are reduced by over 70%. An illustration of the Altex low cost micro channel core is shown in the picture on the far right. These cores are being utilized in systems Altex is developing for commercial and military applications, including chillers, oil and gas processing, electronics and data center cooling.

Combined Heat and Power

The Altex low NOx burner is the basis of a Combined Heat and Power system, named the Power Burner, illustrated at right. The Power Burner is jointly being developed and demonstrated by Altex and CMC Engineering and is being commercialized by Leva Energy (www.levaenergy.com). The Power Burner simply bolts onto thermal equipment (e.g. boilers, absorption chillers, process heaters, etc.), where the thermal energy is fully utilized at 82% efficiency, and in addition to converting natural gas to heat like legacy burners, it

generates 100 kWe electricity at a lower cost than the grid. It can achieve a 2-year payback finally making Distributed Generation economically viable for the industrial and commercial markets. The Power Burner also uses the Altex low NOx burner for the Altex developed silo combustor that is used in the micro turbine. As a result, in addition to meeting the boiler NOx regulation, the Power Burner meets the very stringent State of California's CARB 2007 emission standards.

Enabling the Use of Distillate Fuels in Fuel-Cell Power and Cogen Systems

Fuel cells operating on distillate fuels and diesel-like renewable fuels have large markets. These markets include use in military, civilian-truck APUs, shipboard power, backup power, and other applications. However, these sulfur-containing "dirty" liquid fuels must be transformed into a clean hydrogen-rich reformate, suitable for fuel cells. Altex and its team members have overcome this challenge and developed and demonstrated 5-10 kWe Compact Robust Efficient (CORE) Power and CORE Cogen systems, illustrated below. The CORE power system has been demonstrated on MIL Spec JP-8 for over 500 hours at Altex and has been delivered to AFRL, where the system was independently tested for TARDEC, who sponsored the development. The CORE Cogen (right picture) operates on Mil-Spec JP-8, synthetic JP-8 and similar biofuels and produces 5 kWe AC and 10 kWt hot water. This system has been delivered to CERDEC for independent testing at the Aberdeen Proving Grounds Army base.

These systems are based on a desulfurizer developed by Altex and Pennsylvania State University (PSU), with the support of DARPA, ONR, Army and the Air Force. These units have been tested, and delivered to military clients that operate on JP-5, JP-8, and NATO F-76 fuels. These accomplishments have been leveraged to develop reformers for SOFC (left picture) and HTPEM (right picture) fuel cells that have been delivered to ARL and CERDEC, respectively.
Currently Altex, with TARDEC support, is optimizing the form factor of the CORE-Power system to produce a 225 liter TRL-6 10 kWe APU, for integration into a military vehicle. Also, with the support of the State of California Energy Commission, the CORE Cogen is being adapted for use in the commercial fast-food restaurant market, by converting the system to operate on waste vegetable oil, produced at these establishments.

Low Emissions Burners

Based on unique knowledge gained through years of collaborative efforts with world-renowned combustion experts at the Sandia National Laboratories Combustion Research Facility, Altex has developed and proven low-emissions burners for residential, commercial, and industrial use. For example, a residential water heater burner was developed and tested, which reduces NO_x emissions by over 50% at an incremental cost of 50 cents. At the other end of the scale, ultra-low NO_x burners of up to 15 MW scale, which can reliably reduce NO_x from 90 ppm to 5 ppm, have been in the field, as pictured above. This burner produces 12 pm NOx at 3% O_2 with no FGR, 9 ppm NOx with 7% FGR and sub 5 ppm NOx with 22% FGR.

Biomass Processing to Fuels

Altex has developed, with the support of DOE, a biomass densification process, called BBADS, that reduces cost by 76% and 84% relative to conventional pelletization and cubing approaches. This field demonstrated system, shown in the figure below, can be used to economically ship biomass to biorefinery sites that can now be located significant distances from the dispersed sites where the biomass is grown. This will allow the construction of fewer and larger biorefineries that will then lower the cost of biofuels production, making these systems more competitive with fossil fuels. To date, switchgrass, miscanthus, wheat straw, corn stover, and alfalfa have been successfully densified at up to 50lb/cf. Some examples of the densified product are included in the BBADS figure. Another Altex innovation under development, with the support of DOE and the Army, is the CAMBS process that can convert biomass or housing (e.g. paper, cardboard, plastic) wastes into a drop-in and infrastructure compatible fuel. Depending on the process parameters, either a jet or gasoline-like fuel can be produced. The below figure illustrates the jet-like fuel that meets all relevant JP-8 specifications. Unlike alternative conversion processes, the CAMBS process uses targeted intermediates as a base to create the final fuel form through catalytic reactors that have been developed in collaboration with PSU. By not converting the feedstock all the way to a syngas, nor simply using pyrolysis to generate a crude feedstock, the CAMBS process targets the optimal level of processing to minimize costs. To date, tests have shown the capability of CAMBS to successfully process wood waste, housing waste, switchgrass, and wheat straw, as well as low rank lignite and sub-bituminous coals. Based on the successes of the laboratory tests, the process is being scaled up to pilot-scale for planned tests that will further demonstrate the process.

Alfalfa log

Corn stover log

Switchgrass log

Customers

Altex's customers include government, commercial, institution, and academic organizations. Contacts within the below organizations will be provided, upon request.

Federal

The largest percentage of our work is with federal agencies, which support us to define, design, test and demonstrate innovative energy solutions for military and civilian applications. Our federal agency customers include:

Air Force
Army
Defense Advanced Research Projects Agency
Department of Agriculture
Department of Energy
Environmental Protection Agency
Navy

Repeat work with these agencies indicates that Altex is well regarded by these agencies.

State

We are also supported by state agencies to define, develop, test and demonstrate innovative energy solutions, for the emissions restricted California market. State agency customers include:

Bay Area Regional Technology Alliance
California Air Resources Board
California Energy Commission

Altex technology developments have been used to support Best Available Control Technology state regulations, and have been deployed in critical air quality regions in California.

Academic

Under joint efforts, Altex has worked cooperatively and synergistically with top technical academic institutions, including:

Massachusetts Institute of Technology
Pennsylvania State University
Texas A & M University

Institutions

Altex has supported institutions, which have broad responsibility in developing and deploying technologies for the U.S. electric power and gas industries. These institutions include:

Electric Power Research Institute
Gas Technology Institute

Commercial

Many commercial customers have looked to Altex to provide energy and environmental solutions, which broaden their product lines, or enhance their operations. More recently, we have begun to support fuel cell stack providers, by supplying distillate fuel reforming capability. Commercial customers include:

Advanced Technology Materials, Inc.
Alzeta
Cleaver Brooks
CONSOL
DB Riley
Eclipse Combustion
Hi-Z
Mountain Safety Research
NIECO
ST Johnson
Weyerhaeuser

Company Profile

Altex is a privately held corporation, organized in the State of California, and located in the heart of Silicon Valley, just south of San Francisco. The company was founded in 1985, to pursue the development of novel fuels processing, combustion, thermal management and power systems technologies, including fuel cells, gas turbines, biomass conversion, burners and heat exchanger components and systems. The early focus of the company was on the research and understanding of fuels and combustion processes. This work was accomplished in cooperation with academic and government research laboratory personnel at Sandia National Laboratories, Livermore. During the mid 90s, the company focused on the transition of fundamental knowledge to benefit power, energy and environmental products. This transition of knowledge to innovative products has been applied to all our development activities

Altex's facility has nearly 15,000 square feet of space, with approximately one half devoted to testing and test article preparation. Test instrumentation covers all of the equipment needed to characterize fuels and combustion system performance, including flow and temperature monitors, total sulfur analyzer, GC, and continuous gaseous emissions (CO, CO_2, O_2, NO, NO_x and unburned hydrocarbons) monitors.

Management

Dr. John T. Kelly – President and founder of Altex , has 36 years of experience in fuels, combustion, power systems and thermal management engineering. His career combines both technical innovation and a track record in building a successful energy and environmental systems development company. At Altex he has successfully developed and tested many innovative energy and environmental systems that are now used by industry. Innovative systems developed by Dr. Kelly have been implemented in the utility, industrial process, commercial, semiconductor and solar industries. Prior to Altex, he acquired power system experience at Consolidated Edison, Pratt and Whitney, Aerochem and Acurex. Dr. Kelly holds five patents, plus two pending, related to energy systems. He received his BS in Mechanical Engineering from the Cooper Union of New York, MS in Nuclear Engineering from the Massachusetts Institute of Technology (MIT), and PhD in Aeronautics and Astronautics from the Polytechnic University of New York.

Dr. Mehdi Namazian – Vice President of Altex, has 30 years of experience in fuels processing, combustion and power systems, with both technical and practical insights. Dr. Namazian has developed several burners that have evolved from development work he led at Sandia National Laboratories and at Altex, where he is currently a Vice President in charge of the company's engineering operations. He received his BS in Mechanical Engineering from Tehran University, and his MS and PhD in Mechanical Engineering from MIT. After graduating from MIT, he joined the UC Berkeley M.E. Department and worked as a researcher at Lawrence Berkeley National Laboratory. He is the recipient of the Arch T. Colwell Merit Award from the Society of Automotive Engineers. He has published over 100 technical articles and holds five U.S. patents, including a patent on a low NOx burner that is commercialized.

Core Advantage

Altex's core advantage includes unique combustion and heat management and fuels processing skills based on proprietary technology. This is based on nearly 20 years of fuels processing and combustion R&D, using unique analysis and testing tools. These competencies allow Altex to create innovative solutions to problems in deploying fuel cell and microturbine-based power systems, biomass conversion systems, low emissions burners and thermal management systems. Once Altex has addressed the problem through analysis, modeling and laboratory testing, relevant manufacturers are brought into the process to support the demonstration and commercialization of the solutions. Altex has the advantage of having strong relationships with several manufacturing partners that support Altex from demonstration of the technology through commercialization. By being able to create teams strong in R & D, as well as product commercialization, solution development can proceed in a timely manner at low risk.

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