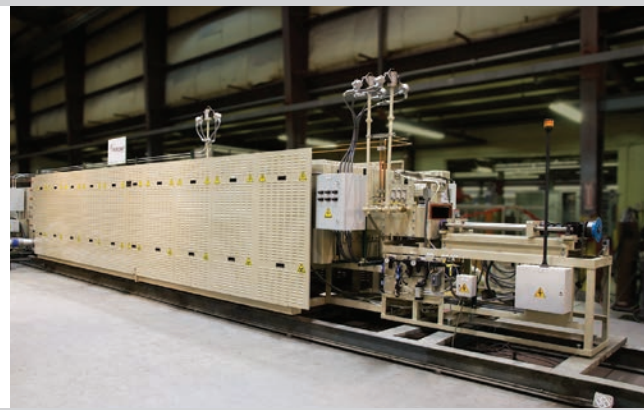


Pusher Tunnel Furnaces

Precise control for processing of advanced materials.



 **Harper**
International
Spark the future.™

Pusher Furnaces

Harper's advanced pusher plate and tunnel kilns are designed for processes requiring precise control of temperature and atmosphere, ideal for those with longer residence times that require exact control of the heat up rate of the product (temperature profile) and lower gas/solid reaction. Our focus is on designing systems that offer the greatest operating life, lowest operating cost, and highest efficiency for the manufacturing of advanced materials. We bring innovative solutions to designs for continuous processing of advanced materials such as granular, powder, or particulate aggregates in high purity and specialty atmosphere environments at temperatures up to 2800°C.

Our innovative design enhancements consider the delicate pressure control within the system to provide accurate direction of the atmosphere flow path in the furnace. This facilitates evacuation of volatiles and optimizes atmosphere uniformity. Additionally, Harper's unique gas curtain technology provides zone-to-zone atmosphere definition under specific conditions. Our distinctive stripping chamber design provides optimal isolation of internal tunnel chamber environment from ambient as well as efficient purging of ambient atmosphere entrained within the load entering the furnace without the use of mechanical doors and seals.

Harper offers the unique ability to accommodate a variety of process atmospheres that others simply cannot. We approach the design of a pusher furnace as a complete system, with the ability to incorporate process control systems, gas treatment and handling, turnkey installation and complete field commissioning. Field service can incorporate control instrumentation integration and programming as well as process engineering optimization and support.

Our experience in designing unique systems spans a range of advanced materials for use in a pusher furnace, including technical ceramics, metal powders, nuclear materials, and more.



A.



B.

Depend on the vision, innovation and devotion of Harper International to deliver the most innovative and precise thermal processing system for your needs.

Pusher Furnace Design Enhancements

- Advanced graphite pushers for high temperature applications incorporate strategic heating element placement to achieve optimal temperature uniformity and advanced insulation designs to reduce energy consumption
- Precise control of atmosphere dew point along the length of the furnace achieved through sophisticated gas distribution technology
- Optimized design for maintenance and replacement parts and minimization of field installation effort through modular construction
- Multiple independently controlled temperature zones (length and width)

Capabilities & Features

- Temperatures to 2800°C
- Electrically heated or gas-, oil- or dual-fuel fired
- Controlled atmospheres including flammables and toxic gases – hydrogen, nitrogen, air, oxygen, ethylene, methane, CO₂, CO, chlorine gas
- Process gas circulating and conditioning systems
- Automatic material handling and return systems
- Defined residence times
- Advanced seal design
- Automatic lubrication
- Feed level detection

Typical Applications

- Sintering
- Oxide Reduction
- Calcination
- Carbonization
- Purification
- Gas-solid reaction
- Solid-solid reaction
- Metalizing
- Debinding
- Part Processing

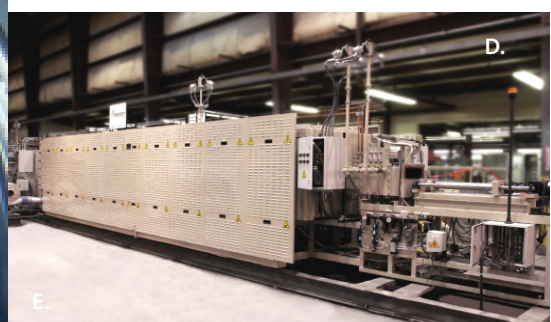
A. Harper has extensive experience in multi-zone pusher tunnel designs.

B. Our systems are ideal for technical ceramics processing, such as silicon carbide.

C. We offer a variety of customized material feeder solutions.

D. Our complete systems include material handling and gas treatment.

E. Harper offers furnaces as well as fully integrated process lines.



Thermo. Dynamic.™

Harper International is a global leader in complete thermal processing solutions and technical services essential for the production of advanced materials. From concept to commercialization, from research scale to full production line operations, Harper is perpetually on the cutting edge. For decades, we have pioneered some of the world's most innovative, customized systems, with a focus on processing materials at high temperatures and in non-ambient atmospheres.

Our value proposition is unequalled — decades of industry experience, a highly specialized, multi-talented group of employees, and a passion for partnership. We don't shoehorn a standard line of products to fit our customers' requirements. Harper's culture is one of genuine ingenuity and creativity, which ensures we are constantly challenging ourselves to craft the best-engineered technology solution for our customers' unique needs.

Harper's philosophy is not only to deliver comprehensive systems with the latest technologies, resulting in distinctive solutions, but also to design features that ensure the most efficient and effective operations. Whether it's optimized waste gas treatment, control systems with predictive maintenance, or energy efficiency techniques, Harper always has the complete solution in mind.

"In the field, I deal with everyone from the contractors to the engineers to the project manager, people on the board and owners of the company. It is great to be involved with our customers so closely and to develop that kind of relationship."

*– Dr. Renee Bagwell
Senior Process Technology Engineer*



"We work with new processes through the developmental stage, to the point where it will actually work. At the end of the day, you want something that not only is a neat idea, but it actually has to work."

*– Dr. Peter Witting
Senior Process Technology Engineer*

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