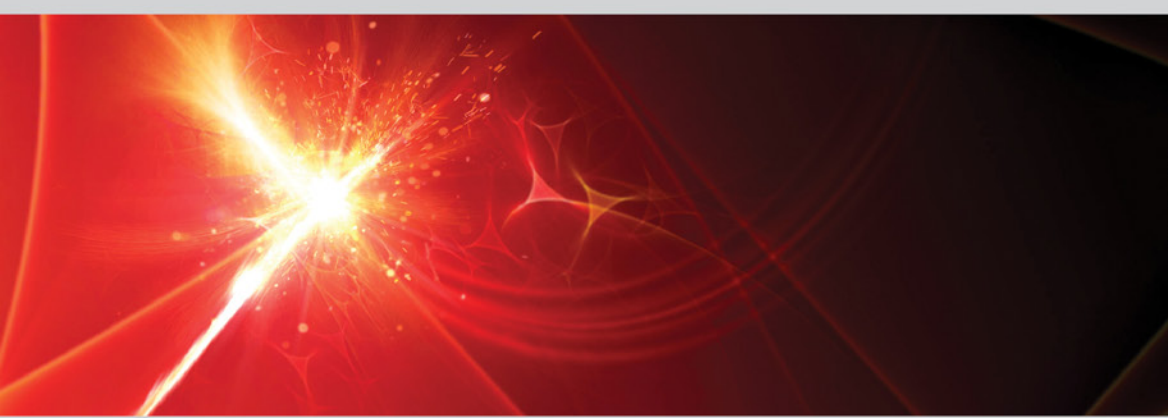


Pusher Tunnel Furnaces

Precise control for processing of advanced materials.



 **Harper**
International
Spark the future.™

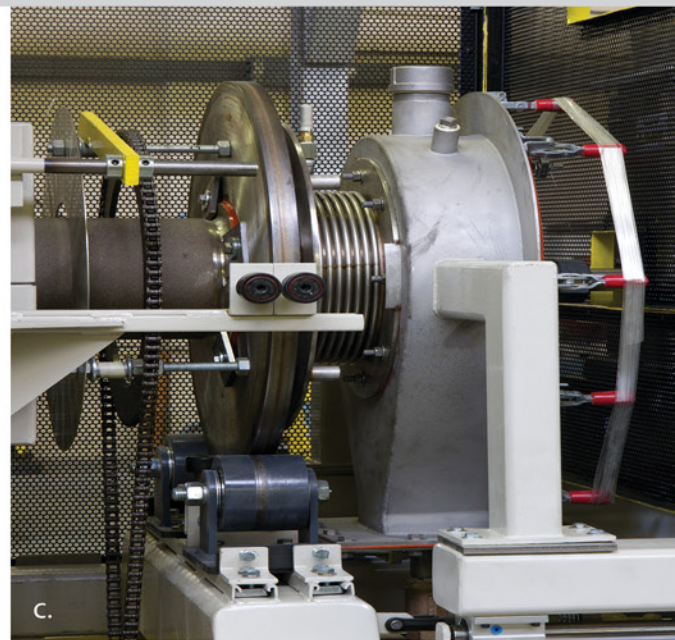
Pusher Furnaces

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 Metal Oxides, Powders, Rare Earths, Technical Ceramics, Graphene, Energy Storage Materials, Energy Generation Materials and more.



After more than 85 years at the forefront of thermal processing solutions for cutting-edge materials, we're just getting warmed up.

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 2400°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. We offer a variety of customized material feed solutions.

B. Harper's complete systems include material handling and gas treatment.

C. Our advanced end seal design ensures exact atmospheric control.

D. We offer furnace systems as well as fully integrated process lines.

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

F. Our fully integrated controls help ensure the system is operating as efficiently as possible.



Thermo. Dynamic.

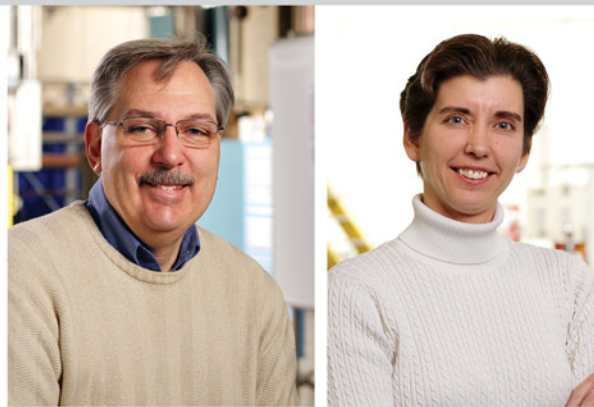
Harper International is a global leader in complete thermal processing solutions and technical services essential for the production of advanced materials. From concept to commercialization, from research scale to full production line operations, Harper is perpetually on the cutting edge. For decades, 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.

"At Harper, it's about stretching our horizons, taking bigger risks in bigger markets, and that's pretty unique. The beauty of it has been sustained over decades and there's a lot to be said for that."

*– Ron Vacek
Director of Project Management*



"In the field, I deal with everyone from the contractors to the engineers to the project manager, and I've even dealt face to face with the people on the board or 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
Process & Technology Engineer*

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