

# Nuclear Fuel Thermal Processing Solutions



*Spark the future.™*

## Typical Applications

- Sintering  $UO_2$  Pellets for Reactor Fuel Rods
- Oxidation of  $UO_2$  to  $U_3O_8$
- Denitration
- Hydrofluorination
- Waste Remediation

## Technology Solutions

- Pusher Tunnel Furnaces
- Rotary Tube Furnaces
- Various Batch Configurations
- Specials for Restrictive Access Environments
- Complete Systems

Harper International has been a critical partner for thermal processing solutions for decades to companies developing new energy generation technologies, focused in the areas of nuclear power, solar energy and fuel cells.

Harper's founder invented the first furnace to process nuclear fuels in the 1940's. Since producing our first nuclear fuel sintering furnace over 60 years ago, Harper has become the world's leading provider of customized systems for reacting and sintering nuclear fuels. Harper is the preferred choice offering advancements in energy efficiency, temperature uniformity, maintenance, and safety control. Harper also offers reliable systems for fuel processing.

As the development of energy generation materials continues to grow, Harper aims to enable companies to scale up from the lab to full commercialization, helping make their innovations a reality. We tailor our batch and continuous furnace systems to each unique application, ideal for processing in controlled and specialty atmospheric environments and at the required elevated temperatures. Additionally, we can work to devise a turnkey solution with our range of offerings including gas treatment and handling and fully integrated control systems.

## Technology Solutions - Pusher Tunnel Furnaces

Harper's 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 systems that offer the greatest operating life, lowest operating cost, and highest efficiency for the manufacturing of advanced materials.



Our innovative design enhancements consider the delicate pressure control within the system to provide accurate direction of the atmosphere flow path in the kiln. 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.

## Sintering Pusher Furnace Capabilities

- Temperatures to 1800°C
- Electrically heated
- Controlled Hydrogen atmospheres
- Hydrogen atmosphere dew point control
- Defined residence times and capacity
- Automatic material handling and return systems
- Advanced seal design

# Nuclear Fuel Thermal Processing Solutions

## Technology Solutions - Rotary Furnaces

Every Harper rotary tube furnace is designed for the customer's unique specifications. Harper rotaries offer exceptional versatility, reliability and energy efficiency.

Our designs include multiple patented features that enable better gas/solid mixing, resulting in improved heat transfer and mass transfer. Additionally, the tumbling action of the product within the tube results in a high degree of temperature uniformity and gas-solid contact, producing a more homogenous product, reducing processing times and increasing production rates.

We offer the unique ability to accommodate a variety of process atmospheres that others cannot. Our excellent seal designs, advanced gas monitoring and handling systems, and indirect heating method allow the safe use of flammable and toxic gases. Harper approaches the design of a rotary 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.



## Harper Rotary Furnace Capabilities

- Electrically or gas heated
- Controlled atmospheres including flammable and toxic gases – hydrogen, nitrogen, air, oxygen, ethylene, methane, CO<sub>2</sub>, CO, chlorine, fluorine, etc.
- Variety of tube materials – alloys, mullite, alumina, silicon carbide, quartz, graphite
- Process gas circulating and conditioning systems
- Automatic material handling and return systems
- Defined residence times
- Advanced seal design
- Automatic lubrication
- Feed level detection

Contact us today to learn more about Harper's Nuclear market solutions at 001.716.276.9900 or email us at [info@harperintl.com](mailto:info@harperintl.com).

