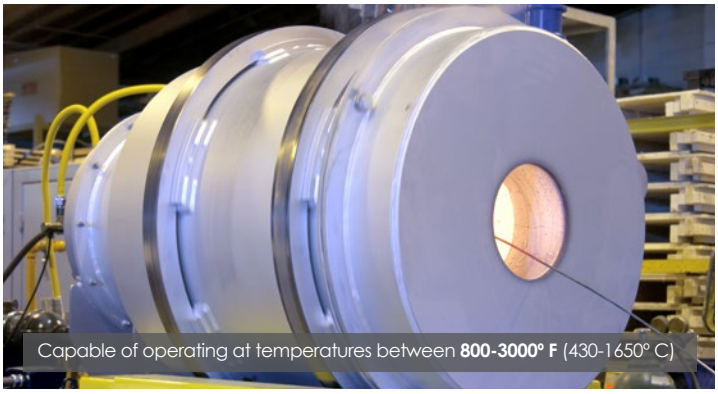
FEECO INTERNATIONAL

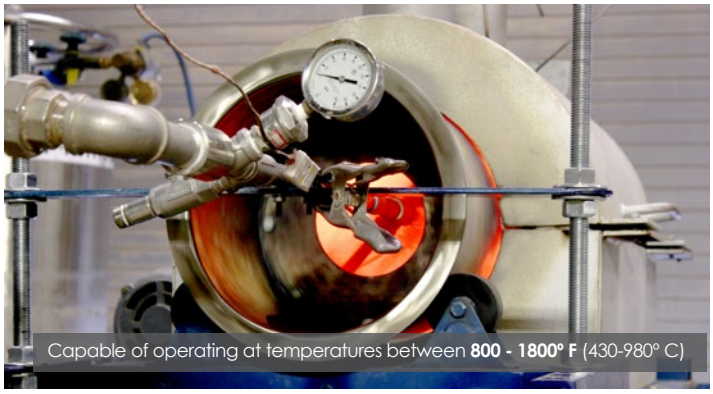
ROTARY KILN TESTING

The FEECO Innovation Center offers a variety of test kilns that can simulate the conditions of continuous, commercial-size rotary kilns. Our available test kilns are described below.



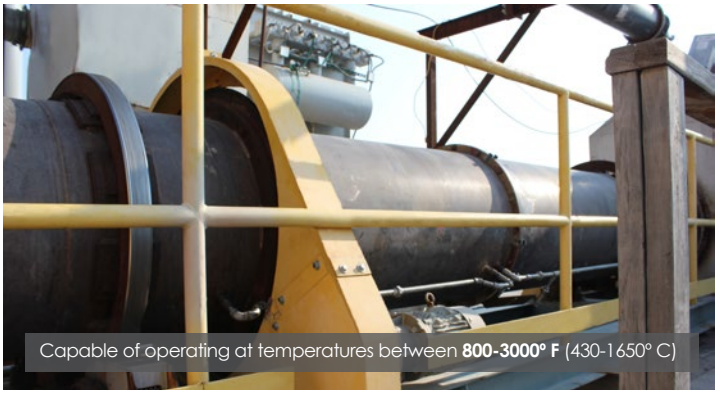
18" X 24" DIRECT-FIRED BATCH KILN (0.46 x 0.61m)

Our direct-fired batch kiln is equipped with a propane burner with oxygen enrichment, variable speed drive, and both bed and gas thermocouples. A reducing atmosphere can also be used. The batch kiln is lined with 99% alumina castable refractory and can be operated to simulate either co-current or counter current flow.



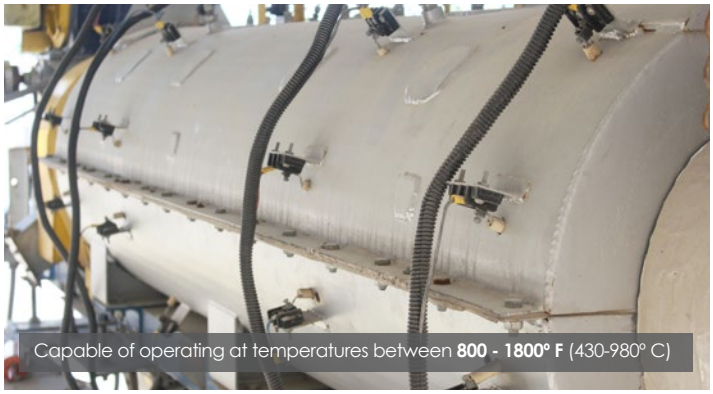
10.5" X 24" INDIRECT-FIRED BATCH KILN (0.27 x 0.61m)

Our indirect-fired batch kiln is heated with a propane burner beneath the shell. Dams inside the kiln hold material within the heated zone. Two thermocouples, located near the shell in the furnace, are used to measure its temperature. Two additional thermocouples are used to measure the bed and exhaust gas temperatures. Kiln ends can be sealed and have an inlet for a purge gas and an outlet for purge gas exhaust.



30" X 20' CONTINUOUS DIRECT-FIRED PILOT KILN (0.77 X 6.1m)

Our continuous direct-fired pilot kiln is equipped with a refractory brick lining, feed system, natural gas burner, and cooled screw. Adjustable dams allow for a deeper bed depth and longer residence times. The kiln can be operated in either a co-current or counter current configuration. Kiln exhaust is ducted through a thermal oxidizer (TO), quench chamber, bag filter, or wet scrubber and ID fan.



6.5" X 84" CONTINUOUS INDIRECT-FIRED PILOT KILN (0.17 X 2.1m)

Our continuous indirect pilot kiln is divided into two electrically heated zones. Thermocouples in each zone near the shell measure temperature and control outputs from the heating elements. Both kiln speed and slope can be adjusted to alter the bed profile and residence time. Kiln exhaust is ducted through a thermal oxidizer (TO), quench chamber, bag filter, or wet scrubber and ID fan.

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THE ROTARY KILN **TESTING PROCESS**

Testing in the Innovation Center offers a host of invaluable information, allowing you to gain critical data on your material, work out process variables, and develop a recipe for process scale-up. Our flexible setup, combined with the expertise of our process engineers and our experience with hundreds of materials allows a variety of thermal tests to be expertly conducted. We also have the capabilities to incorporate additional processing, including drying and agglomeration.

COMMONLY CONDUCTED ROTARY KILN TESTS:

- Carbon Activation
- Catalyst Activation
- Calcination
- Desorption & Combustion
- Heat Setting
- Metal Recovery
- Organic Combustion
- Reduction
- Sintering
- Upgrading of Ores

We offer comprehensive testing options in four categories:

1. Feasibility/Proof of Concept
Muffle furnace testing along with Thermal Gravimetric Analysis (TGA), Differential Scanning Calorimeter (DSC), and chemical analysis to determine your specific material's chemistry and reaction to heat.

2. Proof of Product
Batch testing where it is determined whether a product can be made to the required specifications.

3. Proof of Process
A continuous testing phase that aims to establish the equipment setup and parameters required for commercial production of your specific material.

4. Process/Product Optimization
An in-depth study to optimize your specific material's characteristics and/or production parameters for an operating industrial kiln.

OPTIONAL TESTING CONDITIONS & EQUIPMENT:

- Baghouse
- Data Collection & Trending System
- Direct or Indirect
- Parallel or Counter Current Flow
- Removable Flights, Dams, and Bed Disturbers
- Thermal Oxidizer
- Water Quench Tower
- Wet Scrubber

COMMONLY TARGETED TEST INFORMATION:

- Baghouse Efficiency
- Bulk Density
- Crush Strength
- Dust Generation
- Exhaust Gas Composition
- Extent of Reaction (e.g. Calcination, Reduction)
- Particle Size Distribution
- Reactivity of Product
- Temperatures
- Thermal Oxidizer Efficiency





REPORTING & DATA IN REAL TIME

Our state-of-the-art system allows you to monitor various data points, trending them, and even adjusting process variables in real time, all from a single interface, or even from a remote device. This allows for a user to view process data and respond accordingly during production.

FEECO is a Rockwell Automation partner, providing integrated process control solutions, both as a service in the Innovation Center, and as part of a system purchase. FEECO and Rockwell Automation process control solutions are provided with current technology, motor control centers, programmable logic controllers, and data collection systems with advanced technologies for reporting. The Innovation Center features a Rockwell Automation MCC system, which utilizes current technologies for optimizing testing operations.
Data gathered includes:

- Burner Fuel Usage
- Drum Slope
- Emissions
- Fan Speed RT
- Feed & Product Rates RT
- Temperature (Feed end, Internal, TO, product, & exhaust gas) RT
- Heater Amps RT
- Natural Gas Flow Rates RT
- Outlet Gas Parameters
- Quench Tower Water Flow RT
- Residence Time
- Rotational Speed
- Samples: Feed, Product, & Internal Kiln
- Screen Analysis of Feed & Product
- Steam Flow RT
- System Pressures RT
- Gas Sampling & Analysis (Oxygen, Carbon Monoxide, Nitric Oxide, Nitrogen Dioxide, Sulfur Dioxide, and combustibles discharged from various thermal processes) RT

Automated with Rockwell Automation
Allen-Bradley · Rockwell Software

(RT) indicates that the data can be tracked in real-time.

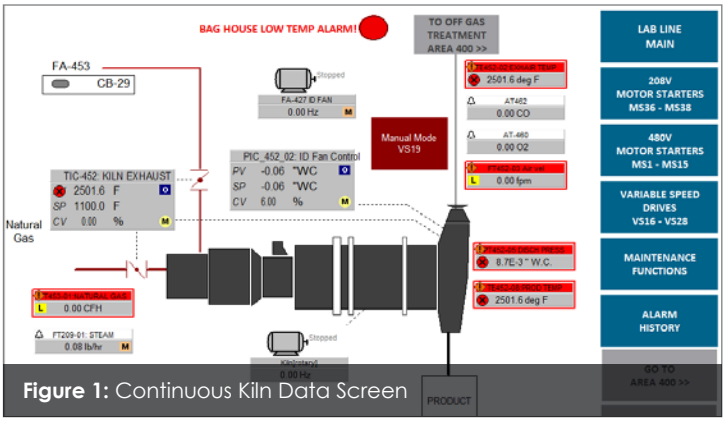


Figure 1: Continuous Kiln Data Screen

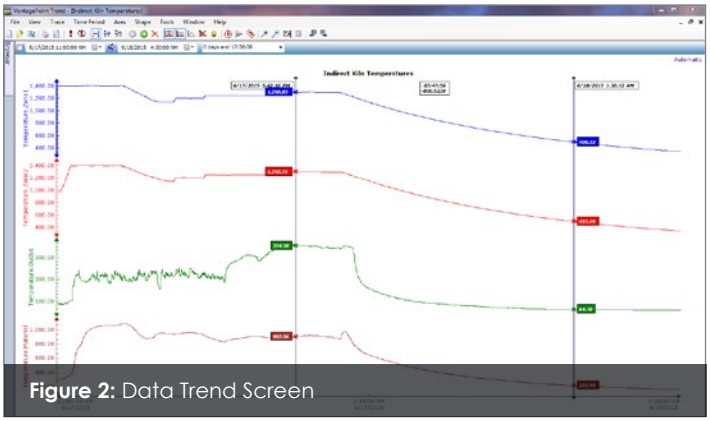


Figure 2: Data Trend Screen

FEECO can integrate third party equipment into your control system, giving you complete process tracking and visualization. Secure remote access to the system by a Rockwell Automation expert provides unparalleled troubleshooting capabilities.

MATERIAL **TRANSFORMATIONS**

Completed through testing in the Innovation Center

BEGINNING MATERIAL	FINAL END PRODUCT	Agglomeration	Drying	Blending	Thermal	Compaction
Ammonium Sulfate	Granular Fertilizer					●
Ash (Wood, Fly)	Granular Fertilizer	●	●			
Bentonite Clay	Cat Litter Granules	●	●			●
Biomass	Biochar, Activated Carbon		●		●	
Bone Meal	Granular Fertilizer	●	●			
Calcium Carbonate	Granular Fertilizer	●	●			
Calcium Chloride	Ice Melt Pellets	●	●			
Calcium Sulfate	Granular Fertilizer	●	●		●	
Carbon Black Dust	De-dusted Pellets	●	●			
Cell Phone Batteries	Lithium, Zinc Metal Recovery				●	
Cement Kiln Dust	Granular Calcium Fertilizer	●	●			
Ceramic/Aluminum	Refractory	●	●			
Clay	Proppants				●	
Clay	Cat Litter, Oil Dry Granules, Encapsulate Seeds	●	●	●		
Coal Dust	De-dusted Coal Pellets	●	●			●
Composts(Yard Waste)	Granular Fertilizer	●	●	●		
Copper Dust	Metal Recovery Pellets	●	●	●		
Corn Cobs	Cat Litter, Oil Dry Pellets	●	●	●		
Diatomaceous Earth	Filter Agent	●	●			
Dredge Sludges	Non-leaching Granules	●	●	●		
Electric Arc Furnace(EAF) Dusts	Metal Recovery	●	●	●		
Ethanol Plant Waste(DDG)	Animal Feed	●	●	●		
Foundry Dust	Metal Recovery	●	●	●		
Glass Batch	Glass Blend	●	●	●		
Gold Ore Dust	Precious Metal Recovery	●	●	●		
Grain Dust	Non-explosive Pellets	●	●	●		
Gypsum	Granular Fertilizer	●	●			
Gypsum Wallboard Waste	Granular Fertilizer, Cat Litter Pellets	●	●	●		
Humate	Granular Fertilizer	●	●	●		
Iron Ore	Metal Recovery Pellets	●	●			
Iron Oxide	Metal Recovery Pellets	●	●	●		
Kaolin Clay	Paper Coating	●	●			
Lime (Wastewater Treatment Sludge)	Granular Calcium Fertilizer	●	●	●		
Limestone	Granular Calcium Fertilizer	●	●	●		
Manure – Cattle/Chicken/Hog	Granular Fertilizer	●	●	●		
MAP Fertilizers	Granular Fertilizer	●	●	●		
Mined Frac Sand	Dried Frac Sand		●			
Municipal Wastes	Granular Fertilizer, Fuel Pellets	●	●	●		
Nickel Ore	Metal Recovery Pellets	●	●			
Nitrogen Fertilizers	Granular Fertilizer	●	●	●		
NPK Blends	Granular Fertilizer	●	●	●		●
Paper Sludge	Granular Fertilizer, Cat Litter	●	●	●		
Paper Sludge	Bright White Clay				●	
Petroleum Coke Dust	Fuel Pellets	●	●	●		●
Phosphates Powder	Granular Fertilizer	●	●	●		
Potassium Chloride	Granular Fertilizer	●	●	●		●
Raw Coal	Purified Coal				●	
Saw Dust	Cat Litter, Fuel Pellets	●	●	●		●
Soda Bottles	Recycled Plastic				●	
Soy Flour	Animal Feed	●	●	●		
Steel Dusts and Sludges	Metal Recovery Pellets	●	●	●		●
Sugar	Sugar Pellets	●	●	●		
Sulfur Dust	Non-explosive Pellets	●	●	●		
Sulfur Stack Emissions	Granular Fertilizer	●	●			●
Talc Ore	Sterilized Baby Powder				●	
Tar Sands Waste Sludge	Substitute Fuel Pellets	●	●	●		
Titanium Dioxide	Pigment Pellets	●	●			●
Titanium Metal Shavings	Metal Recovery	●	●	●		
Tungsten Oxide	Metal Recovery Pellets	●	●			●
Zinc Oxide	Metal Recovery Pellets	●	●			●

Agglomeration: Drum, Pan Pelletizer, Pin Mixer

Drying: Rotary Drum Dryer, Fluid Bed Dryer

Blending: Pug Mill

Thermal Process: Rotary Kiln

Roll Compaction: Roll Compactor

SCHEDULE A TEST

To discuss your testing needs with one of our process engineers and schedule a test, contact us today at:
FEECO.com/contact

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