CEI Overview
and
Project Examples
Pilot Plants
- Design
- Build
- Operate

Alkali Metal Experts
- Na
- K
- NaK
- Li
- KO₂
- Na₂O₂

Engineering Services
- Process
- Project
- Mechanical
- Electrical
- Automation
- Controls
CEI OVERVIEW

- Core Capabilities
  - Process engineering
  - Mechanical and electrical design / automation
  - Project management
  - Pilot Plants – Design, Build and Operate
  - Skid systems
  - Custom equipment

- We have hundreds of years of combined experience in the design, construction, and operation of chemical facilities.

- We focus on long term relationships in which we supplement a customer’s engineering staff.
CEI OVERVIEW

- Experience in most unit operations
  - Continuous and batch reactions
  - Distillations
  - Filtrations
  - Hazardous materials
  - High temperature applications
  - Powder handling
  - Bulk material handling
  - Liquid and gas handling
  - Ultra high vacuum or high pressure
  - High purity

- Many project examples available to discuss
CEI STAFF

- Chemical Engineers
- Mechanical Engineers
- Instrumentation/Electrical Engineers
- Fabricators
- Technicians
- Administration
- Licensed PEs on staff for multiple states including Texas, Pennsylvania, Maryland, Nevada, and more
- PMI accredited project managers

- 15,000 SF Process + Engineering facility opened in 2015
- Satellite office in Greenville, SC
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ALKALI METALS EXPERTISE

- Engineering Design
  - Na and NaK heat transfer
  - Loading / Unloading
  - Pilot plants & skid systems
  - Storage & transportation
  - Process Safety Analysis

- Alkali metal reactions
- Handling & purification
- Equipment & instrumentation
- Metal Halide reductions (700+ Deg. C)
ALKALI METALS SERVICES

- On-site clean up & removal
  - Na
  - NaK
  - Na$_2$O$_2$ - KO$_2$
  - Li
  - K
- Site inspection
- Hands-on training and demonstrations
- Building, fire code and DOT shipping consulting
Electromagnetic pumps and flow meters for Alkali Metals and other fluids

High temperature NaK filled pressure transmitters

Sodium supply, custom sized sodium ingots

Custom shaped extruded Alkali Metals

Purified Alkali Metals

Sodium Dispersion

Sodium Etchant
ALKALI METALS PROCESSES

- Sodium and other Alkali Metals are widely used for
  - Fluoropolymer etching
  - Sodium peroxide production
  - Reduction of organic esters
  - Descale of metals
  - Purification of molten metals
  - Sodium Cyanide production
  - Sodium Hydride production
  - Many more
ALKALI METALS PROCESSES

- Sodium Dispersion can be used in a number ways for the following processes or end uses
  - Organic Synthesis
  - Dechlorination of PCBs
  - Agrochemicals
  - Pharmaceuticals
  - Fragrance and Flavors
  - Carboxylation
Sodium Dispersion is produced via joint venture

- Creative Engineers, Inc. + Columbia Sales International joint venture.
- Two production units
- Batch sizes of 75 to 400 gallons
- Made to order
Creative Engineers Inc.

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PROCESS ENGINEERING

- Conceptual process design
- Evaluation of alternatives
- Scale-up design
- PFDs - Process Flow Diagrams
- P&IDs - Piping and Instrument Drawings
- MEB - Mass and Energy Balances
- Operating procedures
- Relief valve sizing and PSV/PSE analysis
- PHA - Process Hazard Analysis facilitation and resolution
EXAMPLE P&ID
EXAMPLE 3-D MODEL
PROCESS EXAMPLES

- Sodium, water reactive, and other hazardous chemicals
- Alkali, refractory, rare earth, other metals
- Metal halides and hydrides (use & manufacture)
- Sodium Methylylate
- Highly exothermic or endothermic reactions
- Photovoltaic silicon
- Solar thermal
- Flammable & toxic materials
PROCESS MATERIALS

- Specialty Chemicals
- Polymers/Monomers
- Pigments
- Energetic materials
- Pyrophorics
- Powdered Steel
- Zeolites
- PCC/GCC/Minerals
- Zr & Al based Chemicals
- Salts & metals for solar applications
- Cement
- Silica
- Glass
- Hydrides (B and Si)
- Ta, Ti, Si, B, Sn, Pb, Sb, Sc, Nd
- Metal halides
- Oil
- Solvents
- Activated Carbon
- Waste Water
PROJECT MANAGEMENT

- Scope development & control
- PMI methodology
- Project estimates
  - Conceptual
  - Budgetary
  - Construction
- Schedule development
- RFP/RFQ development
- Expediting of long lead or critical path equipment
MECHANICAL ENGINEERING

- Equipment selection
- Materials of construction/material selection
- Utilities (of all types)
- Autodesk Plant Design Suite plus Inventor
- PSV/PSE sizing
- Designing for extremes of temp/press/vac
- ASME/BPE compliance
FABRICATION

- Custom machines
- Equipment design and build
- Skid systems
- Modular process units
- Pumping systems
- Custom valve manifolds
- Bubbler Systems
- Multi-zone process heating carts
ELECTRICAL ENGINEERING

- Control system design
- Power distribution
- Motor controls
- Panel design
- Interlock design, implementation and testing
- Wiring details including one-line and three-line diagrams
- Electrical heat trace design
- Load studies
- NEC/NFPA compliance
AUTOMATION & CONTROLS

- Process control strategy
- System-level architecture
- HMI design and implementation
- DCS, PLC, PXI, NI LabVIEW, NI FPGA/cRIO, cDAQ
- Data acquisition and data logging
- Instrument specifications
- Control loops design and implementation
OTHER SKILLS

- IBC – International building codes
- IFC – International fire codes
- Dust Hazard Analysis to NFPA 652
- Rapid response capability
- Startup support
- Construction management
Creative Engineers Inc.

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PILOT PLANT TYPES

- Pilot plant or R&D Unit
- Bench-top or Lab-scale Set Up
- Demonstration Unit
- Skid mounted Systems

- Proof of Concept
- Technology Evaluation
- Milestone Data for Investors
- Economic Feasibly
- Commercialization
PILOT PLANT BENEFITS

• Complete customization
• Customer-owned equipment
• All IP Developed is customer owned
• Delivery to customer location  ....or...
• Operated at CEI facility in New Freedom, PA
• Experienced pilot plant staff on hand
• Many project examples
EXAMPLE PROJECT

“ENERGETICS” Reactor System

Raw material addition cart for “Energetics” production. Pictured during early construction.
EXAMPLE PROJECTS

Feed tanks for production of key material for a medical device maker.

Reactor system with pumps and flow controls.
High temperature Batch Calciner designed and operated by CEI.

- 850 Deg. C
- 1 Millitorr

Portable Helium leak checking system; a combination vacuum pump and compressor set.
EXAMPLE PROJECT

Filtration test system designed, built, and operated at CEI. Features a 500 gallon flow loop with operation up to 1100 Deg. F and 25 psig.
Complete pilot plant designed, built, and operated by CEI that incorporates the heating system at left.

Hot oil heating system
EXAMPLE PROJECT

1000 BPD Bitumen feed metering and collection system for a proprietary reactor. Designed and built by CEI. Pictured during final days of construction.
EXAMPLE PROJECTS

PTFE Etch System

High temperature reactor – one cubic meter capacity.
EXAMPLE PROJECTS

Modifications to overhead components of existing reactor.

Portable superheated steam system.
EXAMPLE PROJECT

Portable tubing etch cart ready for customer delivery.

3-D model for installation space planning.
EXAMPLE PROJECTS

On-site custom reactor delivery and installation.

High temperature R&D reactor.
A UNIQUE SET OF SERVICES

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