Innovative Chemistry & Engineering Solutions

ees

Improving
Boiler Efficiency,
Emissions &
Water Recovery

www.eescorp.com

About EES Corp

1992

EES formed for environmental and testing consulting to utilities and OEMs

1994

Fuel treatment commercialization for fouling and corrosion

2004

R&D in slag control and subsequent commercialization of CoalTreat®, the leading anti-slagging treatment for coal

2008

EES conducts extensive mercury control studies in coal

2012

KLeeNscrub™ mercury precipitant launched with commercial success

2015

KLeeNwater JV launched to focus on water reuse and regulatory compliance for power generation

2017

EES acquires STEP Combustion, adding burners, controls, APC technology and a host of engineering support services

2018

EES acquires Combustion Technologies and Delta Instruments: strategic and synergist additions of airflow and coal flow measurement and best-in-class O_2, CO, and NOx analyzers for challenging environments

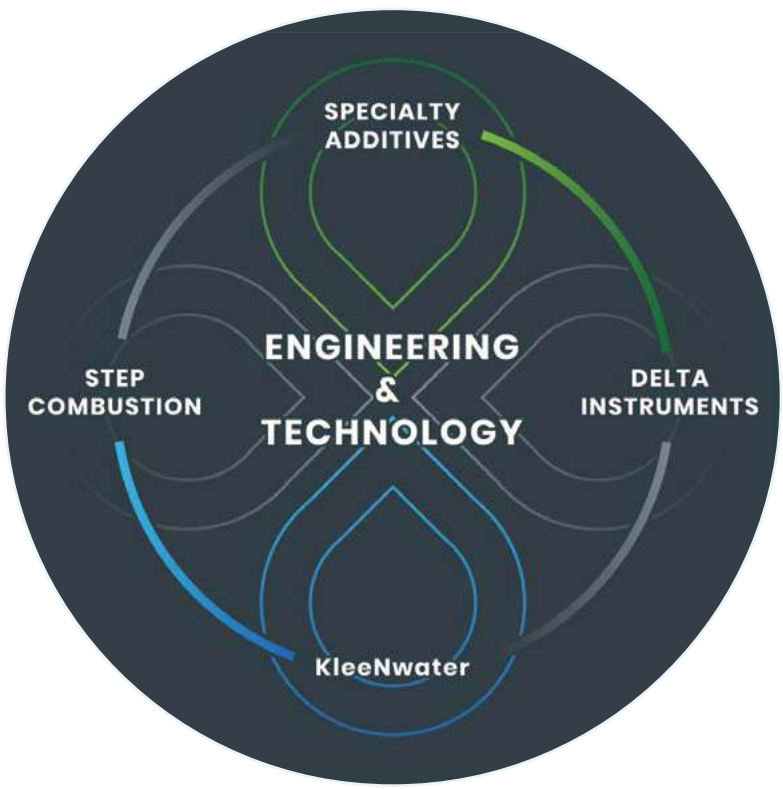
2019

EES acquires assets of Novinda Holdings: amended silicate technology for mercury oxidation and capture

A CLEAN ENERGY COMPANY

Environmental Energy Services, Inc. provides clean energy technologies to power and industrial facilities utilizing innovative chemistry and engineering. EES provides specialty additives, combustion measurement & enhancement, boiler performance optimization, nitrogen oxide & mercury emissions control, and water treatment technologies to energy facilities across the globe. EES' suite of clean energy technologies allow us to provide a comprehensive approach to solving performance issues such as:

- Specialty chemical formulations and anti-slagging boiler additives providing the flexibility to burn a variety of lower cost fuels
- STEP-wise NOx emission reduction for improved combustion efficiency at utility and industrial power plants
- Single and multipoint process analyzers for precise measurement of CO, O_2, NOx, and SO_2
- Mercury control additives and sorbents for enhanced mercury oxidation, precipitation, and capture in wet and dry FGD systems
- Wastewater treatment chemistry and equipment to maximize water reuse and minimize compliance costs



Specialty Additives

CoalTreat Optimizes Boiler Performance

EES provides a full suite of specialty additives formulated to enhance the performance and efficiency of coal, oil, and biomass-fired utility and industrial boilers. The optimum additive or blend is designed specifically for each boiler based on fuel, boiler operating conditions, and performance requirements.

CUSTOM REAGENTS TAILORED TO REDUCE SLAGGING

Current market conditions require O&M cost reductions to improve competitiveness and increase operational run-time. Cost saving strategies often include burning lower rank, higher sulfur and higher ash coals. These opportunity fuels increase boiler slagging, reducing heat transfer and contributing to costly tube wastage. The proper application of specialty formulated anti-slagging and anti-fouling additives can mitigate most of the factors that add O&M cost to operations, leading to fewer forced outages.

CoalTreat® is a customized fuel treatment specifically designed to reduce slagging in coal fired boilers by adjusting ash characteristics. It is applied to the fuel pre-combustion, and is tailored to meet the plant's specific operating, environmental, and economic objectives. Key benefits include:

- Increased **fuel flexibility** allowing burning of lower-cost opportunity fuels
- **Heat rate improvement** reduces the cost of fuel purchases
- **Reduced slag** and heat transfer surface wastage reduces the number and duration of forced and unforced outages
- **Increased power output** from improved heat transfer reduces or eliminates derating

CoalTreat® reagents are applied pre-combustion to adjust fuel chemistry and are highly effective for solving furnace slag problems

COALTREAT® ON-DEMAND

CoalTreat® On-Demand is an innovative portable delivery system for our proven anti-slagging additives. The system provides on demand CoalTreat® delivery to eliminate slag issues during high risk operating periods. The modular design provides rapid deployment of single or multiple units depending on coal types. CoalTreat® On-Demand system provides delivery of single or multiple CoalTreat® additives in a fully PLC controlled ISO Tank Container system with pumps, tank agitation, insulation and heat tracing.

EES Additive Solutions

COAL

CoalTreat® is an innovative customized fuel chemistry solution that mitigates furnace slagging and heat transfer surface fouling

OIL

Opacitrol™ combustion catalyst increases carbon burnout and reduces particulate emissions

MH Series™ are magnesium-based solutions mitigating SO_3 emissions, slagging, and fouling in oil-fired boilers thereby improving heat transfer and reducing air emissions

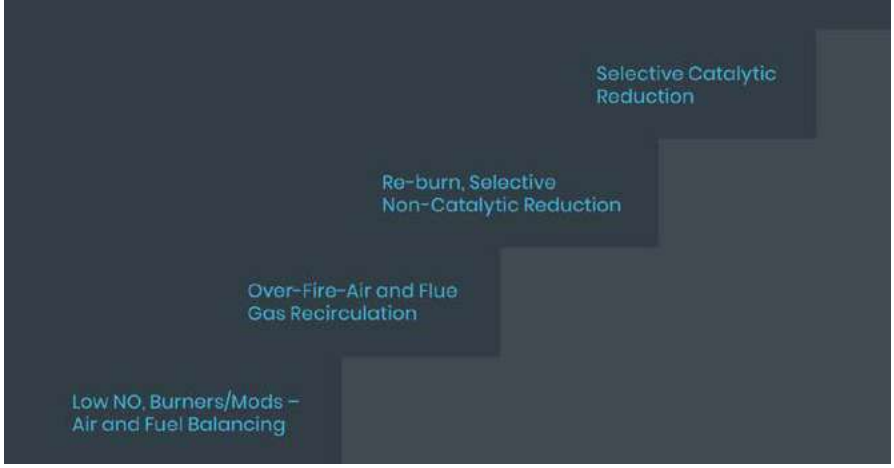
BIOMASS™

AddChem™ additives improve heat transfer and reduce surface corrosion caused by acid gases, such as HCl and SO_3

Burners, Retrofits, & Fuel Conversions

EES' STEP Combustion is a provider of best-in-class burners and retrofits for new and existing coal, gas, oil or biomass fired equipment. Our Variswirl© burner line is USA engineered, designed, and fabricated multi-fuel capable burners and burner upgrade kits. Variswirl© burners can be provided in sizes ranging from 10 to 300MMBtu/h for a wide array of fired equipment (boilers, heaters, cracking units, etc.), serving a vast customer base in power, mining, industrial, marine, institutional, and more.

New and upgraded burners have also been provided for wall, opposed, and tangentially fired boilers, package boilers, heaters, dryers, and other applications. Upgrades are very economical and a fraction of the cost of new burners due to STEP Combustion's expertise in air registers, combustion air control and balancing.



STEP-WISE APPROACH PROVIDES ECONOMICAL AND COMPLIMENTARY NOx REDUCTION

STEP'S TECHNOLOGY FOR BURNER RETROFITS

After an initial feasibility review, a full evaluation (aerodynamic, fluid dynamic, geometric) of the existing burner is performed to establish baseline operating conditions and to facilitate the retrofit design and application

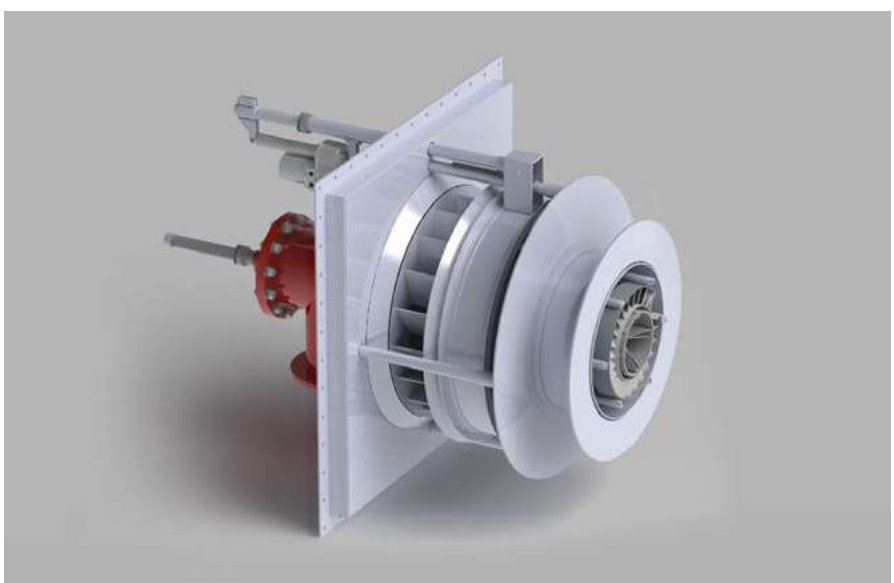
Hardware is designed to suit the existing burner, avoiding unnecessary expense and extending the life of existing fired-equipment

Emissions requirements can often be attained through retrofit of aerodynamic and fuel injection hardware, alone.

FUEL CONVERSION

Through burner replacement or retrofit, STEP designs, engineers, and supplies gas and multiple fuel conversion burner kits for both fuel co-firing and complete fuel conversion applications with burner sizes ranging from 10 to 300 MMBtu/hr. For retrofits, STEP begins with an analysis of the existing burner including: aerodynamic model of the combustion air, computational fluid dynamics (CFD) combustion model, as well as fluid dynamic models of the fuel delivery equipment. These capabilities are particularly important when upgrading older equipment.

STEP COMBUSTION VARISWIRL® COAL AND GAS BURNER

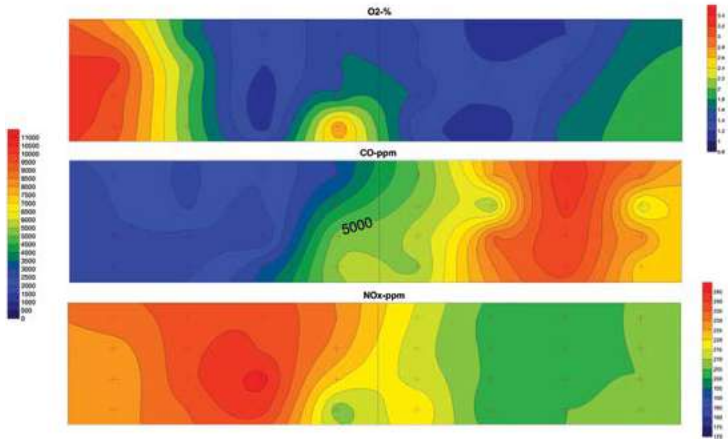


Fuel Pipe Balancing Valves, CFD Modeling and Field Services

STEP Combustion also offers continuous, real time coal mass flow systems, coal velocity measurement systems, portable coal flow measurement systems and coal pipe balancing services.

NT Series (NTS) Adjustable, Diffusing Coal Valves offer precise control of coal mass flow and velocity for burner to burner fuel balancing of coal fired power plants. Available features and options include:

- Balance coal distribution pipe-to-pipe
- Improve in-furnace temperature distribution
- Increase combustion efficiency and reduce emissions in minutes
- Perforated damper blades designed to dissipate coal ropes for improved homogeneous coal mixture to burners
- Hardened steel components (AR Plate) for longevity in highly erosive environments
- Arc spray coating is available for higher wear applications, as well as silicon carbide for extreme wear protection
- Manually or electrically actuated
- Precise “lock-in” positioning for optimum control of flow



ECONOMIZER OUTLET EMISSIONS GRID FOR AN 800+ MW UTILITY BOILER

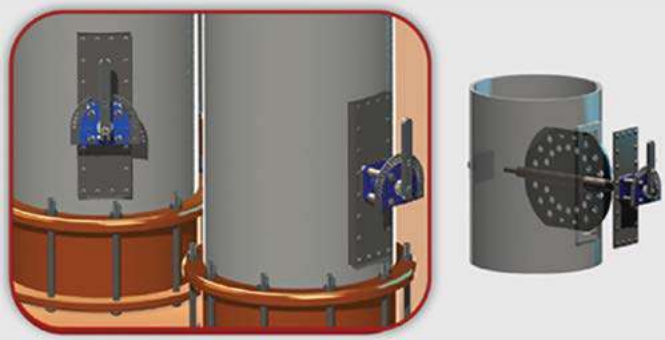
ENGINEERING & CFD MODELING

Whether for troubleshooting, baseline equipment evaluation, or system design, our team of engineers uses the latest computational fluid dynamics (CFD), finite element analysis (FEA), and other numerical modeling applications.

- SNCR & SCR Performance
- Soot
- Slagging and Fouling
- Heat Transfer
- Stress Analysis
- Fluid and Particle Dynamics
- Combustion Modeling
- NOx & Pollutant Formation Chemistry

FIELD SERVICES

STEP Combustion provides a full complement of field services for fuel conversion products and boiler optimization, customized to address annual tune-ups and assessments per the US EPA Major Source Industrial Boiler MACT. Specific capabilities include burner and flame pattern inspections, component replacement, and all associated burner management system adjustments. Inspections are tailored to control air-to-fuel ratios and CO emissions consistent with manufacturer’s specifications. STEP Combustion’s service capabilities extend to any of its emission and fuel conversion products, including boiler optimization, combustion performance testing, diagnostic testing, fuel studies and energy assessments.



Selective Catalytic and Non-Catalytic Reduction (SCR/SNCR) Systems

STEP's high efficiency SNCR system features the proprietary SARIS™ injection system. SARIS™ injectors deliver urea or ammonia into the flue gas to reduce smog-causing NOx to atmospheric Nitrogen (N_2) and water. The SARIS™ advantage lies in atomization and injection technology:

- **DUAL FLUID DESIGN**
  for improved and controlled atomization
- **CUSTOMIZABLE SPRAY PATTERNS**
  for efficient and optimized coverage
- **STEAM OR AIR ATOMIZED**
- **SELF-COOLING OR RETRACTABLE DESIGNS AVAILABLE**
- **TUNABLE DROP SIZE AND DISTRIBUTIONS**
  for unparalleled load-based optimization
- **US ENGINEERED AND FABRICATED**

STEP's SNCR systems can use anhydrous ammonia, aqueous ammonia, or aqueous urea and can be applied to coal, biomass, fuel oil and gas fired units.

STEP COMBUSTION SARIS™ INJECTION NOZZLE

SCR SYSTEMS FOR MAXIMUM NOx REDUCTION

For maximum NOx reduction, STEP provides Selective Catalytic Reduction (SCR) systems for a wide array of fired-equipment. We design and supply complete systems including: NOx, CO, NH_3 catalysts, reactors and stacks, off-loading and pumping equipment (urea, NH_3 (aq), and NH_3(g)), and ancillary equipment.

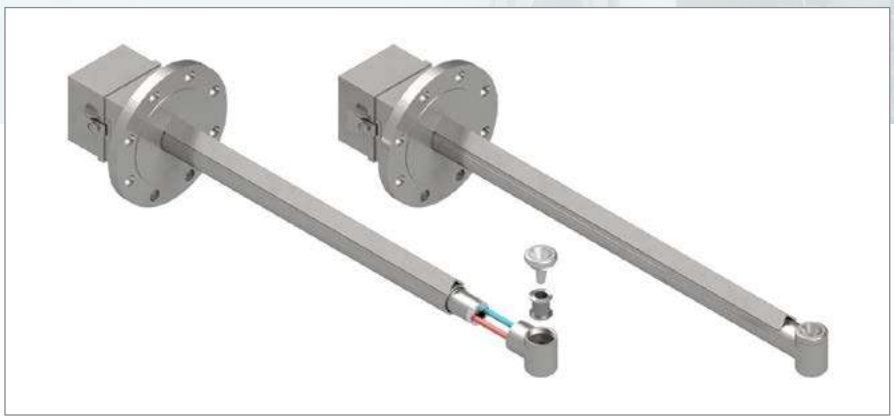
STEP Combustion provides SCR design or services related to:

- Aqueous, anhydrous, urea applications and delivery systems
- Transition ducts, turning vanes, reactor and stack design
- Catalyst specification, testing and replacement
- Ammonia Injection grid design and tuning
- CO catalyst specification and design
- Advanced flow distribution modeling (CFD, Physical)

STEP'S SCR SYSTEM USES A VARIETY OF CATALYST TYPES
Honeycomb, Plate or Corrugated
BASED ON APPLICATION REQUIREMENTS

Delta Gas Analyzers

Through our Delta Measurement division, EES designs and manufactures best-in-class multi-point continuous combustion and emissions analyzers. Our analyzers are suitable for use in clean and harsh environments alike, such as utility and industrial boilers, kilns, calciners, recovery boilers, and more. They measure CO, CO_2, O_2, NOx, and other constituents, are incomparable for combustion optimization, process control and feedback, and NOx reduction.



DELTA MEASUREMENT'S PROBE DESIGN OFFERS MAINTENANCE FREE OPERATION IN HIGH ASH & HIGH SULFUR ENVIRONMENTS

Using our patented probe design, multi-stage sample conditioning, and automated purge system, Delta measurement's extractive analyzers excel in dusty, sulfurous, and other challenging environments. The multi-point system can be arranged for emissions mapping and trending with local HMI and climate-controlled analyzer cabinets. Combustion and NOx analyzers are used for operator tuning, feedback to neural net systems, troubleshooting and optimization. Various length probes can be installed in a grid formation and local cabinets can be mounted close to extraction probes for simple and low-cost installation.

KEY BENEFITS

- Non plugging probe design (patented)
- Novel purge-to-drain to keep sample filters clean
- 3 Stage sample conditioning for maximum reliability
- Non-dilution for low end sensitivity
- Latest instrument technology

APPLICATIONS

- Combustion monitoring
- Neural net control/feedback
- Combustion tuning and optimization
- SNCR/SCR optimization
- Process control

DELTA'S CUSTOM EXTRACTIVE PROBES AND LOCAL INSTRUMENT CABINET

Amended Silicates™ Achieve High Mercury Capture Without Corrosive Halides

Coal fired power plants continue to face challenges to remain competitive with the increase of natural gas and renewable generation, as well as growing costs to meet stringent emission standards. Existing technologies for mercury mitigation, such as halide treatments (e.g. CaBr2), can be corrosive to downstream plant equipment, contaminate wastewater discharge and reduce plant availability. Activated carbon injection can render ash unsalable, create opacity issues and significantly increase plant O&M costs.

EES Amended Silicates™ offer a cost-effective alternative designed to augment mercury oxidation, safely capture mercury, and improve air pollution control equipment performance without corrosion and damage to balance of plant equipment.

AIR-HEATER CORROSION TYPICAL OF HALIDE USE

WHAT ARE EES AMENDED SILICATES™

EES Amended Silicates™ are patented formulations of advanced compounds combining a non-carbon substrate with a highly reactive surface coating. These reactive coatings are designed to capture and stabilize pollutants and provide other balance of plant improvements: reduces fly ash resistivity (improves ESP performance), minimizes metal leaching from fly ash, and eliminates the need for corrosive halides. EES Amended Silicates™ have been engineered for various applications including:

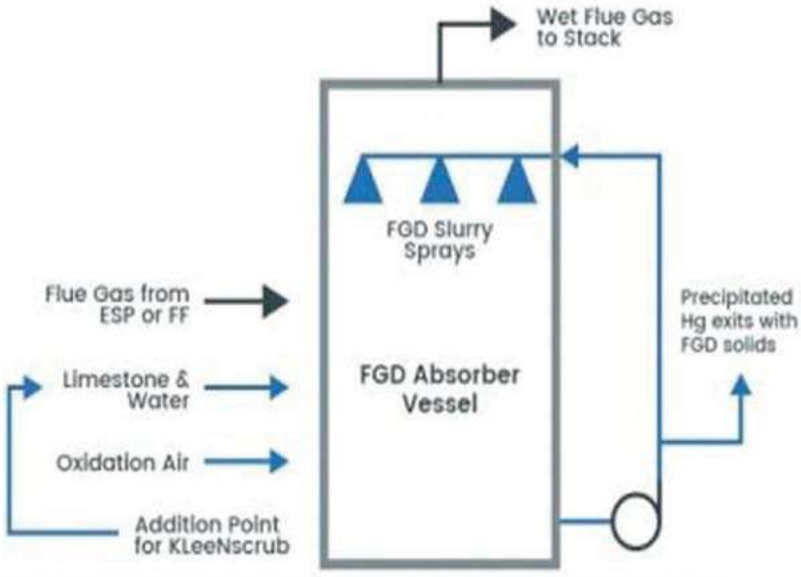
- AS-DryScrub – optimized to capture mercury from dry scrubbers and circulating dry scrubbers
- AS-HgOx – engineered for superior catalytic oxidation of mercury in flue gases
- AS-ULTRA – formulated for extremely high mercury capture in unscrubbed units or units requiring capture upstream of a wet FGD
- AS-DIOX – developed for the catalytic destruction of dioxins, furans, and other toxic organic compounds associated with waste incineration and other industrial processes

AS-HgOx REDUCES MERCURY COMPLIANCE COSTS

For units equipped with wet FGD and halide fuel treatment, AS-HgOx is an ideal alternative to eliminate associated corrosion and reduce O&M costs. Unlike halide treatments, EES' AS-HgOx is injected downstream of the boiler in cooler flue gas zones of 300-600F. Key benefits include:

- Improves fly ash quality and saleability (no additional carbons or halides)
- No equipment corrosion or waste water discharge issues caused by halide additions
- Reduces operational costs for better ROI than halides and activated carbon injection

KLeeNscrub™ Removes Mercury from Flue Gas



KLeeNscrub™ is a suite of organosulfide-based additives formulated by EES to support MATS compliance. KLeeNscrub™ provides a highly efficient and cost-effective solution for coal fired power plants struggling with emissions of mercury and other metals, such as lead, copper and cadmium, often found in power plant wastewater. KLeeNscrub™ additives are injected into make-up or recirculating absorber slurry within wet flue gas desulfurization (FGD) systems where they react with these metals to form complex compounds that are easily precipitated and removed with the FGD solids.

KLeeNscrub™ has proven its effectiveness in reducing overall mercury levels at the stack exit when burning any type of coal in a variety of scrubber conditions. Further, since KLeeNscrub™ reagents react with mercury to form stable precipitates, mercury re-emission from the reduction of ionic mercury (Hg++) back to elemental mercury (Hg0) is avoided.

KEY BENEFITS OF KLeeNscrub™

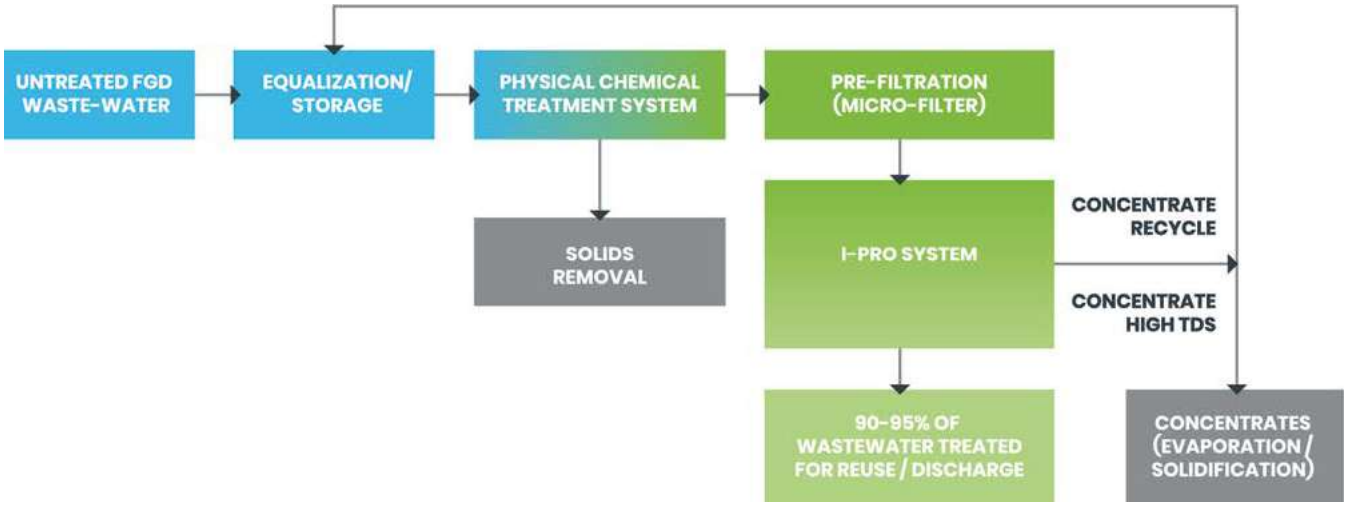
- Highly efficient sulfur-based reagents precipitate dissolved mercury, preventing mercury re-emission
- Mercury control utilizing FGD capture is extremely economical as compared to most activated carbon injection approaches
- Large, stable precipitant is easily removed, passes toxicity characteristic leaching procedure (TCLP) protocols, is thermally stable and is suitable for wall board manufacture
- EES can formulate KLeeNscrub™ additive packages to customize mercury partitioning and solids handling
- Captures additional metals, such as lead, copper, thallium, cobalt, cadmium, nickel, zinc, iron, silver, and tin
- Reagents are non-corrosive, non-hazardous, and manufactured in the USA

KLeeNwater Produces Contaminant Free Wastewater

EES' KLeeNwater provides water management system solutions to the power generation market. KLeeNwater designs, fabricates, installs, and operates water treatment systems tailored to address specific plant water recovery or disposal requirements. Our expertise in coagulants, flocculants, dispersants, and trace contaminant capture is available to improve operations.

KLeeNwater enables plants to re-use 85% or more wastewater, reducing load on zero liquid discharge (ZLD) systems and managing FGD/Cooling Tower blowdown, pond levels, coal pile runoff, and industrial wastewater streams. Systems are robust, capable of intermittent use, and treatment exceeds all requirements enumerated in US EPA Coal Combustion Residuals (CCR) and Effluent Limitation Guidelines (ELG) such as halides, trace metals and all forms of selenium.

A Typical KLeeNwater FGD Wastewater Treatment System



Please contact us to discuss innovative solutions to your plant engineering and operational concerns.

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COMBUSTION™ cleaner burning coal solutions TECHNOLOGIES

AMENDED SILICATES

KLeeNwater