Process Optimization

FLUE GAS CONDITIONING SOLUTIONS

Maximizing Fuel Flexibility, Reducing Costs and Regaining Lost Production

NEUNDORFER
PARTICULATE KNOWLEDGE
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Neundorfer consultants provide a full range of flue gas conditioning solutions and highly reliable controls integration to improve the performance of particulate collection, resulting in:

- Fuel flexibility that results in reduced operating and maintenance costs
- Reduced emissions and improved compliance
- Regaining lost production due to high opacity

A Process Optimization Service

Flue gas conditioning is a core Neundorfer process-optimization service, built on two decades of knowledge and hands-on experience working with plants that utilize coal-fired boilers to help improve fuel usage flexibility, including lower-cost high-ash and low-sulfur coals, without diminishing the performance of electrostatic precipitators. Without flue gas conditioning, precipitator efficiency is reduced when low-sulfur coals are used and the likelihood of re-entrainment and increased emissions increases.

Neundorfer can install new flue gas conditioning systems or upgrade older systems to make them more reliable and efficient. For new or upgraded flue gas conditioning systems, the Neundorfer team has the knowledge and engineering expertise to help attain the perfect balance of ash resistivity for optimized particulate collection.

To assess the need and potential impact of flue gas conditioning on a collector, Neundorfer offers a full range of flow modeling and laboratory services in order to provide testing, analyses and recommendations for improved collection efficiency and production performance:

- Computational Fluid Dynamics (CFD) modeling and Physical Flow Modeling to evaluate and optimize gas flows through collection devices in order to improve flue gas conditioning and sorbent injection results
- Laboratory consulting services to test and analyze ash particulate or coal to validate the potential impact of flue gas conditioning
Neundorfer has been at the forefront of sulfur trioxide (SO₃) flue gas conditioning for decades, delivering solutions for plants using low-sulfur coals solely or in variable blends. The production of supplemental sulfuric acid (H₂SO₄) to reduce fly ash resistivity is a proven method for counteracting the negative performance impact of low-sulfur coal combustion.

Neundorfer offers flue gas conditioning using molten or granular sulfur feedstock, with patented, unique approaches and reliable controls integration for either system—to ensure reliable dust collection performance. Generally, the process implementation includes these steps:

**Step 1:** Elemental sulfur, in granular or molten form, is burned to form sulfur dioxide (SO₂) gas and then converted to SO₃ with the aid of a catalyst.

**Step 2:** The resulting SO₃ is injected into the flue gas where it reacts with moisture to form sulfuric acid, which reduces fly ash resistivity and improves ash charging and collection.

**Step 3:** Integrated with a PLC control system, the quantity of injected SO₃ is continually monitored and adjusted using intelligent controls to automatically achieve the correct feed rate and optimal ash resistivity for effective collection performance.

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**SO₃ Flue Gas Conditioning**

SO₃ system basic process

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**Diagram:**

- **Granular Sulfur** or **Molten Sulfur**
- **Furnace**
- **Process Air Heater**
- **SO₂ Gas**
- **SO₃ Gas**
- **SO₃ Probes**
- **Converters**
Molten or Granular Sulfur

The choice of either molten or granular sulfur feedstock varies based on specific plant conditions and process considerations. Many of Neundorfer’s patented technologies are incorporated into our SO$_3$ conditioning systems and we offer two sulfur feedstock options: molten or direct-fired granular sulfur.

- **Granular sulfur** eliminates the risks and challenges associated with heating and handling molten sulfur. The granular, formed sulfur is used in a dry, pellet-like state at ambient temperatures. Granular sulfur feedstock:
  - Reduces maintenance time and costs associated with sulfur pluggage
  - Enhances safety by avoiding the use of steam or hot water boilers
  - Lowers operating costs associated with steam usage

- **Molten sulfur** systems from Neundorfer can provide mechanical upgrade solutions to correct common problems with standard molten sulfur metering and delivery in order to:
  - Improve sulfur delivery and system performance by minimizing leaks or overinjection
  - Reduce costs by recirculating unused molten sulfur to the storage tank
  - Enhance flexibility to improve system performance and efficiency

Flexible Equipment Options

For either a molten or granular sulfur feedstock system, Neundorfer offers patented cross-tie and remote SO$_3$ converter technologies which provide optimized equipment configurations and system efficiencies. These options also provide:

- Lower capital, operating and maintenance costs
- Higher efficiency with fewer components
- Enhanced collector performance from more precise, optimized controls
Neundorfer consultants have had good success using ammonia (NH₃) conditioning to improve precipitator performance either in a standalone system or in conjunction with SO₃ conditioning. NH₃ conditioning is an affordable approach for improved particulate collector performance and its effects occur quickly and with dramatic impact.

NH₃ conditioning can improve precipitator performance when these conditions exist:

- Air heater outlet temperatures exceed 330°F
- Flue gas distribution is uneven across the precipitator
- Precipitator face velocities exceed design values
- Loss-on-ignition (LOI) is greater than 5%
- Fine ash particulate contributes to rapping re-entrainment losses

Anhydrous NH₃ feedstock is combined with SO₃ (either naturally occurring from coal combustion or from SO₃ flue gas conditioning) to create a reaction with the moisture in the flue gas to form ammonium bisulfate [NH₄]HSO₄ or ammonium sulfate particulate [NH₄]₂SO₄. These ammonium compounds agglomerate and create larger, more cohesive fly ash particles that are more readily collected. As a result, rapping and re-entrainment are reduced which, in turn, reduces emissions and stack opacity, improving particulate collector performance.

It is important to note NH₃ conditioning includes taking precautions for safe handling and storage of anhydrous ammonia, a poisonous gas. Other forms of ammonia are available and more safely stored, but these are also more cumbersome and costly to process. Also, NH₃ can appear in the flue gas plume, leak from storage tanks and, in concentrations higher than 10ppm, render fly ash unsalable for concrete production.

Neundorfer consultants can help evaluate the considerable benefits of NH₃ conditioning. Neundorfer typically recommends an ammonia flue gas conditioning pilot plant as a starting point to provide a low-cost but fast test and assessment of the impact of NH₃ injection.
Sorbent Injection

Sorbents injected into the gas stream act as agents to capture pollutants, ensure regulatory compliance and provide cleaner emissions. The injection of activated carbon, hydrated lime, sodium carbonate and other sorbents acts as a catalyst to generate chemical reactions with mercury, SO$_2$ or nitrogen oxides (NO$_x$) to alter and contain these substances. Through years of hands-on engineering, Neundorfer consultants can diagnose and apply the use of sorbents as needed.

Technical Services

Injection Dispersion Modeling

Neundorfer’s technical services include the capability of modeling the dispersion of the injection of SO$_3$, NH$_3$ and sorbents. Our consultants use in-house CFD and physical modeling tools to determine the proper location of injection nozzles and to help select the best nozzle design for each application. This service helps improve total system performance by optimizing the injection points, assuring proper mixing and treatment times.

Data Collection & Analysis

Minerva is Neundorfer’s state-of-the-art analysis and reporting tool. As a subscription service, Minerva applies Neundorfer algorithms to analyze and interpret real-time data from customer equipment operation and processes. Daily and weekly reports keep customers continuously informed regarding collection efficiency, cost and energy savings and avoided pollution. In addition, Neundorfer engineers augment this automatic reporting with personal contact regarding customer-specific analysis, interpretations and recommended actions.

Laboratory Testing & Analysis

Neundorfer provides testing and analyses for ash resistivity and mineral content to establish a baseline and/or to assess the effects of flue gas conditioning with SO$_3$ or NH$_3$. This particle analysis enables predictive performance modeling to:

- Better understand processes contributing to high outlet emissions (or opacity) in order to create solutions
- Deliver customized recommendations to improve ESP collection efficiency and quantify performance improvement expectations
- Establish criteria for fuel selection and other process inputs for improved precipitator performance
- Indicate adjustments to SO$_3$ injection to improve the effects of flue gas conditioning

Technical Consulting

Neundorfer’s services are also supported by a full complement of consulting services for maintenance, inspections, upgrades and training.

As consultants first, Neundorfer provides well-engineered flue gas conditioning solutions to enhance and optimize collector efficiency and performance. For more information, contact your Neundorfer representative or visit our website at www.neundorfer.com.