Technology Applications, Inc.
Mike Mansfield Advanced Technology Center

Technologies for the Future
Responsible Solutions for Today

Plasma Treatment System

MSE Technology Applications, Inc.'s (MSE) Plasma Treatment System is a fixed-facility thermal treatment process capable of disposing large quantities of industrial and military hazardous waste.

The technology uses a plasma arc torch to combust organic material and melt inorganic material through high-temperature oxidation. Electrical energy, supplied to the plasma torch, ionizes and heats a process gas to temperatures exceeding 18,000 ºF (10,000 ºC). Organic waste fractions are destroyed in a highly effective combustion reaction, while inorganic fractions are oxidized to a highly stable glassy-ceramic slag product. This slag product meets the leachability requirements of the U.S. Environmental Protection Agency's Toxicity Characteristic Leaching Procedure and the Nuclear Waste Glass Product Consistency Test.

Due to the low volume of offgases generated, sophisticated pollution abatement equipment is technically and economically practical.

MSE's plasma treatment system.

MAJOR SYSTEM COMPONENTS

MSE's Plasma Treatment System consists of the following major components:

- a primary processing chamber;
- a 500-kilowatt (kW) nontransferred arc plasma torch;
- a 1.0-megawatt (MW) transferred arc plasma torch;
- a slag tapping and handling system; and
- integrated system controls.

PRIMARY PROCESSING CHAMBER

The primary processing chamber consists of a water-cooled hearth and a refractory-lined water-cooled vessel. The refractory system is custom designed for the target waste stream and provides a balance between energy efficiency and control of operating temperatures.

PRIMARY PROCESSING CHAMBER CHARACTERISTICS

- Oxidizing stoichiometry
- Waste material energy release—5.1 million British thermal units per hour (1,500 kW) (maximum)
- Waste material gas generation—15.4 pounds per minute (7 kilograms per minute) (maximum)
- Torch thermal input—250 to 1.0 MW
- Supplemental oxygen—190 standard cubic feet per minute (5,400 normal liters per minute)
- Combustion gas residence time—2 seconds (minimum)
- Maximum operating temperature—2,900 ºF (1,600 ºC)
- Refractory life—3 to 5 years

TORCH/POWER SUPPLY FEATURES

Torch Configurations

- 500-kW nontransferred arc
- 1.3-MW transferred arc
- Air arc stabilization gas

Power Supply Ratings

- 675 kW (nontransferred torch)
- 1.5 MW (transferred torch)
- 4,160-volt input
- <10% total harmonic distortion

SLAG TAPPING AND HANDLING FEATURES

MSE's Plasma Treatment System is equipped with a fully enclosed, remote-controlled, semiautomatic hearth tapping system. The hearth tapping system uses a commercially available burning lance and MSE-designed drive and control hardware.

Slag is poured into standard drums for easy handling, storage, and disposal. Remote operation and positioning of the drums is provided by a driven roller conveyor within the slag tapping chamber.

FEED HANDLING SYSTEM DESIGN FEATURES

The unit can be fitted with feed systems to handle liquids, soils, and aggregate materials up to 4 cubic inches (10 cubic centimeters) in size, or specialty items of a larger size. Feed systems are designed to provide isolation of the primary processing chamber at all times eliminating fugitive emissions.

OFFGAS SYSTEM DESIGN FEATURES

MSE's Plasma Treatment System can be fitted with a pollution abatement system to meet regulatory and operational requirements. Both wet and semidry systems are easily adapted. With a properly designed pollution abatement system, the following criteria can be readily achieved:

- 99.99% destruction efficiency of organic compounds;
- secondary combustion of organic materials at temperatures over 2,000 ºF (1,093 ºC) with a residence time greater than 2 seconds;
- 99% removal of hydrogen chloride gases;
- removal of particulate matter to below 0.015 grain per dry standard cubic foot (34 milligrams per cubic meter); and
- 90% removal of oxides of nitrogen.

Wet pollution abatement systems can be equipped with a water treatment and recycle system, which allows the majority of the scrubber water to be reused within the process.

PROCESS CONTROL DESIGN FEATURES

MSE's Plasma Treatment System is fully integrated and interlocked with a personal computer-based control system that has the following features:

- a single operator in a centralized control room can operate the entire treatment system;
- the control system provides an automated fail-safe configuration of treatment system components in abnormal or equipment failure scenarios; and
- a centralized data acquisition system records data for process evaluation and regulatory compliance reporting.

FOR MORE INFORMATION, CONTACT:

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