Report: Industrial Visit to Tehkhand Waste-to-Electricity Plant

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Institution/Department: Maharaja Agrasen Institute of Technology (MAIT) – EEE Department

Participants: 3rd Year EEE Students

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Acknowledgement: Support and motivation from HOD ma'am

1. Purpose of the Visit

The industrial visit to the Tehkhand Waste-to-Electricity Plant was organized to provide 3rd-year Electrical & Electronics Engineering students with practical exposure to an operational waste-to-energy (WTE) facility and to connect classroom concepts with real-world implementation.

The key objectives were:

1. To understand how municipal solid waste (MSW) is converted into electrical energy through an engineered process.
2. To observe the end-to-end plant workflow: waste reception, processing, combustion/energy recovery, and power generation.
3. To understand how such plants contribute to sustainability goals by reducing landfill dependence, producing energy, and improving environmental outcomes.
4. To link the plant's operation with Sustainable Development Goals (SDGs) such as clean energy, sustainable cities, responsible consumption, and climate action.

2. Overview of the Plant and Its Significance

The Tehkhand Waste-to-Electricity Plant functions as an integrated facility that processes municipal solid waste and recovers energy in the form of electricity. Such plants are designed to reduce the volume of waste sent to landfills while also extracting usable energy from waste that would otherwise become an environmental burden.

A key observation from the visit was the plant's self-sustaining operational nature—the facility is structured to run continuously using engineered systems that control waste input, combustion conditions, emissions, and power generation. Students found the visit highly insightful because it demonstrated sustainability as a working system (not just a concept): waste was being treated as a resource, energy was being recovered, and environmental controls were visibly integrated into operations.

3. Plant Process (End-to-End Flow)

A. Waste Collection, Receiving, and Storage

Waste Arrival: Municipal solid waste is transported to the facility via collection vehicles.

Weighing and Logging: Incoming waste is typically measured and recorded for operational monitoring and compliance.

Tipping/Unloading Area: Waste is unloaded in a designated zone designed to manage odour, dust, and spillage.

Waste Storage Bunker: The waste is stored in a bunker or storage area that allows continuous feeding into the processing line.

Mixing/Blending: Waste is often mixed to maintain a more uniform feed. This improves combustion stability and overall plant efficiency.

Engineering relevance for students: load management, process continuity, material handling automation, industrial safety protocols.

B. Waste Pre-Processing

Depending on plant design, MSW may undergo some level of sorting and size reduction before combustion or conversion:

Removal of oversized/inert items to protect equipment and improve fuel quality.

Segregation to reduce non-combustibles (metals, stones, debris) and improve calorific value.

Shredding/conditioning to improve consistency of feed and combustion performance.

C. Energy Recovery Section (Core Conversion)

Most waste-to-electricity plants operate on thermal conversion where heat is recovered for power generation. In simple terms:

Controlled Combustion / Thermal Processing:

Waste is fed into a combustion chamber (or thermal reactor). The process is controlled using:

- regulated air supply (primary/secondary air)
- temperature monitoring and control
- engineered furnace/grate mechanisms
- continuous feeding to maintain steady operation

Heat Generation:

Combustion produces high-temperature flue gases. This heat is not wasted; it is captured for energy generation.

Boiler/Heat Recovery System:

Hot gases pass through a boiler system where heat converts water into steam. Boiler design is engineered to:

- maximize heat transfer
- protect against corrosion/erosion
- support continuous steam generation

D. Steam Turbine Generator and Power Generation

Steam Turbine: High-pressure steam drives the turbine.

Generator: The turbine shaft is coupled to an electrical generator which produces electricity.

Electrical Systems: Generated power is conditioned and synchronized before being used internally and/or exported through: switchgear, transformers and protection relays, metering and grid interconnection systems.

Students could directly relate this to power systems concepts such as generation, synchronization, protection, and distribution.

E. Emission Control and Environmental Systems

A critical part of modern WTE plants is the emission control stack, designed to comply with environmental norms and reduce pollutants. Typical systems include:

- Particulate removal: via filters or electrostatic systems
- Acid gas control: neutralization of gases like SOx/HCl using reagents
- NOx control: combustion optimization and/or treatment systems
- Continuous emission monitoring: real-time tracking of key emission parameters

F. Ash Handling and Residue Management

Post-combustion residue is managed as:

Bottom ash: collected from furnace base; often treated/processed for safe disposal or potential reuse (depending on regulations and composition).

Fly ash: captured from pollution control systems; requires careful handling due to higher contaminant concentration.

4. Self-Sustainability and Operational Continuity

The plant was observed as self-sustainable in the sense that it operates as a continuous cycle:

waste input → energy generation → internal power needs supported → regulated output automation + monitoring ensures stable operation environmental systems ensure responsible functioning.

5. SDG Alignment (Direct Learning)

The visit clearly mapped to multiple SDGs, including:

- SDG 7: Affordable and Clean Energy – electricity generation from waste resources
- SDG 11: Sustainable Cities and Communities – improved waste management and reduced landfill pressure
- SDG 12: Responsible Consumption and Production – converting waste to usable outputs
- SDG 13: Climate Action – reducing methane emissions from landfills and improving overall waste lifecycle outcomes
- SDG 15: Life on Land – reducing land degradation by minimizing landfill expansion

6. Student Learning Outcomes

By the end of the visit, students gained practical understanding of:

- how MSW can be integrated into a structured energy recovery system
- real-world application of thermal systems, turbines, generators, and protection equipment
- industrial automation, monitoring, and environmental compliance
- the importance of feed quality, operational discipline, and safety
- sustainability as a systems-engineering outcome, not a slogan

7. Conclusion

The Tehkhand Waste-to-Electricity Plant visit was a high-value learning experience for 3rd-year EEE students. It connected core power engineering concepts with a real sustainability-driven infrastructure. The plant demonstrated how engineering can directly contribute to conserving and preserving nature while addressing urban waste challenges.

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