

Controllability of HCI and SO₂ release in a grate-fired Waste-to-Energy furnace

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Waste-to-Energy: process

Typical problems:



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Waste-to-Energy: combustion control

Main setpoints:

- Steam flow (thermal output)
- %O₂ (efficiency of combustion)
- 2) Derived setpoints:
 - Waste throughput
 - Air supply
 - Air ratio (primary vs. secondary)

3 Waste layer control

- Gratespeed
- Air division



De Greef, J., Hoang, Q. N., Vandevelde, R., Meynendonckx, W., Bouchaar, Z., Granata, G., ... & Vanierschot, M. (2023). Towards Waste-to-Energy-and-Materials Processes with Advanced Thermochemical Combustion Intelligence in the Circular Economy. Energies, 16(4), 1644.

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Perspective

Towards Waste-to-Energy-and-Materials Processes with Advanced Thermochemical Combustion Intelligence in the Circular Economy

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Analysis and quantification of relation between:

- Combustion control variables
- Chemical composition of flue gas (especially HCl and SO₂)

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Three-step approach

Analysis of industrial process data of a grate-fired WtE-furnace



Step 1: Description of plant operation



Conclusion: **Different operating** conditions over time



2022.02

2022.05

Step 2a: Analysis of combustion control



Step 2b: Analysis of combustion control



Ergun's equation:





with:

 $\varepsilon = 0.225$

• $\rho = 0.96 \text{ kg/m}^3$

• $D_p = 0.02 \text{ m}$

Conclusion: Different physical conditions in waste layer

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Step 3: Analysis of emissions from waste layer



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causes different **physical conditions** in waste layer resulting in **variable emissions → controllable!!**

De Greef, J., Verbinnen, B., & Van Caneghem, J. (2016). Chemical engineering analysis of SOx and HCI from municipal solid waste in grate-fired waste-to-energy (WtE) combustors. In Proceedings of the 6th International Symposium on Energy from Biomass and Waste-Venice 2016.

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Conclusion

- Physical conditions in the waste layer influence the release of SO₂ and HCI in grate-fired furnaces
- The release of SO₂ and HCI from the waste is proactively controllable
- Existing potential to upgrade control systems in state-of-the-art WtE with thermochemical intelligence towards SO₂ and HCI
 - Significant economic impact! (avoidance of boiler corrosion and reduction of dosed chemicals in flue gas cleaning)

Future work:

- Development of control models based on machine learning methods
- · Elucidate packed-bed reactor behavior of waste layer

