Influence on combustion and ash characteristics during co-combustion of municipal solid waste and pelletized sewage sludge

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01 Research Background

**Domestic sludge**
36 Mt/year

**Industrial sludge**
38 Mt/year

- Landfill 65%
- Compost 15%
- Natural drying 6%
- **Incineration 3%**

**Contaminant**
- Heavy metal
- Germs, etc.

**Harmless treatment rate** 32%

**High Sludge Production**

**High Concentration Pollutants**

**Low Harmless treatment rate**
01 Research Background

**Landfill**
- Require Large area
- Hard to kill germs completely
- Fetor
- Low cost

**Incineration**
- High rate of volume reduction
- Harmless treatment
- Recovery energy
- High cost

Better Option
Study target
Combustion and ash characteristics during co-combustion of MSW and pelleted sludge in a grate furnace
## 02 Experiment System

**Experiment Conditions in the Tube Furnace***

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Drying section</th>
<th>Combustion section</th>
<th>Burn-out section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow velocity (m/s)</td>
<td>1.15</td>
<td>4.48</td>
<td>1.22</td>
</tr>
<tr>
<td>Residence time (min)</td>
<td>18</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Temperature Condition a(℃)</td>
<td>250</td>
<td>600</td>
<td>450</td>
</tr>
<tr>
<td>Temperature Condition b(℃)</td>
<td>300</td>
<td>1050</td>
<td>700</td>
</tr>
</tbody>
</table>

*Based on the measured data of a grate furnace in Zhejiang Province

**Variables**
- Temperature conditions
- Diameter of pelleted sludge (powder, 3mm and 8mm)
- Addition of desulfurizer (CaO, mass ratio: 1%)
02 Experiment System

Sludge powder

Sludge pellet—3mm

Sludge pellet—8mm
02 Experiment System

- 10g sample (drying sludge, moisture: 28%)
- Section 1, 3 and 5 are used to simulate different combustion conditions (drying, combustion and burn-out)
- Bottom ash and fly ash are collected to get the ratio.
- Concentration of flue gas pollutants is measured online.
03 Result and discussion

- CO, NO\textsubscript{x}, SO\textsubscript{2} reaches maximum at combustion section under all conditions.
- Low concentration of CO and SO\textsubscript{2} appear at drying section under condition b.
• Addition of CaO (1%) in sludge pellets can reduce the average SO₂ concentration in each section.
• During the combustion section with the highest SO₂ concentration, the maximum SO₂ removal rate can reach 80%.
03 Result and discussion

• With the increase of diameter and compressive strength, the ratio of slag ash and its clinker ignition loss increase, while the ratio of fly ash decreases.

• Under condition a, the clinker ignition loss of slag ash may reach as high as 11.9%.
• Addition of desulfurizer (CaO) in sludge pellets can reduce SO$_2$ emission concentration greatly.
• With the increase of diameter and compressive strength, the combustion specific surface area of sludge pellets decreases and the fly ash inside the pellets is hard to escape from it.
• Under a low combustion temperature condition (600°C), the clinker ignition loss of slag ash exceeds the limit (5%).
• Temperature on combustion section should be higher than 800°C to avoid incomplete combustion.
Future work

1. Effect of sludge pellet on ash fusion temperature
2. Co-combustion experiment of sludge and municipal solid waste.
3. Study on crystalline phase and elemental composition of co-combustion of sludge and municipal solid waste by XRD and XRF.
Thanks for your time