



Waste Solid Separation from Flue Gas for Carbon Capture

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Abstract

The purpose of this project is to design a backend system that will separate waste solids from lime kiln flue gas. This will improve up the current baghouse. The flue gas will then be sent to an eventual carbon capture plant.

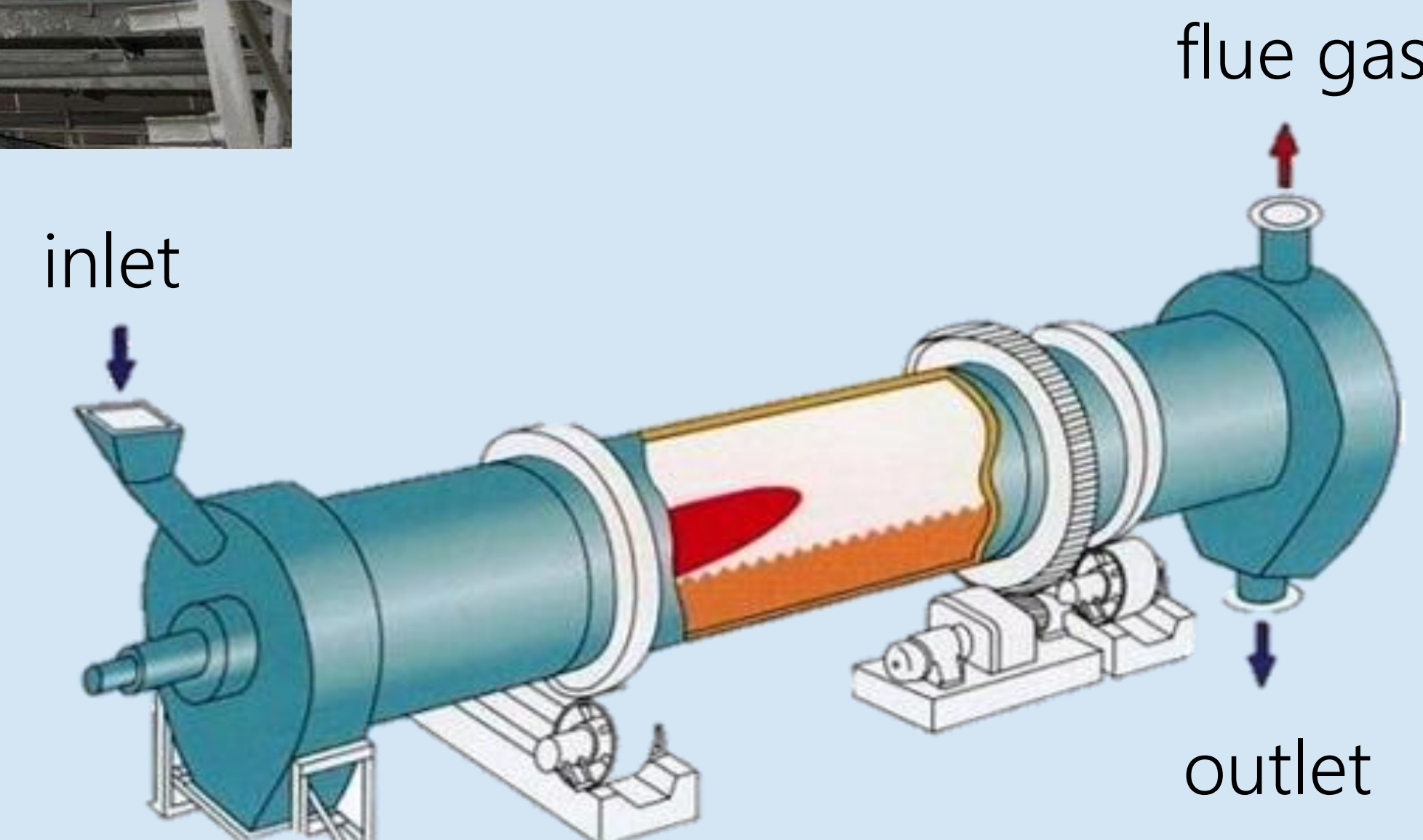
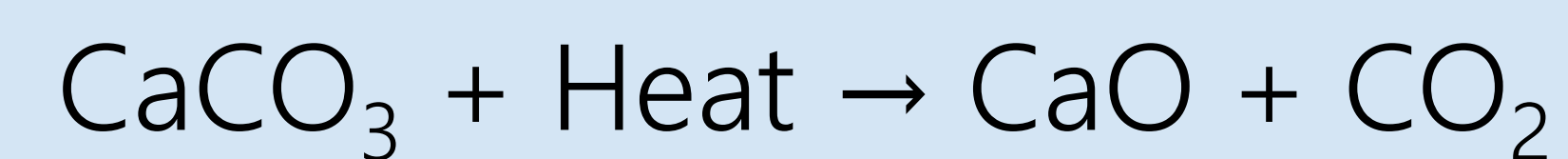
Carmeuse Lime & Stone

Carmeuse is a Belgian mining company that produces lime and limestone. They have plants around the world. The plant in Gary, Indiana that our team is working with produces quicklime (CaO) from limestone (CaCO₃) by driving off CO₂. Quicklime is used in various industries such as agriculture, steel, paper, cement, and wastewater treatment.

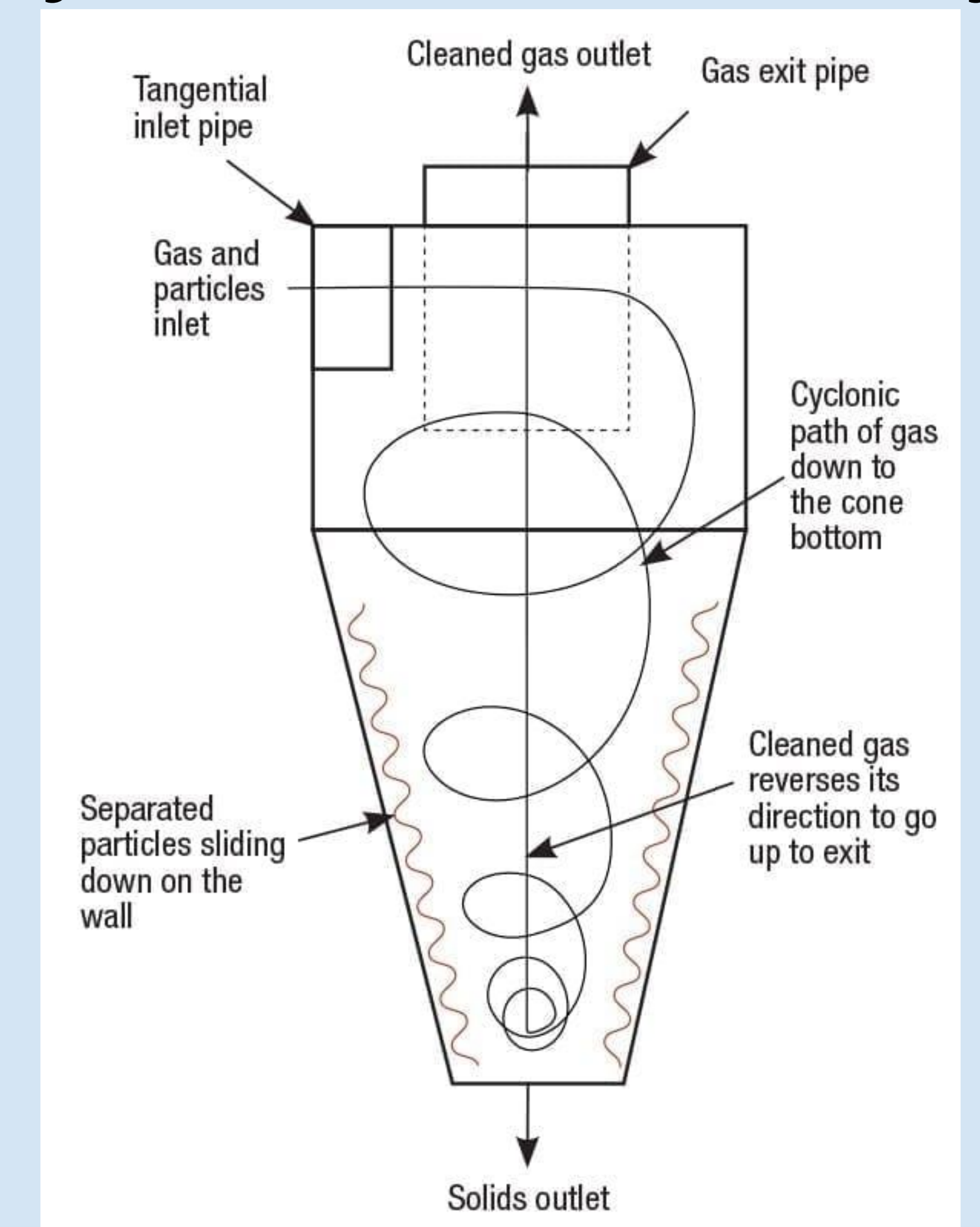
Rotary Lime Kiln Overall Process Flow



Process temperature:
900°C - 1000°C



Cyclone Functionality



Cyclone Design – Leith & Licht Empirical Design Methodology

| | | |
|----------------|----------|-------------------|
| D | 1.5 | m |
| T | 500 | K |
| V _o | 100 | m ³ /s |
| ρ _p | 3340 | kg/m ³ |
| μ | 3.17E-05 | Pa*s |
| d | 3.00E-05 | m |
| ρ | 0.2 | kg/m ³ |

| | Method - Lapple | Units |
|--------------------------------|-----------------|-------|
| number of times gas turns (Nt) | 27.504 | turns |
| natural length (l) | 2.183 | m |
| efficiency (η) | 0.998 | |
| cut off diameter (dpc) | 1.02E-06 | m |
| pressure drop | 606.8 | Pa |

Design Decision

| Criteria | Cyclone | Electrostatic Precipitation (ESP) |
|------------------------|------------|-----------------------------------|
| Pressure Drop | Green | Light Blue |
| Particle Size Range | Light Blue | Green |
| Separation Efficiency | Light Blue | Green |
| Space | Light Blue | Green |
| Equipment/Capital Cost | Green | Light Blue |
| Maintenance Costs | Green | Light Blue |
| Operating Costs | Green | Light Blue |
| Inherent Safety | Green | Light Blue |
| Inherent Simplicity | Green | Light Blue |

Future Work

Once a more efficient solid separation method is implemented, the eventual goal is to add a carbon capture plant that will reduce the carbon emissions of the quicklime process.

