### Heat and material transport in a rotary drum

Background

The development of rotary kilns began in the second half of the 20th century, largely due to the intensive production and quality control of cement during the clinkerization process. Numerous physical mechanisms ensuring energy transfer between the different phases present can operate in these processes (Bisulandru et al., 2023).

Moreover, this equipment has since been applied to other types of materials of mineral or organic origin (Huchet et al., 2018), other than its historical application. The thermochemical conversion of waste (e.g. biomass) is one example among many cited in the literature (TiO2, Aluminium, Asphalt Aggregates, Wood and Coal Pyrolysis).

Objective

The scientific challenge of this industrial process lies in its physical modeling, the complexity of which remains a major stumbling block. Indeed, several thousand particles cohabit at the same time and are subjected to intense heat flows. Chemical reactions can give rise to endothermic and exothermic reactions responsible for changes in the state of the granular material. General laws of gas and grain transport and energy transfer govern these complex physical processes:

- Granular flow regimes and solid load control parameters (Piton et al. 2015, Kozacovic et al. 2023);

- Heat transport, whether conductive, convective or radiative (Le Guen et al. 2013, Le Guen et al. 2017, Le Guen et al. 2020);

The aim of the thesis is to gain a better understanding of the physical mechanisms operating in rotary furnaces. The thesis work will be based on experimental tools developed at laboratory and numerical scales in collaboration with industry and academia.

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