**Why?**
- Solid sorbents are a promising option to reduce the energy penalty associated with capturing flue gas CO2.
- System simulations are needed to consider various process tradeoffs.
- Reactor models for these types of processes are not currently available in commercial process simulators.

**Features**
- Predictive computational 1 dimensional PDE process model for moving bed reactors.
- Flexible in wide range of operation conditions (unit size, gas and solid flowrates and compositions, particle properties and etc.).
- Includes reaction kinetics and correlations for heat and mass transfer between gas, solid and immersed heat exchanger tubes.

**Major Equations**

**Gas Phase Balance Equation**
\[
\dot{w}_\text{gas} = \left( \rho_f \right) \frac{d\rho_f}{dt} = 0
\]

**Solid Phase Balance Equation**
\[
\dot{w}_\text{solid} = \left( \rho_s \right) \frac{d\rho_s}{dt} = 0
\]

**Tube-side Balance Equation**
\[
\dot{w}_\text{solid} = \left( \rho_s \right) \frac{d\rho_s}{dt} = 0
\]

**Optimization Framework**

**Objective Function**
- Maximum gas velocity in reactors.
- Minimum approach temp. in HXs.
- Etc.

**Design Variables**
- 2 Integer variables
  - Number of ADS units
  - Number of RGN units
- For each reactor (ADS, RGN)
  - Diameter and height
  - Avg. voidage
  - Tube diameter
- Other operating variables for ADS
  - # of tubes
  - Gas inlet temp. in ADS
  - Sorbent inlet flowrate and temp.
- Other operating variables for RGN
  - Steam inlet flowrate
  - Circulation medium flowrate
  - Extent of regeneration

**Process Model**
- Objective value: 110.46 $/MWh
- After 1600 designs evaluation over 32 hours.
- High % of "error designs": 38% - Large non-feasible area.
- Design History:

**Optimal Design**
- 15 ADS units + 12 RGN units
- Objective value: 110.46 $/MWh
- After 1600 designs evaluation over 32 hours.
- High % of "error designs": 38% - Large non-feasible area.
- Design History:

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