DRYER

Overview:

In chemical engineering, drying is a combination of "art" and "science." While practical experience shapes industrial design and operation, scientific approaches enhance our understanding of the processes involved. The Rotary Dryer is a vital component in various industries, including fertilizer production, pharmaceuticals, cement manufacturing, and more.

DRYER PROCESS:

The Rotary Dryer operates through a revolving cylindrical shell, slightly inclined toward the outlet. Wet feed enters one end, and dry material exits the other. The process involves three main components:

1. **Lifting of Particles**: Internal flights lift the material from the bottom to the upper part of the drum.
2. **Forward Movement**: Particles move forward due to drag from the drying gases.
3. **Cascade Action**: Particles cascade down based on their angle of repose and are pushed forward by the material behind them.

SIMULATION APPROACH:

The simulation utilizes the Shrinking Core Model, where each granule is viewed as having a shell and a core. As drying progresses, the core shrinks, and the drying rate depends on the balance between external mass transfer and effective diffusivity of water vapor in the porous medium.

Key processes in the rotary dryer include:

- **Particle Dynamics**: The movement of particles through cascading and resting phases within the drum.
- **Heat Transfer**: Transfer of heat from hot gases to particles, providing the latent heat of vaporization.
- **Mass Transfer**: Movement of moisture from the particle core to its surface and then to the hot gases.

To enhance simulation accuracy, the dryer is divided into **four zones** instead of treating it as a single well-mixed zone. This division allows for monitoring profiles of moisture content and temperatures for both air and solids within each zone.