Collaborating on Chemical Processing Equipment Design

Part 1: Dialogue

Characters: Rachel (Chemical Engineer), Mark (Mechanical Engineer)

Rachel: Mark, we need to refine the design of the **fluidized bed reactor**. The airflow distribution isn't uniform, and it's affecting reaction efficiency.
Mark: I noticed that, too. We might need to modify the gas inlet configuration. Also, have you checked for signs of **heat exchanger fouling**? That could be reducing heat transfer efficiency.
Rachel: Good point. Buildup on the heat exchanger surfaces might be limiting performance. We should test different cleaning cycles to prevent efficiency loss.
Mark: Agreed. We also need to look at the **rotary kiln**. If the rotation speed isn't optimized, it could impact material flow and reaction consistency.
Rachel: That's true. I'll run simulations to see how different speeds affect residence time. Meanwhile, can you review the **agitator design**? We need better mixing to ensure uniform reactant distribution.
Mark: Absolutely. I think we should consider a variable-speed agitator to improve shear force control. But we also need to watch for **pump cavitation** in the fluid transport system.
Rachel: Right. If we have pressure fluctuations, vapor bubbles could form and damage the pumps. I'll check the operating conditions to ensure we're within safe limits.
Mark: That would help. Also, I'll analyze the mechanical stress on the rotary kiln components. If we need adjustments, it's better to catch them early.
Rachel: Sounds like a solid plan. Let's meet again after the simulations and stress analysis so we can finalize the modifications.
Mark: Agreed. I'll compile my findings, and we can compare notes to ensure the best outcome.

Part 2: Comprehension Questions

1. What issue does Rachel mention with the fluidized bed reactor?
    - (A) Uneven airflow distribution
    - (B) Excessive energy consumption
    - (C) High raw material costs
    - (D) Structural instability
2. What does Mark suggest to improve the agitator design?
    - (A) Increasing rotation speed
    - (B) Using a variable-speed agitator
    - (C) Adding more reactants
    - (D) Reducing the reactor temperature
3. What problem does Rachel identify in the fluid transport system?
    - (A) Heat exchanger leaks
    - (B) Low mixing efficiency
    - (C) Pump cavitation
    - (D) Corrosion buildup
4. What aspect of the rotary kiln does Mark want to analyze?
    - (A) Temperature fluctuations
    - (B) Structural wear and tear
    - (C) Mechanical stress
    - (D) Energy efficiency

Part 3: Key Vocabulary

- **Fluidized bed reactor** – 流動層反応器
- **Rotary kiln** – 回転炉
- **Agitator design** – 撹拌機設計
- **Pump cavitation** – ポンプキャビテーション
- **Heat exchanger fouling** – 熱交換器汚れ

Part 4: Answer Key

1. **What issue does Rachel mention with the fluidized bed reactor?**
   ✅ **(A) Uneven airflow distribution**
2. **What does Mark suggest to improve the agitator design?**
   ✅ **(B) Using a variable-speed agitator**
3. **What problem does Rachel identify in the fluid transport system?**
   ✅ **(C) Pump cavitation**
4. **What aspect of the rotary kiln does Mark want to analyze?**
   ✅ **(C) Mechanical stress**