FORCE ON A SINGLE SLAT DURING THE START-UP PROCESS OF A FLUIDIZED BED

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Internal baffles made of multiple slats are widely employed in the industrial fluidized-bed reactors to split bubbles and improve lateral bubble distribution to enhance gas-solids contact, and meanwhile suppress gas/solids back-mixing to optimize their residence time distributions, and ultimately to achieve good product selectivity and higher profitability. However, as fluidized-bed reactors are often required to be operated continuously for years, the long-period reliability of the baffles immersed in bed is also an important issue. Therefore, detailed information of forces acting on the baffles under different operating conditions is very important for their proper structure and strength design. During our past cold model experiment, we once found by chance that a steel probe with OD 20 mm was bent in a fluidized bed of ID 800 mm during the start-up process of the bed. This indicates a high short-term force and a potential danger during the start-up period of the bed, e.g. when sudden power-down or stopping of the blower happens, that may impair the reliability of immersed baffles in industrial fluidized reactors.

In this study, we investigated the force acting on a tested slat during the start-up process of a fluidized bed systematically. The experiment was carried out in a cold model fluidized bed with a square cross section of 300 mm×300 mm. The solids material in the fluidized bed was silica sand particles belonging to typical Geldart B particles. A horizontal slat of 50 mm (height) ×300 mm (width) ×2 mm (thickness) was immersed in the bed during tests. The force acting on the slat was measured by adhering two strain gauges on the surface of both ends of the slat. The influencing factors considered in this study included superficial gas velocity, inclination angle and installation height of the slat.

The experimental results showed that the typical stress signal obtained as the process of a fluidized bed start-up is an impulse with a high magnitude and the duration time is in the range of 0.5~1 s. Besides, the peak value of the start-up pulses is about three times higher than the stress pulses during normal fluidization status, as shown in Figure 2. The peak value of the start-up pulses is approximately linearly proportional to the superficial gas velocity, except when the slat was installed near the bottom of the bed. The peak value of the start-up pulse is highest when the slat is installed in the middle of the bed. The effect of the inclination angle on the peak value is smaller than the other parameters. When the inclination angle is 0o, there is no observable pulse at any operation conditions, indicating very low force acting on the slat.

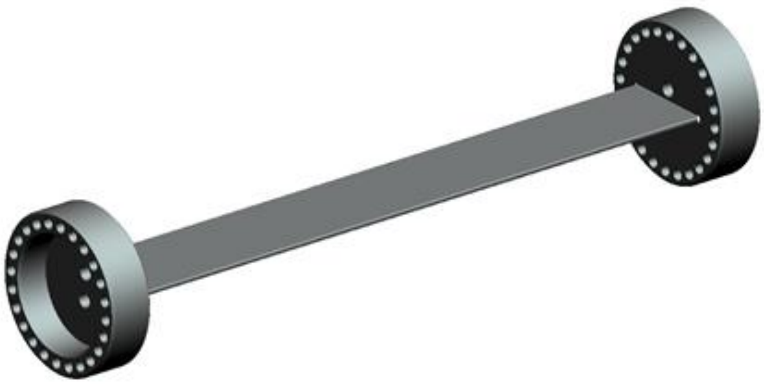

Fig. 1 Schematic of the tested slat

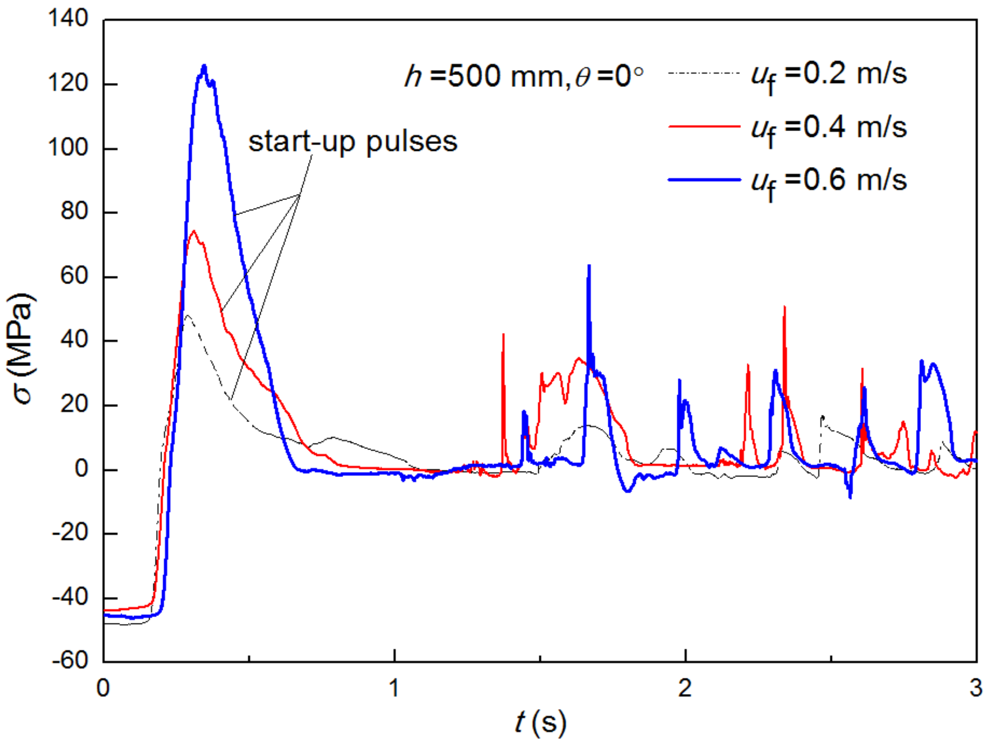

Fig. 2 Typical time-series stress signals of the tested salt during the start-up process of a fluidized bed