FLOW REGIME MAP OF A LIQUID-SOLID MICRO-CIRCULATING FLUIDISED BED

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Solid-liquid micro-fluidised beds (FBs), which are essentially fluidisation of micro-particles in sub-centimetre beds, hold promise of applications in the microfluidics and micro-process technology context. This is mainly due to fluidised particles providing enhancement of mixing, mass and heat transfer under the low Reynolds number flows that dominate in micro-devices. Sometimes particle circulations is required or desirable (e.g. continuous regeneration of a catalyst) for which circulating fluidised beds are ideal, not to mention advantages of better interfacial contacting and reduced backmixing compared to a classical fluidised bed (1). Albeit there are quite a few studies of solid-liquid micro-fluidised beds, we are presenting the first study of micro-circulating fluidised bed.

A transparent micro-circulating fluidised bed was made by micro-machining channels of 1 mm2 square cross section in Perspex as shown in Fig. 1. We used soda-lime glass microparticles and tap water as fluidising medium to study flow regime transition for this micro-circulating fluidised bed. The flow regime map as proposed by Liang et al. (2) was produced for a micro-circulating fluidised bed and is given in Fig. 2. Essentially results are almost the same as for the macroscopic counterparts with the transition to the circulating fluidised regime occurring at velocities, *Ucr*, slightly above the particle terminal velocities, *Ut* (1,2). The reported critical transition velocity is for high enough solid inventories (above 10% of the system volume) where this transition velocity is constant, while for lower solid inventories it is bigger as in previous experiments (1,2). While the minimum fluidization velocity, *Umf*, is influenced by adhesion forces and wall effects (3), there is a weak increase in the normalized critical transition velocity for circulating regime, *Ucr*/*Ut*, with an increase of particle diameter (not shown here). This may be due to the wall effects but more studies are needed to elucidate this further.

REFERENCES

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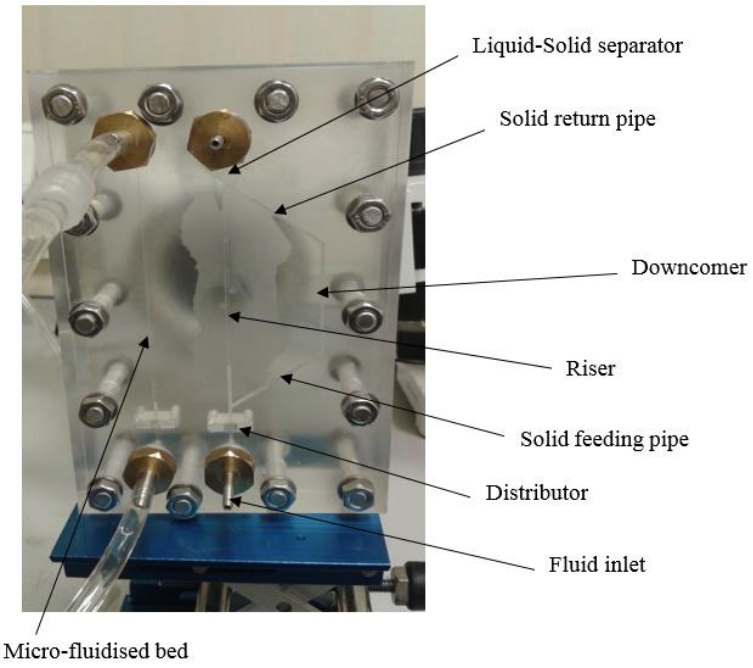

Figure 1.Photograph of the micro-FB on the left hand side and micro-circulating FB on the right hand side.

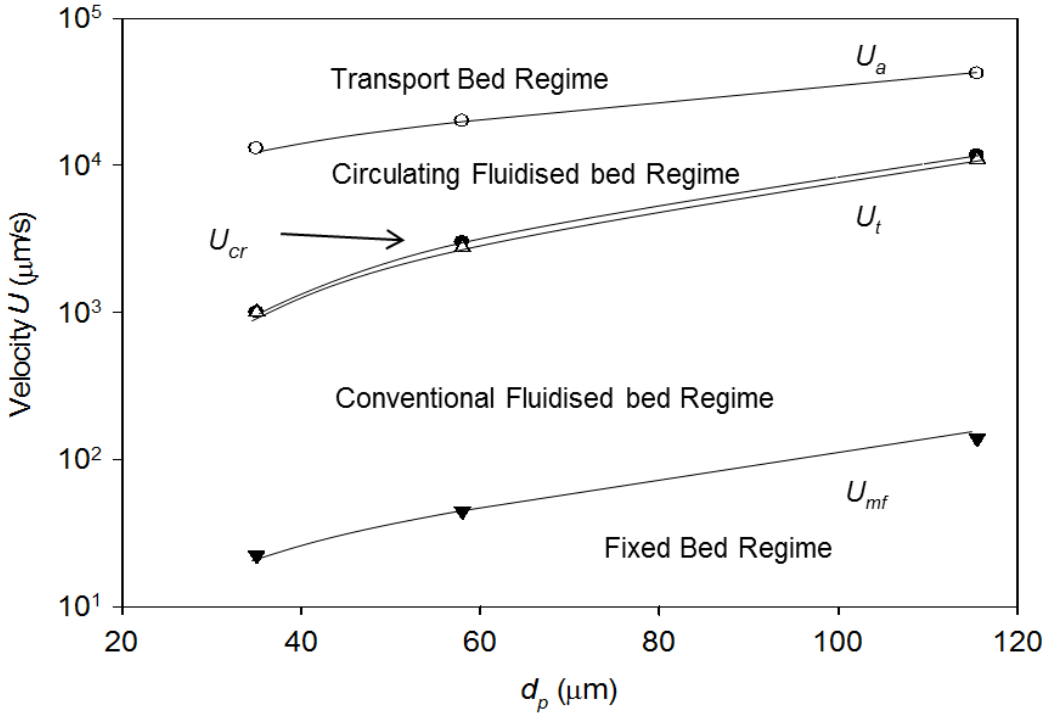

Figure 2. Flow regime map of glass micro-particles in liquid-solid micro-circulating fluidised bed.