



Figure 5.12 Micro-mixedness ratio α versus superficial gas velocity: $U_{LS} = 0.030915 \text{ m s}^{-1}$, the superficial liquid velocity used in the crystallizer with coaxial mixing of hot solution with cold liquid; $U_{LS} = 0.015457 \text{ m s}^{-1}$, the superficial liquid velocity used in the crystallizer with radial mixing of hot solution with cold liquid; Reynolds number $Re_L < 2100$.

restricted to satisfy $Re_L < 2100$. Note that the value of α is high even for small values of U_{GS} . The corresponding values of the segregation X_s indicate almost perfect mixing, as X_s is below 0.01 for the range of conditions reported in the continuous crystallizer.

5.4 Controlled Crystal Growth in Slugs with Temperature Zones

When the size distribution of product crystals is not satisfactory, there are ways to adjust the distribution (to some extent) during the growth stage. For a compound with temperature-dependent solubility, spatially varying temperature profiles can be applied. The temperature zones along the length of the tubular crystallizer were set with tubing submerged in heat baths² or heat exchangers.³²

5.4.1 Heat Baths for T Zones

In order to narrow the size distribution and increase average size (*e.g.*, for faster filtration), temperature cycles were applied, with fast heating followed by slower cooling, to dissolve smaller crystals and grow on larger crystals (Figure 5.13).² Even with uncontrolled nucleation (*e.g.*, cooling in laminar flow), temperature cycles based on two heat baths (*e.g.*, using peristaltic pumps and Proportional-Integral controllers²) effectively narrowed the final product crystal size distribution and reduced aggregation.