Interfacial area and oxygen transfer

• Factors affecting the interfacial area
  – Effect of bubble size
  – Impeller design and stirrer speed
  – Flooded impeller
  – Sparger design
  – Detergents and antiforms
  – Gas hold up
  – Draft tubes
Factors affecting the interfacial area

• Increasing the interfacial area
  – increases the value of $k_L a$
  – increases the oxygen transfer rate

• The interfacial area is determined by
  the
  – aeration rate
  – bubble diameter
Effect of bubble size

• bubble size plays a major role in determining the total interfacial area.

• The smaller the bubble size the larger the interfacial area.

• But, an average bubble size which is too small can have detrimental effects on the oxygen transfer rate.
• Bubble or globule size is determined by the

- presence of surface active agents such as antifoams and oils (This is covered more in detail in the next chapter)

- characteristics of the agitation system
• Another mechanism is to decrease the size of the globule or bubble. The smaller the object is its larger surface area to volume ratio.
The smaller the size of the bubble or globule, then the larger will be the surface area (per unit volume) available for mass transfer.
Impeller design and stirrer speed

• Impellers designed for the maximization of oxygen transfer rates typically produce high shear conditions.

• The high shear conditions are used to reduce the bubble size.
Impellers create high shear conditions

Shear forces break apart bubbles and globules
• One such impeller is the Rushton turbine.
• Shear rates increase with the stirrer speed or the impeller tip speed

Eddies form in the wake of the impeller blades and generate a high shear environment