Surface-based solid-liquid separations involving a second liquid phase

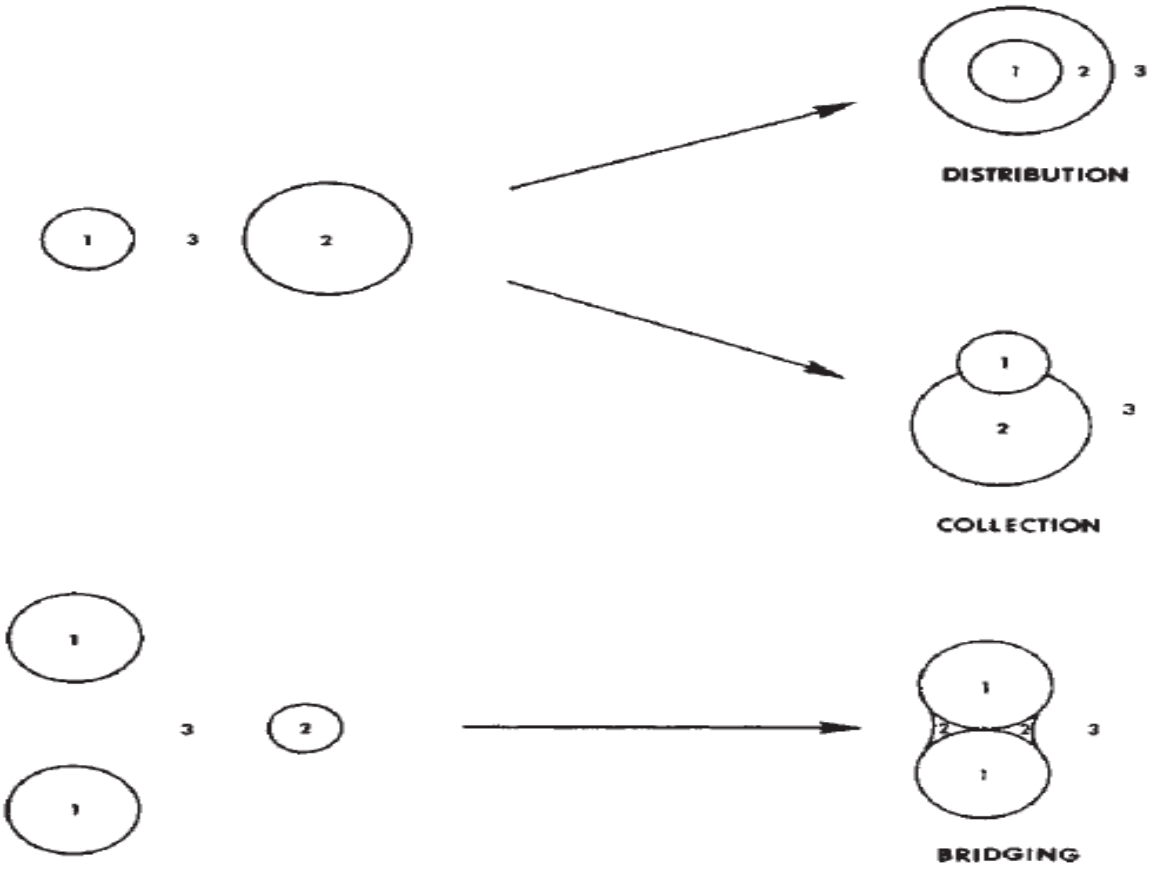
Process Concept:

Three potential surface-based regimes of separation exist when a second, immiscible liquid phase is added to another, solids-containing liquid in order to effect the removal of solids. These regimes are:

1. Distribution of the solids into the bulk second liquid phase
2. Collection of the solids at the liquid-liquid interface
3. Bridging or clumping of the solids by the added fluid in order to form an agglomerate followed by settling or filtration

These separation techniques should find particular application in systems containing fine particles. The surface chemical differences involved among these separation regimes are only a matter of degree;

i.e., all three regimes require the wetting of the solid by the second liquid phase. The addition of a surface-active agent is sometimes needed in order to achieve the required solids wettability. In spite of this similarity, applied processing (equipment configuration, operating conditions, etc.) can vary widely. Collection at the interface would normally be treated as a flotation process distribution to the bulk liquid as a liquid-liquid extraction analog, and particle bridging as a settling (sedimentation) or filtration process.



Regimes of separation in a liquid-solid-liquid system.Phase 1 =Particle; Phase 2 = Liquid (dispersed); Phase 3 = liquid (Continuous)

Even though surface-property-based liquid-solid-liquid separation techniques have yet to be widely used in significant industrial applications, several studies which demonstrate their effectiveness have appeared in literature.

has extensively used particle distribution to fractionate mixtures of biological products. In order to demonstrate the versatility of particle distribution, he has cited the example shown in Table. The feed mixture consisted of polystyrene particles, red blood cells, starch, and cellulose. Liquid-liquid particle distribution has also been studied by using mineral-matter particles (average diameter = 5.5 mm) extracted from a coal liquid as the solid in a xylene-water system. By using surface-active agents in order to enhance the water wettability of the solid particles, recoveries of better than 95 percent of the particles to the water phase were observed. All particles remained in the xylene when no surfactant was added.

TABLE Separations of Particles between Two Phases

System	Top phase	Bottom phase
Polyethylene glycol/ salt	Polystyrene	All others
PEG/ Dextran; 20,000 MW	Algae	All others
PEG/ Dextran; 200,000 MW	Red cells	All others
Methyl cellulose/ Dextran	Cellulose particles	Starch

Particle collection at a liquid-liquid interface is a particularly favorable separation process when applied to fine-particle systems.