What is ‘Oswald ripening’ and how does it affect the particle size distribution?

It is a phenomenon exhibited by colloidal dispersions and suspensions with polydisperse particle size distribution. With progress of time, the large particles in the dispersion further grow in their size at the expense of the finer particles. In effect, there is a gradual disappearance at the finer end of particle size distribution and gain at the coarse end.

As we have seen earlier, the chemical potential of the fine particles is far higher than the larger particles. This increases the solubility of fine particles in their immediate vicinity while the solubility around larger particles is lower. This gives rise to a gradient with the high solute concentration around small particles to the low concentration around the large particles. This causes diffusion of the dissolved mass from around the small particles towards the larger ones. Since the concentration around large particles thus exceeds the saturation limit, there is a deposition of the mass on the large particle leading to its growth. This process continues until the fine particles completely disappear and size distribution becomes coarser. The coarse particles, of course, are more prone to sedimentation.
This phenomenon of coarsening of particles is commonly experienced during the digestion period in precipitation reactions and emulsion polymerizations.

Following Figure schematically depicts the phenomenon of ‘Ostwald ripening’:

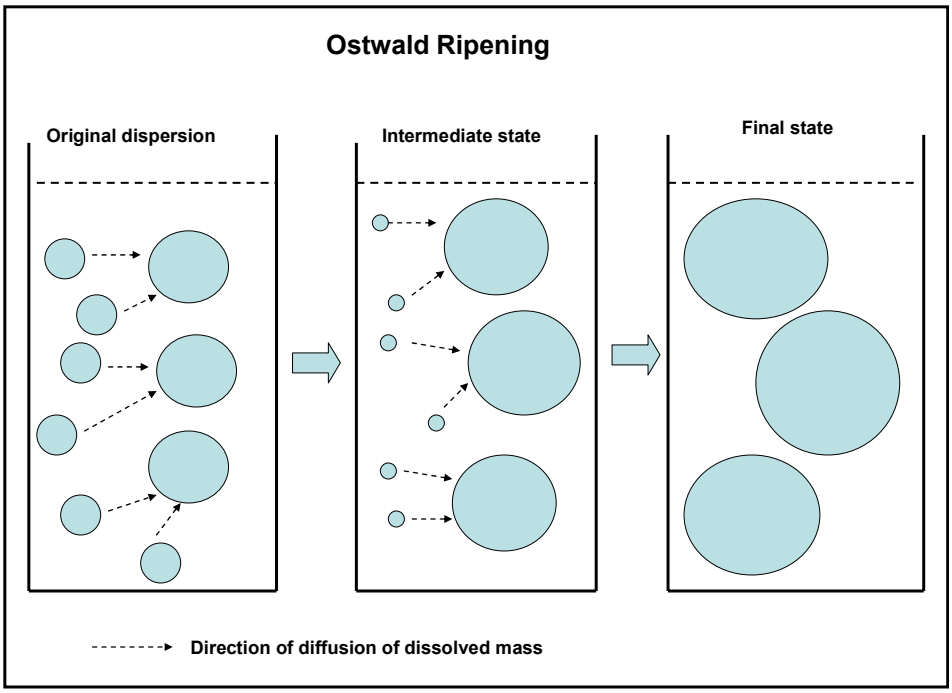

Figure: Ostwald ripening leading to coarse particles on keeping

Understanding of Ostwald ripening makes us aware of the following points while working with nanodispersions:

- Destabilization and sedimentation in dispersions can be manifestations of Ostwald ripening.
- Narrow particle size distributions are less susceptible to coarsening.
- Dispersions with broad size distribution have to be well stabilized with large amount of stabilizer to prevent coarsening.