Tech Tips: Surface Tension and DEM

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July 18, 2013, 5:51 am
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How Do You Consider Surface Tension Effects Between Particles When Using DEM?

In STAR-CCM+, we can model the effect of the presence of the liquid film on the surface of DEM particles in the approximation of liquid bridge model.

The capillary force resulting from the surface tension and the pressure difference inside the liquid bridge has known dependence on the wetting angle, liquid surface tension, particle size, etc.

If one assumes particular shape of liquid bridge, the solution of Laplace-Young equation provides the solution for hydrostatic pressure within liquid bridge. This gives the analytical solution for the maximum force needed to separate two particles connected with liquid bridge (lots of literature is available on this, including using liquid bridge model with DEM). Now, you just need to equate the liquid bridge force with STAR-CCM+ expression for linear cohesion force and voilà! - obtain the value of STAR-CCM+ cohesion parameter. Using cohesion model this way should account for the surface tension effect on the bulk flow of wet grains.
The other assumptions in this approach include:

- The total amount of liquid in the system is perfectly mixed throughout the entire particle bed: each liquid bridge has the same amount of liquid
- Liquid bridge is formed when two particles (or particle and wall) come in contact
- Capillary force acts only in the normal direction

Do you have a question for Dr. Mesh? Ask me a question below and it may be our next featured Tech Tip!

Here's a schematic representation
of liquid bridge

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