Slurry Pipeline Flows:
Coarse Behaviour From Some Otherwise Fine Particles

R. Sean Sanders[1] and Randall G. Gillies[2]

[1] NSERC Industrial Research Chair in Pipeline Transport Processes
Dept. of Chemical and Materials Engineering, University of Alberta
Edmonton AB Canada

[2] Distinguished Engineer
Saskatchewan Research Council, Pipe Flow Technology Centre
Saskatoon SK Canada

ABSTRACT:

The pipeline transport of particulate solids in a liquid (aka. slurry transport) is a critical component of many industrial processes. Historically, the particle size has been viewed as the input parameter of primary importance: if the particles are "fine", then the slurry is classified as a "homogeneous" mixture and can be assumed to behave as a single-phase fluid, whose density and viscosity (or more appropriately, *rheology*) is altered by the presence of the particles. If the particles are coarse, then the mixture is considered to be a "settling" or "heterogeneous" slurry.

For a homogeneous slurry, rheology measurements are crucially important; if properly done, pipeline design is rather straightforward using an appropriate fluid model. With heterogeneous slurries, the primary variables of interest are the minimum operating velocity required to prevent the accumulation of particles in the pipeline, which is often referred to as the 'deposition velocity' (V_c), and the pipeline pressure drop (dP/dz). The effects of particle properties (size, density, shape), solids concentration, fluid properties (rheology, density) and pipe diameter on the deposition velocity and pressure drop have been studied extensively.

In this presentation, we consider the ways in which particle size is relative, and if considered alone, is particularly misleading. Since the notion of pressure drop is not of direct interest to the mixing community, we focus on parameters that must be considered in concert with particle diameter to predict **deposition velocities** and **time-averaged concentration distributions** in horizontal slurry pipeline flows. We pay specific attention to situations where conventional applications of the coarse-fine paradigm do not hold; where the solids in a mixture have a broad size distribution or are of mixed densities; and where non-Newtonian behaviour can be expected to occur.