Closing talk by Allan Thomas

My first T&S was in 2000 at Wroclaw and I have now attended five T&S conferences and I thank Jerzy for introducing me to T&S. Meeting people over the years from so many different countries has been a wonderful experience for me. I have really enjoyed this particular T&S conference at this fabulous location by the sea and catching up with T&S friends. The 43 papers covered a wide range of topics and ranged from the more theoretical to industrial practice. This range is what makes T&S so valuable in my opinion.

Some suggestions in relation to turbulent flow slurry pipeline research projects.

The natural tendency when selecting a project is to study coarse, narrow size distribution sands in water, which typically flow as a saltating/sliding bed. These slurries have been studied quite extensively. Relevant applications are in dredging, and some fixed slurry pipelines, such as for transporting gravel and coarse coal rejects transport over short distances. However these studies are not relevant to a large proportion of slurry pipelines in which the particles are partly, or wholly, supported by turbulence. For the most efficient pipeline transport the particles must be supported by turbulence. Certainly, long distance slurry pipeline transport is only viable if all particles are supported by turbulence.

The onset of turbulence transport could be studied by testing narrow particle size distribution silica sands within the d50 range of say 0.15 mm to say 0.075 mm, both in water and in higher viscosity Newtonian fluids or clay slurries. An initial investigation into the onset of turbulence suspension does not require large diameter pipes. These fine particle slurries could be studied in small diameter pipes, with diameters for example 25 mm, 50 mm and 75 mm, ideal for limited budget University research. The deposit velocity can also be studied and the 3:1 pipe diameter range will allow scale-up of deposit velocity to larger pipes.

Almost all industrial slurries have a wide particle size distribution and so further research into turbulent support and deposition could be conducted by testing wide size distribution sands or actual tailings, with d50's from say 0.15 mm to say 0.075 mm and top sizes say 0.5 mm to 0.25 mm. Once again this could be investigated in pipe sizes as small as 25 mm to 75 mm.

Some thoughts on research into laminar flow pipelines

Traditionally, mine tailings disposal has involved turbulent flow pumping at relatively low concentrations to tailings dams. The trend now is to thicken to higher concentrations in paste thickeners. This means that laminar flow pumping is increasingly required. In laminar flow, pressure gradients around 1.5 to 2 kPa/m are required to ensure stable laminar flow. However such pressure gradients are often economically unviable. For fine particles lower pressure gradients could be tolerated if we were able to predict the pipeline length before settling occurred. At present there is no accepted means of predicting the pipeline length before settling occurs for a given pipe size, particle size, and pressure gradient. The relationship

between these factors could be conveniently studied in small diameter pipe loops (less than 50 mm) of moderate length, whereas very long lengths are required to study this in large diameter pipes. Once again the small pipe loops will suit University research budgets.

Other possible research topics in laminar flow amenable to small diameter pipe loops are:

- Injection of air to possibly help resuspend settled particles towards the end of the pipeline
- Use of pipe with internal spiral ribs to resuspend particles
- Dilute the slurry periodically to achieve turbulent flow to resuspend settled particles
- Add a viscosity modifier periodically to achieve turbulent flow

Might be my last T&S

Sadly for me, this might be my last T&S. My wife has muscular dystrophy which is slowly getting worse and I might not be able to leave her to attend too many more conferences. I will miss my T&S friends.