Summary

Pneumatic transport of particles in dense phase is increasing. The lower energy consumption (25%) with respect to dilute phase is a big advantage. Designing a dense phase pneumatic transport system is more complicated, due to the discrete behaviour of the flow it is more difficult to find the relation between the pressure loss, the length and diameter of the pipe and the material properties. Various models are developed to calculate the pressure loss.

On the first hand Weber has developed a model, but it is commonly used for dilute phase transport. This model has not been found reliable for dense phase transport. A number of models, which are developed later, are described;

- Konrad
- Mi and Wypych
- Wen and Simons
- Woods, Thorpe and Johnson

Mi and Wypych has developed the most accurate model. The pressure loss can be calculated with an accuracy of ±25%. This model is based on the model of Konrad, only a few parameters like K_W and the ϕ are different. The model of Thorpe e.a. is also based on the model of Konrad. The velocity of particles in the plug is not uniform, as was proven by observation. This is adapted in their model, which makes the calculations more difficult. Only by observation of the flow, this constant could be determined.

Besides the use of analytical models the use of numerical models is increasing. The major problem is the amount of particles in the transport system. DEM (discrete elements method) and CFD (computational fluid dynamics) are used to determine the behaviour of the particles, but not to calculate the whole transport system. Both methods are combined often.

Important material properties are the diameter, the internal friction angle, the wall friction angle, the bulk density, the particle density and the bulk voidage. To compare different materials, the Geldart classification is commonly used.

The material flow could be influenced by bypassing the pipe on the inside or on the outside, by slicing the plugs with an airknife or by a gas injection system. These systems improve the flow and decrease the change of blockades in the pipe, but this is coupled with higher investments.