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CONTINUOUS HANDLING

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INFLUENCE OF THE CHARACTERISTICS OF BULK MATERIALS ON THE DESIGN OF PNEUMATIC HANDLING SYSTEMS

1 - REFERENCES

This document forms part of document FEM 2 581 "Properties of bulk materials" and is associated with document FEM 2 582 "General properties of bulk materials and their symbolization".

Document FEM 2 481 defines methods for measuring the specific characteristics of bulk materials as applicable to pneumatic handling with a view to the optimum design of pneumatic handling systems.

2 - OBJECT AND PURPOSE OF THIS DOCUMENT

The aim of this document is to describe the relationship between the properties of bulk materials and their suitability for pneumatic handling.

3 - GENERAL

Pneumatic handling systems have two major types of operation :

1) Operation with gas speeds higher than the saltation velocity.

2) Operation with gas speeds less than the saltation velocity.

Note 1 : The saltation velocity corresponds to the minimum pressure drop of a two-phase flow in a pipe (lowest ordinate point on the diagram illustrating two-phase flows in the document FEM 2 412 - see fig. 1).

In the first type of operation (continuous phase) there are two major phases :

- the dense phase,
- the dilute phase.

In the second type of operation there are three major phases :

- the pulse phase,
- the slug phase,
- the solid phase.

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The relevant definitions are to be found in the document FEM 2 412 "Glossary of general terms used in pneumatic handling of loose bulk marterials" and more specifically in the diagram illustrating two-phase flows.

Note 2 : It should be noted that this diagram of two-phase flows (see fig. 1) cannot be used as experimental curves : it is only a simplified representation of the various phases in order to situate them in relation to each other depending on the gas speed.

The type of operation (continuous or discontinuous phase, dilute or dense phase) will be selected essentially according to the properties of the bulk materials and duty requierements.

Knowledge of these properties is extremely important since they have a decisive influence on the design and manufacture of pneumatic handling systems :

- selection of the phase,
- selection of components,
- pipe assembling systems, etc.

It is therefore necessary that the user shall disclose to the system manufacturer all the relevant information about the material to be handled of which he is aware, and that he shall also point out any items of information which he considers to be interesting even if his knowledge of them is not complete.

4 - INFLUENCE OF THE CHARACTERISTICS OF BULK MATERIALS

The following text deals in turn with the individual characteristics of bulk materials listed in document FEM 2 582, in the sequence laid down there, with reference to their effects on pneumatic handling.

4.1 Name of the bulk material

The name of the bulk material to be conveyed can serve the specialist as an indication on the properties of the bulk material, particularly if it has been previously handled by pneumatic means or if it has been tested, analysed and measured. In most instances, however, the name of the bulk material does not suffice to know its precise properties, since bulk materials of the same nature can have completely different properties which are determined by the origin of the bulk material, as well as by previous processing, conveying and storage processes.

4.2 Grain size

It is essential to know the grain size spectrum for designing pneumatic handling systems. Their performances will be directly in relation with the size spectrum of the material to be transported.

When a grain size analysis is not available and cannot be carried out, the maximum dimension of the largest lump shall be indicated as the reference values of the grain size.

The dimensions of a lump are the dimensions of the edges of the smallest rectangular parallelepiped in which the lump can be contained, i.e. :

- the length L is the length of the longest edge of the rectangular parallelepiped. It is used as the nominal dimension of the grain size,

- the thickness T is the shortest egde of the parallelepiped,

- the width W is the average length of edge of the parallelepiped.