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CONTINUOUS HANDLING

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INFLUENCE OF THE CHARACTERISTICS OF BULK MATERIALS ON THE DESIGN OF EN-MASSE CONVEYORS/ELEVATORS

1 - REFERENCES

This document is part of the document FEM 2 581 "Characteristics of bulk products" and is associated with document FEM 2 582 "General characteristics of bulk products with regard to their classification and their symbolization".

2 - OBJECT AND PURPOSE OF THIS DOCUMENT

The aim of this document is to show the important aspects of characteristics of the bulk materials to be conveyed when selecting and designing an En-Masse conveyor or elevator.

3 - GENERAL

En-Masse handling is the conveying of loose bulk materials by skeleton flights through an enclosed casing with negligible movement between particles, providing the casing remains adequately filled. The chain and the conveyed material move together and practically at the same speed.

The En-Masse system is applied to continuous movement of loose bulk solids ranging from the finest powders through granular sizes up to small lumpy materials. It provides a compact dust tight totally enclosed transfer system that moves the material without dust creation or appreciable degradation by agitation, from single of multiple inlets to outlets as necessary.

The material transported has to gravitate through inlets and outlets and it must therefore be generally free flowing and able to pass through the machine without adhering excessively to the conveying chain or casing.

Selection of an En-Masse conveyor or elevator must therefore be related to many of the characteristics of the material being handled and, in particular, it's ability to be moved by the skeleton conveying flights and also flow into and out of the casing. It is important to make careful decisions in selecting the speed of movement, conveying flight shape and spacing when determining the machine size for each duty. Conveying flight shape differs considerably between the shape for conveying horizontally and the shape for elevating vertically, which in turn influences consideration of the flow efficiency as the material enters and leaves the machine.

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4 - INFLUENCE OF THE CHARACTERISTICS OF THE BULK MATERIALS

The following text deals in turn with the individual characteristics of the bulk materials used in FEM 2 582 for classifying the bulk materials, in the sequence laid down there, with special reference to their effects on conveying by the En-Masse method.

4.1 - Name of bulk material

The name of the bulk material to be conveyed can serve the specialist as an indication of the properties of the bulk material, particularly if he can call on earlier experience of conveying this bulk material with an En-Masse conveyor. In most instances, however, the name of the bulk material does not suffice to give a precise description of the bulk material, since bulk materials with the same name can have completely different properties determined by the origin of the bulk material, as well as by previous processing, conveying and storage processes, and the conditions for the application in question.

4.2 - Grain size

Knowledge of the full grain size analysis (sieve analysis) of the bulk material to be conveyed is useful, but knowledge of the maximum grain size at least is necessary, since this constitutes a very decisive factor on the suitability of the bulk material for conveying by En-Masse conveyors.

The sieve analysis may also help to show whether the material is fine and likely to fluidise. This is an important aspect when elevating by the En-Masse technique especially if the feed rate is liable to fluctuate considerably.

Conversely, the largest grain size is important when considering the sieve analysis of some granular materials and the maximum dimension must be obtained, as correct clearances between flight and casing may have to be selected to minimize damage to the material if it is friable or to minimize damage to the machine if it is abrasive.

If foreign bodies are present, this must be stated and provision made for extracting them if necessary.

4.3 - Grain shape

Grain shapes of classes (I) to (V) according to document FEM 2 582, are generally well suited to conveying by En-Masse methods with the proviso that the ratio of length to width is not excessive.

Circular or rounded particles are likely to be more free flowing and, because the angle of repose may be very similar to the friction angle of material on a steel plate, more care is needed in the selection of flight design and spacing, particularly when elevating.

Sharp angular particles are more likely to damage the machine if hard and abrasive. Lower chain speeds should then be considered and hard faced chain and casing liners provided in extreme cases.

The grain shape of class (VI) according to FEM 2 582 may be suitable provided that the particle size is small in relation to the size of the machine for example. The

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fibrous springy particles will not flow so readily through the strands of flights yet are cohesive and will therefore convey with greater flight space, but longer inlets and outlets may be needed with lower chain speeds.

4.4 - Angle of repose α

The angle of repose α, (according to FEM 2 582) and flow properties are influenced by cohesiveness. The angle of repose can indicate that different power allowances are needed for different materials. It can be used in determining the valley angles and the motor power for extraction from bulk storage (see also paragraph 4.21 - Friction on the wall and paragraph 4.22 - Internal friction).

4.5 - Tendency to pack (cohesion) - (n)

Tendency to pack may result for instance from the materials own pressure or the nature of particles which tend to cling to each other (cohesion).

Such tendency may alter the material contract grain size and affect the dimensioning of certain components or flow cross sections. Material handling conditions (e.g. material moving effort) may also be altered.

4.6 - Abrasiveness (o)

Particles of angular shape both large or small in grain size can cause erosion of casing surfaces and erode surfaces of the chain and flights. In such cases, wear resistant chains should be chosen and hard wearing plates or replaceable liners fitted to the contact surfaces of the casings. Lower chain speeds should also be adopted.

4.7 - Chemical attack and corrosiveness (p)

Stain resistant steels should be chosen when necessary for the casing walls and special materials or chain connection pin joints should be used to maintain the life and strength of the conveying chain.

4.8 - Mechanical sensitivity (q)

En-Masse movement is well known for it's ability to move friable material through a totally enclosed casing with negligible degradation because the movement is so gentle. If the rate of feed is considerably less than the volumetric capacity of the conveyor or elevator, slippage will occur between the conveyed material and the chain strand and it is therefore important to ensure operation near to full capacity rating to minimize damage to the material. Variable speed drives should be fitted when the equipment has a variable rate.

4.9 - Risk of explosion (r)

It must be established whether the material produces an explosive dust cloud. Even so, the gentle movement obviates risk of any explosion being generated by the conveyor. However, other equipment connected at inlets or outlets could cause an explosion that would be transmitted to the conveyor casing which may then need to be provided with relief panels. The Safety Authorities of many

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