FEDERATION EUROPEENNE DE LA MANUTENTION
SECTION II
CONTINUOUS HANDLING

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SPECIFIC CHARACTERISTICS OF BULK MATERIALS AS APPLICABLE WHEN HANDLED MECHANICALLY

1 - REFERENCE

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

According to the mechanical handling system concerned, it could also be useful to refer to the documents which define the influence of the characteristics of bulk materials on the design of special appliances such as :

FEM 2 123 : bucket elevators
FEM 2 124 : troughed belt conveyors
FEM 2 125 : screw conveyors (horizontal or slightly inclined)
FEM 2 126 : en-masse elevators/conveyors
FEM 2 127 : vibrating conveyors
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2 - GENERAL

For the optimal design of a handling appliance it is necessary to know the characteristics of the bulk material or materials to be conveyed. These characteristics can vary according to environmental conditions. Only the characteristics of the bulk materials at the stage at which they are being handled need to be specified.

The subject of this document is the description of those specific characteristics and the external influences which have an effect upon them.

3 - CHARACTERISTICS

3.1 - Name of bulk material

It should define the bulk material as fully as possible and give information on its origin and stage of processing (e.g. raw, run-of-mine, sized, washed, dried). It is advisable to specify the chemical formula, when it is known.

3.2 - Grain size

A complete screen analysis is very useful, but it is not always available. In this case, the most complete description of the range of grain sizes should be indicated, in order to determine with acceptable approximation the maximum and minimum values and the relative proportions of the various lumps (or grains) which form the

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mass to be handled.

The symbolization of grain size is specified in document FEM 2 582 ; it should be noted however that the type of symbolization referring to size analysis (letter A) applies mainly to very fine materials (< 1 mm approximately). With larger grain sizes and according to ISO standard 3435, it is necessary to indicate the (mass) proportion of the lumps ranging from 0,8 d_{max} to d_{max}, d_{max} being the largest possible lump in the material. For instance, quarry run stone 0-200 mm material with approximately 15 % of 160-200 mm will be symbolized as follows : B 0-200 with 15 % of 160-200 mm.

In the case of mechanical handling by vibrating conveyor, for instance it may also be necessary to know the proportion of fine particles.

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

3.3 - Grain shape

It should be defined according to the definitions of document FEM 2 582, e.g. cube, oblong prism, sphere, cylinder, fibre, etc. The user should also make any specific comments on the grain shape.

3.4 - Angle of repose α

The angle of repose α is the angle formed by the horizontal and the slope of a heap of bulk material, when the material falls slowly and regularly from a low height onto a horizontal static surface. The measuring method is defined in document FEM 2 582. It is important to note that :

- the angle of repose can sometimes be decrease, when the material remains stationary for a long time,
- the angle of repose cannot be used as a direct measurement of flow capacity
- this angle can only be used for the estimation of an approximate value of the surcharge angle as defined in ISO 5048, when this angle is not known. The surcharge angle is the angle formed by the horizontal and the tangent to the bulk material equivalent section at its intersection with the moving belt (in the case of belt conveying). It is advisable however to remain cautious on the subject of the relation existing between these angles, especially when the bulk material has unusual flow properties, e.g. a very sticky or a very fluid material.

3.5 - Flow angle β

The flow angle β is the angle formed by the horizontal and the slope surface of a heap of material remaining in a container or on ground, after flowing out of a part of the material stored through a bottom opening.

The value β depends on the geometry and size of the container as well as the characteristics of its bottom opening and on the flow properties of the bulk material. When designing chutes the angle β can be used to determine the minimum inclination necessary for the free flowing of the bulk material.

The angle of repose α and the flow angle β can be used to calculate the total volume and the active volume in heaps and containers.

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The flow angle β is important for the design of the reclaiming equipment.

3.6 - Properties of the material

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

The tendency to pack may result for instance from the material's own pressure or from the nature of the particles which tend to cling together (cohesion).

This property should be mentioned because it is likely to alter the basic grain size and to affect for instance the dimensioning of some components or flow cross sections or handling conditions (e.g. material reclaiming effort).

3.6.2 - Abrasiveness (o)

This is a physical characteristic which enables the material to abrade particles from materials with which it is in contact or to abrade itself during the handling process.

Materials should be described as :

- very abrasive (e.g. coke, slag),
- abrasive (e.g. limestone),
- little abrasive (e.g. grain).

It is important to note however that materials which are often considered slightly abrasive may act in an abrasive manner if handled at a high speed.

3.6.3 - Chemical attack and corrosiveness (p)

If the material is likely to corrode mild steel, as well as other materials such as plastics or rubber, this must be stated.

If the user has experience of materials suitable for efficiently resisting this corrosion, e.g. stainless steel, plastics, etc. he should so advise.

3.6.4 - Mechanical sensitivity (q)

Mechanical sensitivity involves risks of degradation during the handling process and can affect the final size of the material. It should also be noted that the breaking of material lumps may release fine particles, which may alter the general behaviour of the material (clogging problems for instance).

3.6.5 - Risks of explosion (r)

The material may be inherently explosive or have such tendency if excessive dusting takes place during handling, expecially at transfer points (see doc. FEM/VDI 3673).

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