Macawber Mactenn

materials application data & experience

Sugar: Low Velocity Dense-Phase Pneumatic Conveying System

Material Description

There are two general categories of sugar (i) crystal sugar with a reasonably regular granular particle size distribution in the range 2.5 to 1mm and little or no dust and (ii) fine or powdered sugar with a particle range of 250-100m.

Bulk density is in the area of 800-850 kg/m^3 for crystal sugar and 600-700 kg/m^3 for fine sugar.

The sugar material is white in appearance and is free flowing but also hygroscopic (ability to absorb moisture) which subsequently causes coagulation into large lumps and adherence to silo walls with serve damage to the sugar requiring sugar reprocessing or production loss.

Application Data

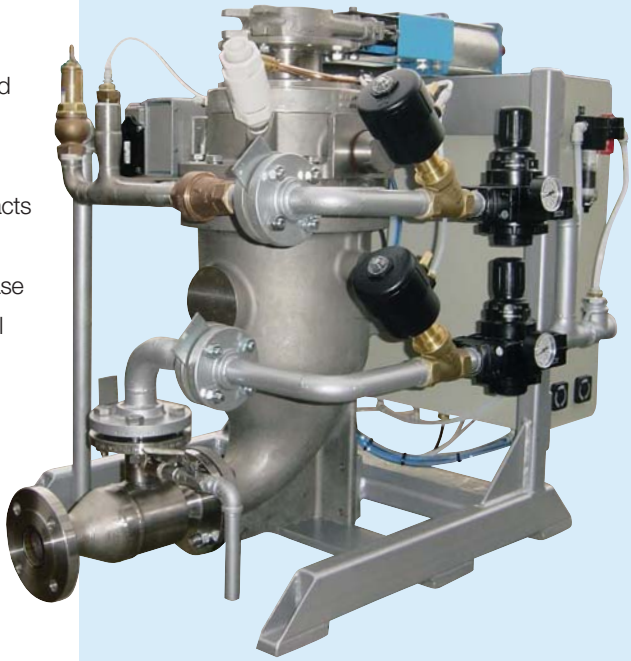
Importance of low-velocity handling of pneumatic conveying.

Crystal sugar is easily damaged. Vigorous pipewall contact and intergranular activity will quickly reduce the crystal to a powder. Average material velocities in excess of 10 metres/second, which is usual in dilute-phase systems (rotary valve feeders) will destroy the crystal. Dilute-phase systems require complete separation of the particles in the air stream to achieve airborne conveying and material velocities in excess of 15 metres/second are required for this method of pneumatic conveying.

The dense-phase pneumatic conveying regime does not require particle separation and high velocity conveying and the particles move at low velocity <3 metres/second as a mass through the pipeline without excessive particle agitation.

Degradation of sugar particles occurs in two ways. Firstly through high velocity impacts in the pipeline, particularly as the sugar passes through bends. Secondly through shearing effects of the sugar dragging along the pipe wall at high velocity. Dilute phase systems cause impact damage through interaction of the particles with the pipe wall and each other. Higher velocity dense phase systems (such as booster type) will cause less impact damage but will also add shearing type degradation.

The best results are found with low velocity plug flow type dense phase systems. The sugar is conveyed in a series of solid plugs, which completely fill the pipeline. Impact breakage is substantially reduced and shearing effects are minimised because only a small proportion of the sugar is actually in contact with the pipe wall.



Importance of dry conveying air.

High velocity dilute-phase conveying systems use low-pressure air of no more than 2 barg. At such low conveying pressure, it is impossible to achieve a suitably low-pressure dew point of the air. Consequently in certain moist ambient conditions moisture will be present in the conveying air, which will be absorbed by the sugar particles. This has the effect of creating large sugar lumps and sugar lumps sticking to the silo and eventually lack of flow from the silo to which the sugar has been conveyed.

Low velocity dense-phase conveying systems use higher conveying pressures of 3-4 barg. At higher conveying pressures a low-pressure dew point is easily and economically achieved by the air source to avoid the possibility of lumps occurring and general agglomerate of the sugar in the silo.

Degradation can also affect moisture content. When sugar particles fracture a proportion of water of crystallisation is released and this is absorbed by the mass of sugar as surface moisture. Severe degradation can also cause moisture problems that are described above.

Effect of high velocity conveying and moisture in the conveying air.

By reducing the particle size of the granular sugar the surface area of the sugar is considerably increased (as it creates powder). Larger particle surface area will more quickly attract moisture from the conveying air.

These conditions have been widely experienced throughout the world where attention to conveying air moisture and particle degradation has not been addressed correctly. Examples of very large sugar silos developing a single mass of coagulated sugar is not unusual.

A further point that is often overlooked is that road or rail tankers unloading to a storage silo using high velocity dilute-phase conveying and ambient air cause moisture to be added to the sugar and the particle size to be reduced and create fines before any subsequent in-plant handling takes place.

Low velocity dense-phase pneumatic conveying and the use of low pressure dew point conveying air is essential to maintaining sugar quality.

Experience

British Sugar. UK. (sugar mill) various grades of crystal sugar.
Domino Sugar. USA. (sugar mill)
Jacobs Suchard. Greece. (candy/confectionary manufacturer) fine sugar.

General

Sugar handling by pneumatic conveying requires the use of the correct technology to avoid substantial losses of both product and equipment investment. Proof of suitable conveying technology cannot be obtained from a simple transfer of a sample through a test facility conveying circuit.

Correct attention must be given to material velocity and fines generation. In addition careful attention must be given to conveying air pressure dew point. An experienced systems provider who has appropriate experience in this specialised application area will correctly address both of these important points.

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