bulk solids handling Volume 1, Number 1, February 1981

Silo Dischargers for Non Free-Flowing Bulk Materials

C. I. W. Hignett, England

Silo-Austragsgeräte für nicht-freifließende Schüttgüter
Déchargeurs de silos pour les matériaux en vrac ne s'écoulant pas librement
Descargadores de silos para sólidos a granel que no fluyen libremente
非流動性粉体材料用サイロ排出装置
非自由流动松散物质的地下卸货装置
أجهزة تفريغ الصوامع المستخدمة في تفريغ المواد السائبة ذات التدفق غير الحر

Silo-Austragsgeräte für nicht-freifließende Schüttgüter

Die Probleme des Austrags von nicht-freifließenden Schüttgütern aus Silos werden umrissen und eine Reihe von mechanischen Austragsvorrichtungen eingehend beschrieben.

Déchargeurs de silos pour les matériaux en vrac ne s'écoulant pas librement

On expose les problèmes associés au vidange des silos de matériaux ne s'écoulant pas librement et on décrit toute une gamme de déchargeurs mécaniques.

Descargadores de silos para sólidos a granel que no fluyen libremente

Se explican a grandes rasgos los problemas vinculados a la descarga de materiales que no fluyen libremente desde los silos, y se describen en detalle varios descargadores mecánicos.

Summary

The problems associated with the discharge of non free-flowing bulk materials from silo storage is outlined and a range of mechanical dischargers are described in detail.

1. Introduction

On the grounds of economy, cylindrical silos provide the most efficient method of storing a wide range of industrial bulk materials. Land use is minimised, spoilage and contamination avoided and stocking levels easily checked with accuracy.

However, for a number of widely used bulk materials, silo storage has not really been practicable in the past because satisfactory discharge arrangements could not be made.

These are the non free-flowing bulk solids which will not discharge by gravity alone and which tend by their nature to stick, clog, cake and bind. The consequence of these properties is bridging and ratholing leading to at best, intermittent and incomplete discharge whether via cone or flat floor. The worst result is the formation of a bridge with either no discharge at all, or sudden breaking of that bridge with consequent overstressing of the silo.

C.I.W. Hignett, Managing Director, Bowerhill Engineering Ltd. Lysander Road, Bowerhill, Melksham, Wiltshire SN12 6SP, England

The correct solution to the problem depends on a number of considerations, but in a wide range of cases mechanical extraction proves to be the most economic. Mechanical extraction also proves more economic than cone discharge where the silo diameter increases to above 6 m owing to the cost of the cone and understructure and the capacity loss below the cone.

The Bowerhill-Parcey range of planetary extractors have been developed over the last ten years to handle non free-flowing materials flow from silos within the diameter range 2 to 20 m. These are now operating successfully worldwide handling materials such as woodchips, sawdust, bread flour, milk powder, soya meal, meat and bone meal, fish meal, green malt, tapioca and lime. Discharge rates vary up to 200 t/h.

Bowerhill-Parcey extrators are available in the following designs:

1. The Planetaire — for silos up to 12 m diameter.
2. The Symetrix — for silos 12 to 20 m diameter.

2. The Planetaire Extractor

The Planetaire extractor (Fig. 1) consists essentially of a triangular beam placed diametrically across the flat bottom

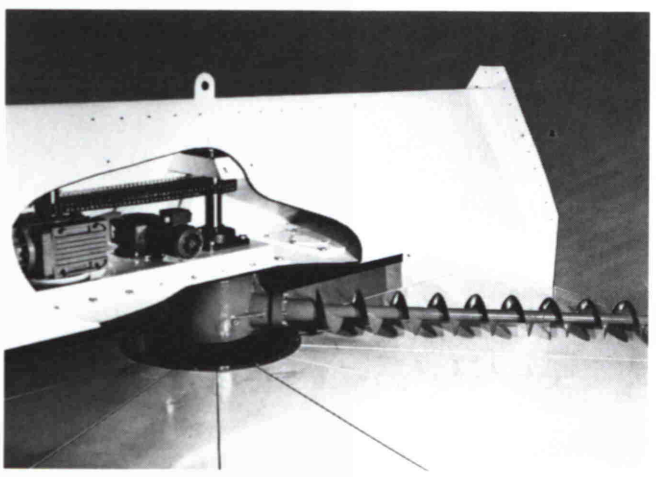

Fig. 1: Bowerhill-Parcey Planetary Extractor

of a cylindrical silo at a small distance above floor level. The interior of the beam contains the drive mechanism to a vertical shaft which is connected to a right angle drive box positioned under the beam on the axis of the silo (Fig. 2).

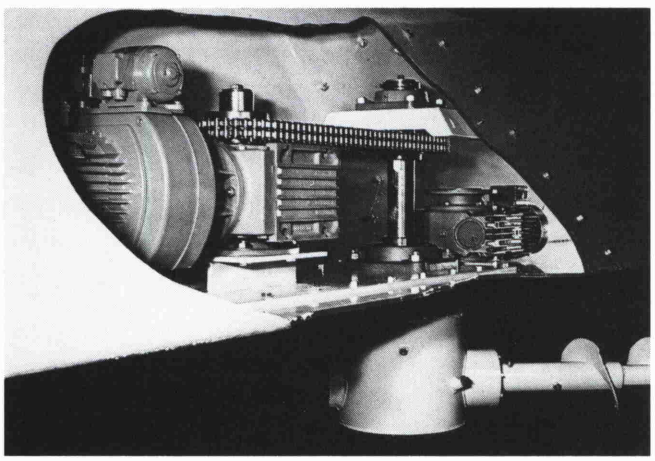

Fig. 2: Positioning of the right angle drive and gearbox

On the horizontal drive from the gearbox a screw is fixed by a rigid coupling. The screw pulls the stored material to a central discharge point. The length of the screw is equal to the radius of the silo.

The operational advantages of this type of silo discharger are as follows:

1. **Simple design consisting of the following items:**
   — Hollow welded steel beam
   — Geared motor
   — Chain drive
   — Right angle drive gearbox
   — A screw and two half cones forming a deflector.
2. **Ease of accessibility:** Because the triangular beam forms an access tunnel, all the mechanical items are accessible, even when the silo is full. One can dismantle and replace all mechanical items via the access tunnel, including the right angle drive and the screw because the bottom of the beam contains access doors for just this purpose. This facility, which is rarely or never used in practice is most important for those users who, quite rightly, require total access in case of breakdown.
3. **Free movement of the screw around the axis of the silo:** A special feature of the right angle gearbox produces a reaction which tends to make the screw 'sweep'. Even when the silo is full the screw carries out its sweeping action and cuts a bed of material which has a thickness equal to its diameter.
4. **Mass flow characteristics:** The combination of the tapering of the screw and its progressive 'flighting' assures an even horizontal discharge without ratholing or bridging and gives first in — first out *mass flow* characteristics.
5. **High percentage live capacity:** Since no cone is required, there is a very considerable gain in the usable volume for a silo of given dimensions when compared with a conical bottomed silo.
6. **No-load condition starting:** The presence of the triangular beam gives rise to the possibility of garaging the screw. This permits the extractor to be started in a no-load condition in the case where products harden in the silo, and this facility also permits the cleaning of the screw.
7. **Evenness of flow:** Evenness of flow from the silo is guaranteed by the screw which is always working in the mass of the stored material bringing the same swept volume to the discharge point on each rotation. Due to the positioning of the deflectors only the material gathered by the screw can reach the discharge point.
8. **Volumetric feeding capabilities:** The planetary extractor can also be used for volumetric feeding. It is possible to modify the rate of output with the aid of a variable drive motor controlled from a panel.
9. **Low Civil Engineering costs:** The Parcey Planetary extractor sits on a simple concrete slab in a flat-bottomed silo minimising the cost of the civil engineering work necessary.

3. The Symetrix Extractor

Above a certain diameter the triangular beam/access tunnel for the planetary extractor, which is a bridge the full width of the silo, reaches a weight and price which is prohibitive. In order to keep the advantages of the planetary system and to avoid the cost of the carrying tunnel, a double screw extractor was developed and patended for silos with diameters in the 12 to 20 m range (Fig. 3).

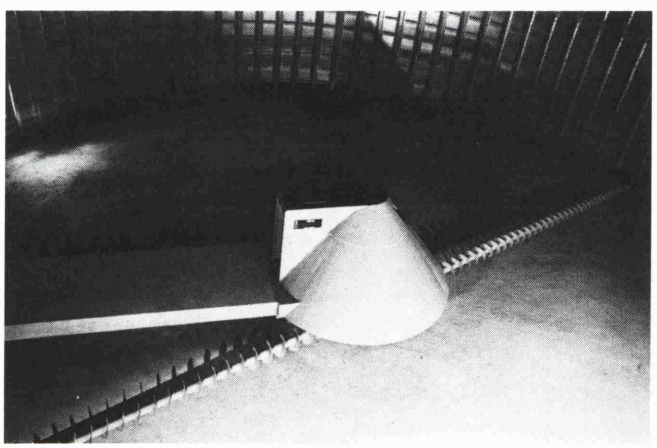

Fig. 3: The Symetrix Extractor

This extractor is made up of a central pivoting box which contains a geared motor or variable drive motor, which drives the shaft to the two contrarotating sweep augers.

The 180° sweeping action is provided by a torque motor which changes direction at the end of each sweep, through the use of proximity switches. The torque motor is attached to the pivoting box by a chain drive. The electrical supply to the motor together with its ventilation system is provided through the hollow bearings which support the pivoting box.

4. Final Comment

Through the use of silo discharges from the Bowerhill-Parcey range, fully automated storage and handling has become possible for a wide range of non free-flowing bulk materials. The capital cost of the silo/discharge system has been considerably reduced in cases where a large diameter steep angle cone was the only possible alternative. Added to this are the benefits of true *mass-flow* and non-segregation.