INTRODUCTION

This article describes how a novel approach was used to solve the problem of receiving and conveying large volumes of bulky material. This particular project is a handling system for alternative fuels. However, the techniques can be applied equally to many bulk materials handling applications, including food products and other bulk materials.

In an article in the October 2005 issue of Solids and Bulk Handling, Dr Harold Wright discussed the issues of handling biofuels. The following illustrates how such problems were overcome for a meat and bone meal fuel handling system.

THE REQUIREMENT

The customer, Lafarge Cement UK Ltd's Aberthaw Cement works, had been given the go-ahead to co-fire Meat and Bone Meal (MBM) as a coal substitute. The logistics of the site dictated that lorries were unable to deliver the MBM adjacent to the coal preparation area of the site.

The agreement with the transport company was that the lorries would be at the material reception area for no more than 20 minutes, including manoeuvring times. Lorry movements were only allowed during office hours and not on Sundays / Bank holidays. Therefore, to allow lorries to return to the road, the system had to be able to receive a complete lorry load in a few minutes and convey it along the site at a much faster rate than the actual consumption rate. Furthermore, the burn rate was specified as a range of throughputs, so the system had to be flexible to handle variations in demand. It also had to cope with lower flow rates as the system was brought on line.

The MBM was specified as being pre-screened to a particular size, but it was foreseen that oversize material or foreign objects would arrive in the delivered material. Therefore, it was a requirement that some coarse screening be included to prevent such objects entering the plant and causing blockages. A material such as MBM is well known for its ability to agglomerate and block chutes.

Whilst the risks of handling this grade of MBM are relatively low, public perception of it is that it is dangerous. Therefore, the plant had to demonstrate 'Best Available Technique' on the installation. Therefore, the MBM had to be contained at all points to ensure that there were no leaks.

The installation is, not only a British first, but probably a world first using this combination of conveying technologies. In order to understand the complete installation, a review of the enabling technologies follows to provide background to the system.

ENABLING TECHNOLOGIES

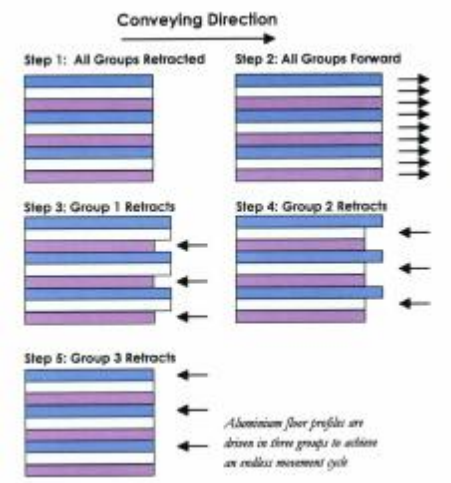
Spirofloor Moving Floor Bunker

Spirofloor Reception Bunker

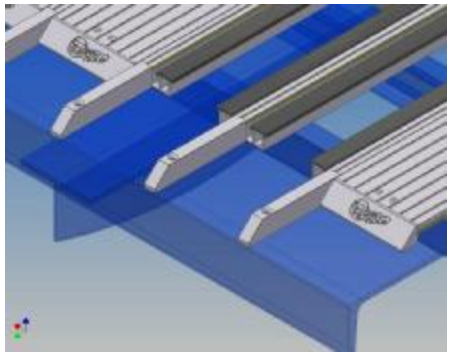
The Spirofloor bunker is a development of Moving Floor principles. This technology is widely used in lorry trailers as an alternative to tippers.

Moving Floor systems generally consist of a series of parallel aluminium planks. They are typically divided into groups of three. By using a repetitive sequence, the floor discharges material.

This sequence of the groups of planks is illustrated in the accompanying diagram. The rate of discharge is controlled by the duration of the sequence. On a lorry trailer, it is possible to discharge a full load in five minutes, whilst also keeping reasonable control of the flow of material.



The TNS floor from Spiro takes this technology several steps further. First of all, it only uses two groups of planks rather than three, but also of importance, is that the planks overlap, preventing leakage of material occurring beneath the floor.



TNS Spirofloor Partial Assembly

The moving floor bunker is built by fitting a moving floor unit at the base and then building up the sides to create the bunker walls. The bunker in this project was designed to hold 45 cubic metres of material i.e. just over one lorry load. It is possible to build systems that can hold several hundred cubic metres. (This throws up the interesting possibility of low height bulk storage for sites where restrictions dictate that a vertical silo cannot be used.) Material moves as a solid mass along the floor and is not disturbed as it moves along. When it reaches the end of the floor it discharges across the complete width of the floor.
MBM is well known for its stickiness and its ability to bridge readily. The TNS Spirofloor was an ideal solution for this as it discharges across a broad width. The unit specified for this application was 2.75m wide by 7.5m

long. This means that the full width of the lorry can be discharged onto the moving floor without having to taper the sides to accommodate a smaller width conveyor.

Whilst the use of moving floor trailers was considered for the project, tipper lorries were used for other reasons. However, there is nothing in the design of the reception system that would prevent moving floor trailers being used in the future.

Renby Active Grid

Spirofloor to Renby Active Grid Transfer Point

In the requirements, it was requested that the received material be check screened to eliminate oversize objects. It was preferred that this be done at the earliest stage in the system to minimise any potential damage to equipment downstream. A classic solution to this would be to fit a rigid mesh into a chute of the system to hold back any foreign objects. This would not work with MBM due to its cohesive nature. Even in its free flowing state, it has the ability to bridge a gap of much greater than 100mm, therefore a 50mm mesh was not an option. There was also insufficient height to permit a traditional vibrating screen, so an alternative solution was required.

A 50mm Renby Active Grid (patent applied for) was fitted to the end of the Spirofloor. This is based upon the patented Renby Grid, which uses material flowing through parts of the grid to clear bridged material elsewhere on the grid. The Renby Active Grid allows the Moving Floor to advance material to the end of the floor, presenting a 2m high by 2.75m wide slice of material which falls onto the grid. The active bars on the grid then allow in spec material to pass as a mass flow column. Oversize off spec material is retained on top of the grid for collection at the end of the delivery cycle. This stage of the system has proved itself several times over by preventing very large objects entering the system thereby eliminating potentially expensive damage / blockages elsewhere in the MBM weighing and storage unit.

Schrage Rohrkettensystem GmbH Tube Chain Conveyors

The final "piece of the jigsaw puzzle" was the Schrage Rohrkettensystem Tube Chain Conveyor. As it was essential that the MBM could not leak anywhere, the system had to be totally enclosed. The 120m route from the reception area to the storage silo involved several different levels, starting below ground level and ending on top of a 25m high storage silo. Upon considering several different routings, the final solution still required that the conveying system pass through a fan house without relocating any existing plant. The conveying run involved several inclines and needed to traverse bends.

Cutaway of Tube Chain Conveyor

The tube chain conveyor conveys material in a steel round tube. Material is 'dragged' through using a series of round disks attached to a substantial chain. By occupying most of the cross sectional area of the tube, large volumes of material can be conveyed in quite compact conveyors.
Material can be conveyed around bends that are set to angles that suit the application, enabling obstructions to be bypassed. As it is totally enclosed, and the material is conveyed at ambient pressure there is no opportunity for material to leak. The MBM could not cause blockages in the tubes as material is conveyed using a positive action throughout. Where required, the system can be ATEX rated, which was important when considering the types of fuel that could be handled by the system.

Silo Discharge Conveyor

The tube chain conveyor can also run full or empty, using fixed or variable speed. This flexibility met the requirement for variable flow rates. The final stage of the conveyors fed a weigh hopper, taking advantage of a further feature of the conveyor which allows it to stop and start with material in the conveyor.

Such a configuration made the Tube Chain Conveyor the ideal conveyor for this application. Furthermore, Schrage Rohrkettensystem GmbH have installed many systems for MBM handling in Europe and could offer extensive experience with MBM and other difficult materials.

FINAL CONFIGURATION OF MBM RECEPTION SYSTEM

The final configuration of the system was as follows:

1. A 45 m^3 Spirofloor TNS reception bunker to receive MBM from tipper lorries.
2. Renby Active Grid to prevent off spec material entering the system.
3. Screw conveyor to regulate flow rate of material from the grid.
4. A series of four Tube Chain Conveyors rated at 40 m^3 / hour to transfer the material from below ground level to the top of the storage silo 120m away.
5. 300 m^3 storage silo by others
6. Two tube chain conveyors to convey MBM at up to 10 m^3 / hour from the silo discharge unit through another two buildings to the MBM weigh feeder unit.

Totally Enclosed Conveying

The complete system handled material on its first day of commissioning and has given reliable operation for the past six months.

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