SMARTENING UP BULK HANDLING

Zico Zeeman, EMT, the Netherlands, explores the move towards more automated methods of bulk handling in the fertilizer industry.

With the present state of global bulk commodity markets and the demand for farmer-specific fertilizer supply, the need for efficient handling and transport of said commodities is continuously stimulating investment around the globe. The decrease in labour-intensive handling – which also requires large, heavy machinery – and its replacement by smart factories that automatically fill or discharge trucks, containers and trains is improving the bottom line of both producers and distributors of fertilizers worldwide.

To see how such machinery is used at various key sites around the world and what steps can be taken to develop the best set-up for each situation, the following article dives deeper into the world of loading and unloading transport vehicles. The filling of bulk material into transport vehicles usually requires high capacity combined with accurate weight information. The discharge side of the story requires accurate distribution of products into their allocated bulk storage areas and effective filling of these areas to ensure the highest possible storage capacity.

Starting on the filling side, various options are available to ensure accurate and speedy filling of the transport vehicle. As mentioned before, the correct weight information is crucial to the filling process. The most important reason is obviously the need to put in the amount of material that has been promised to the end customer. Accurate weighing information will decrease the chance of over-filling (and thus 'giving away' expensive product) or under-filling, with the risk of not delivering the promised amount.

Obtaining the exact weights can be achieved in various ways, which can be divided into three main categories: before filling, during filling and after filling. For some

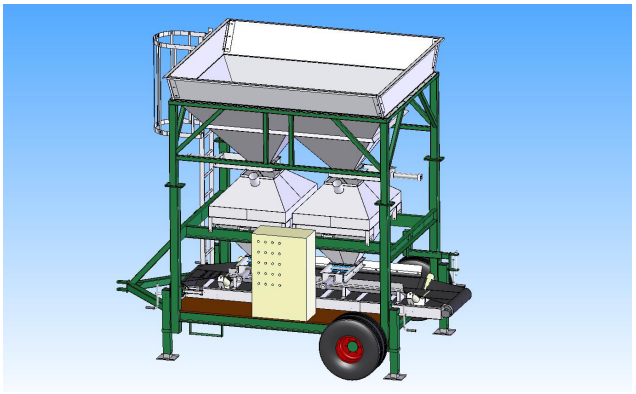

Figure 1. Discontinue weighing.

Figure 2. Horizontal container filler.

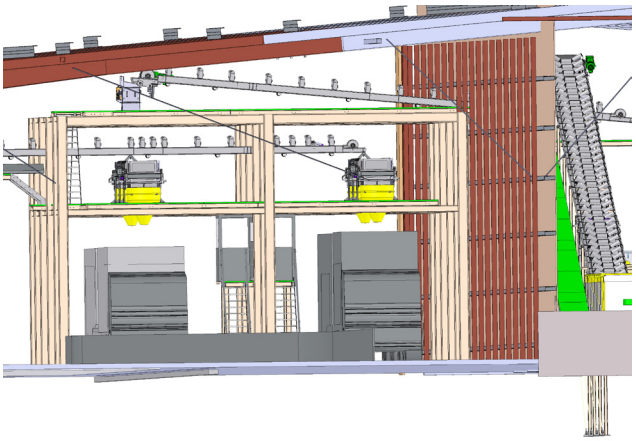

Figure 3. Conveyor truck and trailer filling.

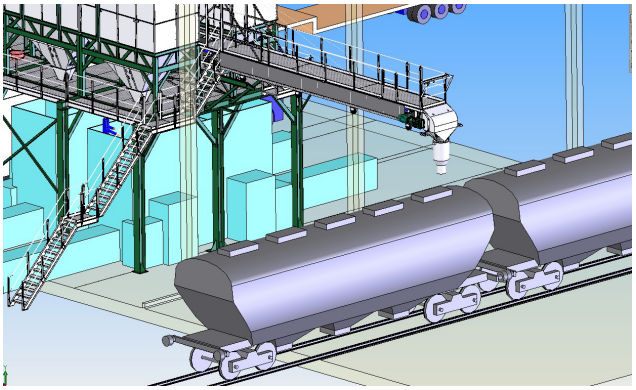

Figure 4. Train wagon filling.

vehicles, such as trains and boats, it is nearly impossible to use the last option due to the high volumes.

Getting accurate weight information before filling is possible in several ways. For example, the material to be filled is produced into a silo on order. In this way the batch can be prepared in the production process and can be filled exactly into the silo. Another option is to set the feeding silo on load cells, deducting the end weight from the start weight of the silo, which will give the amount of material fed from the silo. If a continuous blending system, such as EMT's Weighcont, is used to directly fill the transport vehicle, the blending unit will produce to a predetermined weight and thus will fill the vehicle with exactly the required amount.

Discontinue weighing

Controlling the weight of the bulk product while directly filling the transport vehicles can be more complicated. To solve this question, the Automatic Discontinue Bulk Weigher can be used (Figure 1). The system can be placed in line with a conveyor feeding it and a conveyor removing the discharged material. It is developed with a double weighing system that can be calibrated by local calibration authorities. The system is produced in such a way that it is easily replaceable with a forklift or loader on the facility or can be transported on a truck to another location. The machine continuously uses a batch type weighing, where one scale is filled and registers the weight while the other is discharging. In this way, the exact flow of the bulk product is recorded. This machine can be produced in various speeds of up to 500 m^3/hr.

Drive over weigh bridge

The weight control after filling is usually carried out by driving over a weighing platform. This is only reserved for containers or trucks and requires the empty vehicle to weigh before filling and to weigh again after being filled up; the difference between the two is the total weight of the product.

Horizontal container filling

To fill the different vehicles with bulk product, a series of different options are available, mostly dependent on the type of transport used. To fill bulk containers with product without damaging the granules, a horizontal container filler can be used (Figure 2). In this set-up, the flow of material is either controlled before filling or can be controlled during filling by placing the truck on a weighing scale. The horizontal container filler is a moving transport conveyor that enters the container horizontally; by moving left and right and backwards it can fill the container to up to 95% of the possible volume.

Conveyor truck and trailer filling

Another type of transport used for bulk materials is the open top truck and trailer. These trucks can be easily filled from the top by driving underneath the filling mouth. Another possibility is to use movable conveyors to fill the truck and/or trailer while the truck is standing still (Figure 3). The driver can then control the movement of the conveyor to ensure that the product is evenly distributed into the truck and trailer.

Train wagon filling

For a project in Mexico a combination of a blending line and a truck and train filling line was created. In this machine, a

300 tph capacity granular fertilizer blending line with coating options was installed. The weight control of the blending line controls the exact weight of the product to be filled. The line can transport the material to five storage hoppers of 40 t each, from which bulk trucks can be filled. Another option is to transport the material onto a train loading conveyor placed on wheels so that it can be positioned above the train track just outside of the warehouse. The blending unit can produce the required amount per train wagon, and with only one handling of the front loader the material is blended, coated and filled into the correct train wagon (Figure 4).

Storage options

After the bulk material is ready for transport the vehicles will move to their allocated destinations. On arrival, the same bulk material has to be removed from the vehicles to the storage area. This can be silos but in many cases can also be direct bulk storage on the floor of a warehouse. The storage bins can be divided by walls, which are often made from concrete Lego blocks in order to give future flexibility for the warehouse layout. To easily fill the warehouse with material from the trucks or trailers, tipping trucks or trucks with tipping beds for the containers are mostly used.

Tipping truck discharging

In this process, a truck tips the material backwards into a pit in the floor. A hopper that guides the material to one discharging point is installed in the pit (Figure 5). The size of the hopper can vary, but needs to be at least the width of the widest trailer/truck so the doors can be opened to discharge the material. A large pit gives more time for trucks to drive away and a new truck to be repositioned while the pit is being emptied by the conveyor. From the conveyor, the materials are moved by elevators or conveyors towards the warehouse filling unit.

Train discharge units

To discharge train wagons, longer shaped pits with train tracks through the middle are used. Due to the height required, these pits do not normally lead to one cone, but have several cones to lead to the control conveyor or other transporting machine along the bottom of the pit. The train pulls the wagon above the pit and the bomb doors at the bottom of the wagon are opened to discharge the fertilizer into the pit. The conveyor pulls the fertilizer from the pit and discharges it towards the warehouse filling unit (Figure 6).

Warehouse filling by shuttle conveyor

The warehouse filling unit can have various set-ups, depending on the required filling ratio and the warehouse specifications. A simple set-up would consist of one shuttle conveyor on wheels that can run in two directions. The rail on which the conveyor is positioned can hang from the roof structure or can be supported from the box walls. The conveyor can be moved over the boxes and can discharge on both ends of the conveyor. In this way, nearly all boxes can be filled over the width of the box. The piles will be reversed V-shaped piles. As an example, Figure 7 shows a drawing of a warehouse filling system installed at a fertilizer blender and distributor's facility in Norway.

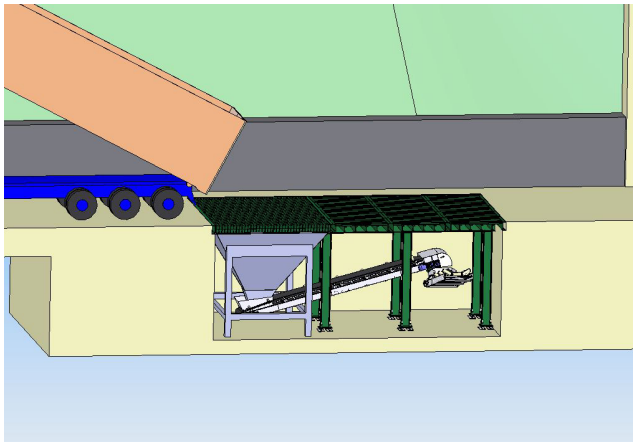

Figure 5. Tipping truck discharging.

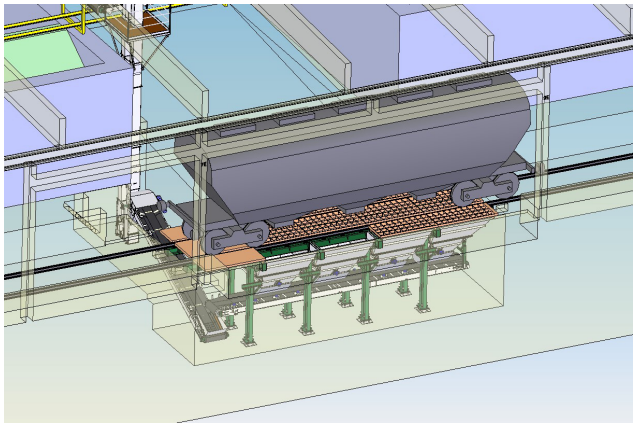

Figure 6. Train discharge units.

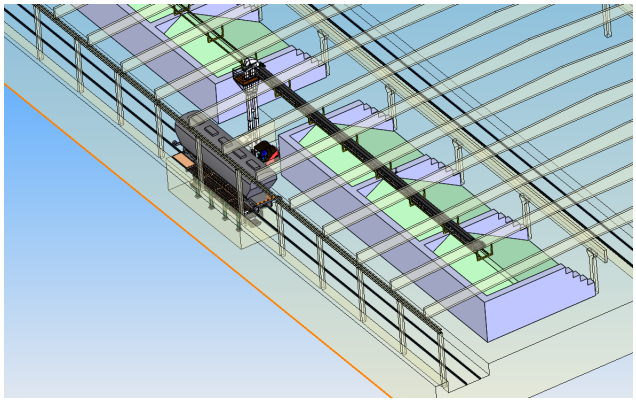

Figure 7. Warehouse filling by shuttle conveyor.

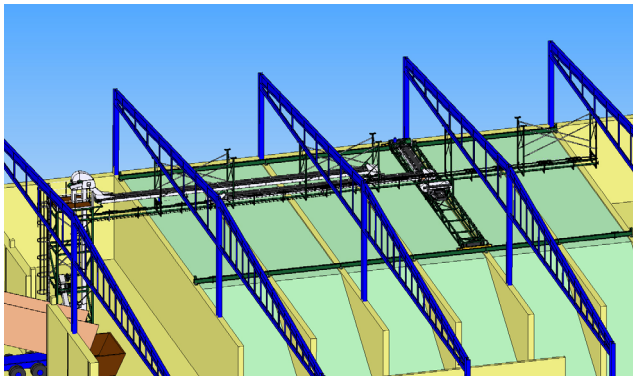

Figure 8. Warehouse filling by distributor conveyor.

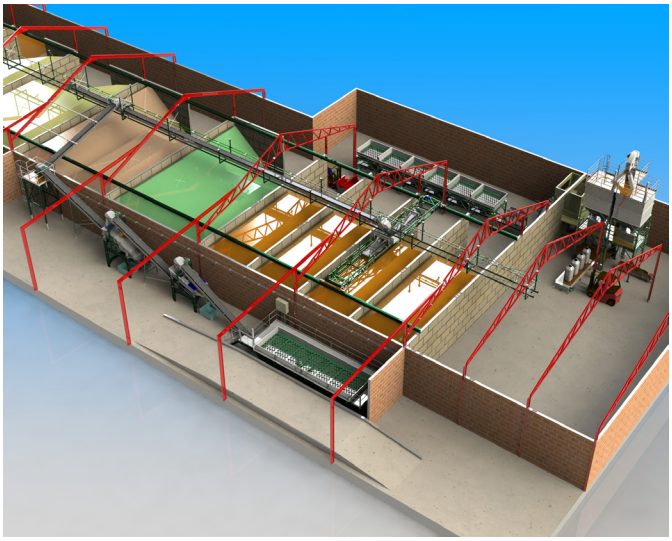

Figure 9. Truck intake and warehouse filling with distribution conveyor combined.

Warehouse filling by distributor conveyor

A more complicated set-up that gives a better distribution of the fertilizer over the boxes, and thus a higher storage capacity to floor area ratio, is the warehouse filling system with a distribution conveyor. In this set-up, the central shuttle conveyor on wheels will remain to get the fertilizer above the correct bay. However, underneath the end of the conveyor a second distribution conveyor can be positioned, which can move left and right in its frame. The distribution conveyor can run in both directions and discharge on both the left and right side. This distribution conveyor can be used to fill the box completely square. Figure 8 shows an example of this system that was produced for a fertilizer blending and bagging facility in Algeria. Figure 9 shows an example of a truck intake and warehouse filling with distribution conveyor combined.

Engineering and construction

EMT's combination of blending, bagging and bulk handling lines are engineered and constructed in-house. All machines are pre-assembled and tested in the company's factory. The machines are all engineered to make them fit into a container or truck/trailer, allowing for easy transport to the customer. Installation is carried out by a supervisor from the company, with the help of the customer's technicians. The whole machine set-up is then a turnkey set-up.

Conclusion

In conclusion, the options available for efficient handling of bulk product are plenty, and largely dependent on the type of transport and the existing facilities.

The most important part of setting up a new handling facility is selecting a good partner that can optimise product flow and offer multiple options, so that together the facility operator and provider can make an educated decision upon the best solution for the operator's particular situation. WF