Zico Zeeman, EMT, The Netherlands, examines the factors that should be considered when choosing systems and equipment for warehouse filling, blending, and bagging.

For every company working with fertilizers (or bulk products in general) one of its major points of attention will be its handling capacities of incoming, internal, and outgoing product streams. Various factors influence the decisions which need to be made in this field. Apart from the obvious capital expenses of certain solutions, other factors can have a bigger influence. This article will explore some of these factors and explain a variety of technical solutions in more detail.

When looking at the intake of products, external factors, such as the country's infrastructure and the easiest ways to transport the materials, play an important role. For example, when there is a railroad or waterway available with direct connection to major fertilizer suppliers, this may be a good opportunity to suppress transport costs.

When looking at the internal handling of raw material feeding to a blending installation, an important choice is the type of storage to be used. Factors influencing this decision, among others, include the humidity of the area, the type of fertilizers used, the warehouse structure, and the floor. Can all raw materials be stored on the floor in bulk bays? If so, then a bulk intake system with distribution conveyors may prove to be the best solution to receive the materials. A front loader or forklift with a dumping bucket is then the easiest way to get the materials to the blender.

When storage is done in either small bags or flexible intermediate bulk container (FIBC) bags, the loading of the blending unit can either be done directly from the bags, or may require an inbetween storage of bulk. The choice between these two solutions is also dependent on the type of blender which is installed.

The handling of outgoing products is again dependent on external factors. What type of transport is possible to get the product to the customer? What type of product can the specific customer segment handle?

In most European countries, farmers have equipment to handle FIBC jumbo bags, making it the preferred choice for suppliers targeting these farmers. However, other target segments may be able to handle bulk or only small bags (private segment). To delve deeper into the various

options available for fertilizer manufacturers, this article will examine the various intake systems with their storage solutions and the types of blenders available to the market.

Bulk intake by tipping truck

Most bulk intake requires some sort of bulk storage solution (unless the bulk product is directly bagged). Bulk is normally stored in a bulk bay on the floor with dividing walls made of wood or concrete: these walls can either be fixed in the warehouse, or can be portable. For new warehouses, it is normally recommended to use portable walls, the advantage being that the setup is not fixed indefinitely but may be changed after new insights or developments require an adjustment of internal logistics.

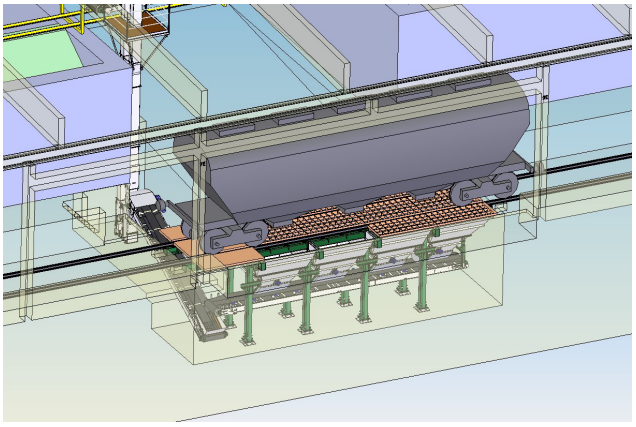

Figure 1. A wagon discharge pit installed at Cemagro, Finland.

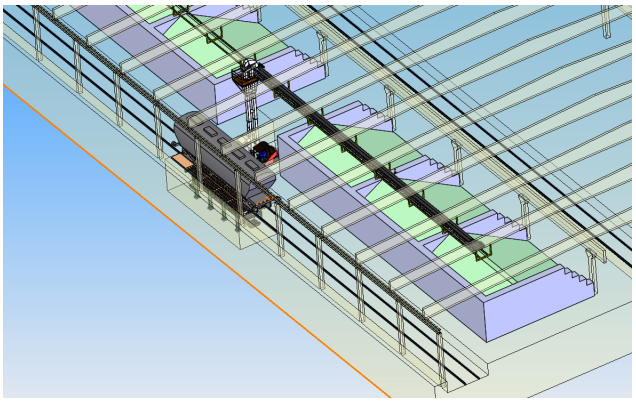

Figure 2. Horizontal shuttle box conveyor and wagon discharge pit installed at Cemagro, Finland.

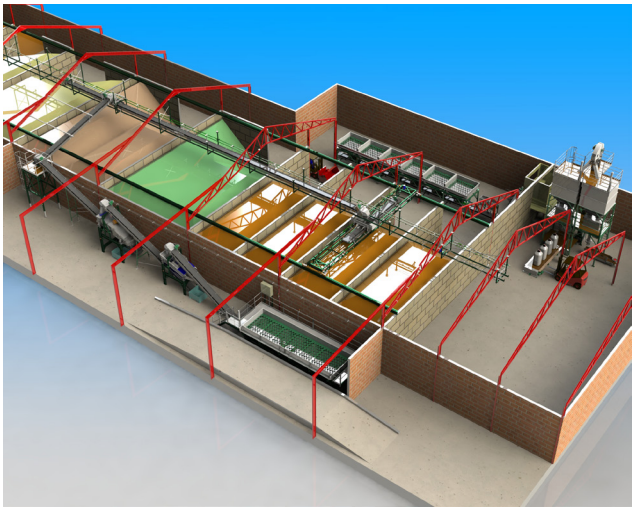

Figure 3. Typical warehouse intake line with fertilizer screens, shuttle, and distribution conveyor, including blending and bagging line.

For truck intake, the truck tips the material backwards or sideways into a pit, which can be in the floor or via a ramp. In the hopper, the material is guided to one discharge point. 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 allows more time for trucks to drive away and for a new truck to be repositioned while the pit is being emptied by the conveyor. From the conveyor, the material is moved by elevators or conveyors towards the warehouse distribution conveyor system.

Train discharge units

To discharge train wagons, longer shaped pits with a train rail through the middle are used. These pits use a conveyor or other transporting machine along the bottom. The train pulls the wagon above the pit and the bomb doors at the bottom 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 1).

Warehouse filling by shuttle conveyor

The warehouse filling unit can be set up in various ways depending on the required filling ratio and the warehouse specifications. A simple setup would comprise of one shuttle conveyor on wheels, running in two directions. The rail on which this 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. This way, nearly all boxes can be filled over the width of the box. The piles will take the form of reversed 'V shaped piles' (Figures 1 and 2).

Warehouse filling by distributor conveyor

A more complicated setup which allows for a better distribution of fertilizer across the boxes, and thus a higher storage capacity to floor area ratio, is the warehouse filling system with a distribution conveyor. In this setup, the central shuttle conveyor on wheels will remain to position the fertilizer above the correct bay. However, underneath the end of the shuttle conveyor, a distribution conveyor can be positioned that can move left and right in its frame. The distribution conveyor can run in both directions and discharge on the left and right sides. This can be used to fill the box completely square.

Types of blending equipment

Various types of blender exist and these can be separated into two specific groups: the batch blenders and the continuous blenders.

Batch blenders work in batches — normally varying from 2 — 16 t per batch. Each batch blender works in cycles, and starts with a filling moment, followed by a blending moment, and then discharging. Capacity normally ranges between 20 — 70 tph. The filling of batch blenders is normally done with a tipping bucket which can dose the required quantity for the specific recipe. Another option is to fill the batch system with weighing hoppers, completing the combination of a batch and continuous system. Since it is more difficult to dose from bags, this could be a good solution for when bags are used as raw materials.

Vertical blender

The blending principle of this type of blender is unique. A conical screw inside the container blends raw materials in a wave motion, while always ensuring an accurate weighing of the product by never suspending any of it. The bottom cone of the blender has a 60° angle to eliminate product build up inside the container. A salem valve on the bottom of the blender, coupled with a sweep on the bottom of the auger, ensures complete cleanout of the blender. The machine can reach a capacity of 60 t/m^3/hr. The complete system is mounted on a digital weighing system.

Horizontal rotating blender

Various branches of the industry have these blenders in operation. The blending process is simple: the turning drum has internal flighting which blends the different raw materials in a folding action. The blend has excellent homogeneity, with little or no degradation or segregation; blending capacity varies from 2 t with a blending capacity of 2 m^3, to 14 t with a capacity of 14 m^3. The weigh hopper has the same capacity as the blender and is mounted on a digital weighing system. The weighing and blending processes are separated in this type of blender.

Paddle blender

Different types of paddle batch blenders can be installed. The paddle blenders are well suited for blending granules but also for blending powdery material like water soluble fertilizers. The twin shaft high speed paddle mixer is ideal for this type of material. Both shafts run in opposite directions at high speeds and can mix the powdery material with ease. These types of blender usually reach 1 – 4 t per batch.

Figure 4. Continuous Weighcont type blender line with weighing hoppers and liquid adding to bagging units.

Continuous blender

Continuous blenders, on the other hand, work continuously and can be filled and discharged at the same time. The material is blended by a blending screw and capacities can reach up to 250 tph.

This blender operates with the most modern technologies. The computer commands and controls the entire weighing and blending process by means of a variable electro system. This guarantees optimum quality.

The system works as follows: the operator fills the hoppers with raw materials by a wheel loader or forklift with a bucket. Each hopper is mounted on a digital weighing system; the stainless-steel dosing conveyors in combination with the digital weighing systems ensure the proper dosing of raw materials. This system has a blending capacity of 20 – 250 t/m^3/hr. The number of hoppers is unlimited. The complete blender is made of stainless steel with a hopper capacity of 4 – 15 t/m^3.

Figure 5. Train wagon discharge in a pit and elevator to warehouse filling conveyor installed at Cemagro, Finland.

Figure 6. Continous Weighcont type blender in the fertilizer warehouse of Cemagro, Finland.

Figure 7. Typical setup of a Shamrock type batch blender with intake hopper and liquid adding unit.

Adding micro nutrients, inhibitors, or additives

Both types of blenders can be used to add micronutrients, inhibitors, or additives to the blend. It is important to know which types of products will be needed to add to the blend in order to increase value to customers. Depending on these, adding a powder adding unit or a liquid adding unit to the blender might be considered.

Intermediate handling

After blending the material, or sometimes before, it might be interesting to condition the fertilizers, depending on the quality of the raw material provided. Screening might be a good option to eliminate dust or large foreign particles to ensure a good quality final homogeneous blend. Another option is to add fertilizer conditioners like lump breakers into the machinery. This can be done for one specific type of fertilizer (for example urea) or for the complete line.

After the material is blended, it is customary to transport it directly to the bagging units. In a setup like this, handling of material is minimised. Different bagging units can be installed behind one blending unit; again this highly depends on the required output. Two types of bagging units can be distinguished: big bag filling units and small bag filling units.

Case study

For a customer in Finland named Cemagro, EMT built a 120 tph train wagon intake and warehouse filling system, complete with a Weighcont continuous blending system and big bag filling line. The system consists of a 10 m long intake hopper in a pit with train rails. The product is discharged in the pit, and through a conveyor and elevator system, is transported to a shuttle conveyor. This conveyor is 40 m long and can distribute the fertilizer across 76 m. Various bulk bays are installed underneath the movable conveyor in which the product is stored.

From these boxes, a frontloader driver picks up the raw material and brings it to the continuous Weighcont blender at the far side of the warehouse. The blender consists of four major weighing hoppers, a micronutrient weighing hopper, and a liquid adding unit.

The system can continuously blend the various products and with an elevator, the product gets discharged into the big bag system. Here, it is weighed before being filled into the FIBC jumbo bags at a speed of 70 tph. The bags get sealed, printed, and then stored directly in the warehouse. From here, they can be loaded into trains or trucks to be taken to the customers of Cemagro.

Conclusions

Even though there are numerous fertilizer handling and blending companies around the world, not one perfect format is available that would be the optimum fit for all warehouses worldwide.

This is mainly due to the various external market differences around the world. However, whether the incoming product is in bags, trucks or boats, and whether the required capacity is 30 or 5000 tpd, it is imperative for fertilizer manufacturers to adjust their intake and handling systems to fit their specific circumstances.

Understanding input and output product flows, internal handling requirements, and the possible technical solutions, will help efficient and future-proof factories to be set up. WF