Introduction

Gallay Systems Ltd specialise in Materials Handling solutions for Primary and Secondary Pharmaceuticals and Healthcare. With extensive experience within the Generics sector, Gallay offer a wide range of technologies and equipment that improve and enhance the efficiency and performance of Solid Dosage Form Plants.

The experience gained in the Generics sector ensures Gallay equipment and technologies are suitable for the very stringent demands of production performance, plant and market flexibility (single/multi product) and of course value.

With world-wide references, Gallay have developed an outstanding reputation for quality and service, to become the clear leader in materials handling technology.

Key technologies and services include:

- Contained Materials Handling Systems
- Powder Handling
- Tablet Handling
- Dispensary Systems
- Container Blending
- Container Washing
- Project Management and Validation

This article details some of the considerations required to specify and select an appropriate materials handling system for a Generics project and gives consideration to the increasing demands in regulatory terms and especially with regard to containment.
Solid Dose Form Materials Handling

Dispensaries

As a key part of any Pharmaceutical processing plant, the dispensing area presents many challenges. In particular, it is important to establish a clear understanding of both existing processes and products, and future requirements as far as possible. Gallay’s approach to some of the key issues for a dispensary within a production based plant can be summarised as follows: -

A dispensary can take many forms: single or multi level, low or high containment levels, commonly incorporating two to four weigh platforms, a weigh hopper, extraction equipment and sieving equipment. The dispensary may also include recipe management software, waste disposal system and a method of handling API.

Excipients and bulk ingredients arrive packaged in various forms, thus requiring differing handling methods. For small volume dispensaries or line dedicated dispensaries with a small batch size, the preferred method may be manual. However, with ever more stringent manual handling regulations, it may be necessary to add automation and mechanical handling to avoid these problems. For larger volume plants and larger batch sizes, it is essential to automate the handling. This is achieved by either simply lifting a pallet with a local stacker truck, or ideally by using a hoist lifter. The advantage of the hoist lifter is its ability to simply handle sacks, drums and bags without the additional difficulties of manoeuvring in what is often a confined area.

Dust exposure is another key consideration. This obviously depends on the types of products, local Health and Safety regulations and dispensary room design. There are several ways to approach this issue, for example as follows.

I. The traditional method is to rely solely on the room air changes and with use of operator protection such as dust masks and air hoods.

II. An alternative approach is to establish an air curtain across the inlet of the weigh hopper. This is a simple but very effective solution provided that the equipment design and extraction levels are properly integrated.

III. Another alternative is use of an extraction hood above the weigh hopper, enabling the operator to dispense ingredients within the extraction zone. This provides additional protection, thereby ensuring a high level of safety, in a cost effective manner.
IV. Extraction booths and laminar flow booths are also often used, sometimes in conjunction with the above solutions, to create an additional airflow away from the operator. This extra protection offers improved flexibility in the working area, although special airflow patterns may be required to ensure safe airflow is achieved around the weigh hopper and any other equipment within the booth.

V. For toxic materials, an isolator may be required, however the number of isolators should be limited due to the comparatively high capital and operating expenses. The use of contained charge vessels can significantly reduce the requirement for isolators, especially when incorporated in the process plant design.

The weigh system typically includes a bench top scale, floor scale and load cells on the dispensing hopper. In addition there may be a weigh frame for ‘check weigh’ purposes. The weigh frame may be located on the same level, or ideally, when charging Intermediate Bulk Containers (IBC), on the floor level below. When filling the IBC on the lower level, it is also possible to integrate the weigh frame into a post hoist to lift and dock at ceiling height, although this can reduce system accuracy.

Sieving is common requirement and must be incorporated in the design of the dispensary to ensure that suitable air flows and dispensary ergonomics are achieved.

The API can be handled in several ways depending on the containment level recommended by the plant Occupational Hygienist. For example, transferring the required quantity of API into a contained charge vessel within an extraction booth or dedicated isolator as mentioned above. This charge vessel, incorporating a Buck® split butterfly valve technology can be manually moved safely around the plant to enabling the API to be safely used at the ‘point of use’. Furthermore, ideally the API can be transferred into a contained charge vessel at the primary production plant, already prepared for dispensing at the point of use, or for contained dosing, negating the need for an isolator.

Recipe management can be achieved in several ways; a paper driven system requiring the operator to record all weigh dispensing operations, a simple recipe display driven and paper based system, or a full SCADA driven system guiding the operator through all key stages ensuring complete control and batch data security in accordance with 21 CFR part 11 – Electronic Signatures and Records. It is essential that a dispensary control system is practical for the operator, e.g. use of bar code scanner with intelligent hand held displays to assist in inventory management, limiting operator intensive tasks and improving production efficiency.

Gallay will normally supply the dispensary system as an integrated package with the specification and design incorporating key issues such as: cleanability, interchangeable weigh hoppers, ease of maintenance, building and utility requirements, and all process requirements.
**Processing**

After the dispensing of the ingredients into an Intermediate Bulk Container (IBC), the IBC can be transferred to the next process step, where the method of IBC discharge will depend on several key factors such as the product characteristics, the facility design and the processes to be undertaken.

The product characteristics have a significant influence on the type and design of IBC and discharge device to be used. Gallay specialise in providing the most advanced technology for transferring and containing powders, granules and tablets. It is essential that the intermediate and active ingredients be tested to establish flow, segregation and handling properties, in order to select the optimum technology for the project.

Where products are known to be difficult to discharge, or susceptible to segregation, then Gallay offer innovative technical solutions such as Vibroflow™, and a full range of technical solutions for varied Occupational Exposure Level (OEL) requirements (10-100 nano g/m³ through to 50 µg/m³ in various technology steps).

Where a plant is to be designed for multi-product use, Gallay often apply their advanced technical solutions to ensure security of outcome, including provision for future unknown products.

The building design has a key influence on the materials flow philosophy. Often existing buildings have limitations in height, number of floors levels and access. These limitations must be recognised as early as possible, to ensure that the Materials Handling system is custom designed to the site requirements. Similarly, it is also essential for the system supplier to be involved at the initial design phase of any new buildings. Key areas of influence can include the number of floors, area classifications, material and process flows and product charging philosophy to the process equipment (described below). In addition, the number of valve operations in each process area must be considered; e.g. these must be limited for contained applications. The process flow can often be improved to minimise the number and type of interfaces between each process step.

Significant project capital cost reductions can sometimes be achieved by enhancing the equipment containment technology (say from 100µg/m³ OEL to typically 5µg/m³ OEL) to reduce facility costs, by reducing the ‘white’ GMP process areas to designated ‘grey’ areas.
Some of the key process areas to be considered at the process equipment and plant design stages are listed as follows:

**Granulation – Addition of API**
With the use of contained charge vessels it is practical to add active ingredients (API) into each process step in a contained yet simple manner. Methods of interfacing with the charge vessels have been established within the **Niro Pharma Systems** group. (Aeromatic-Fielder High Shear Mixers and Fluid Bed Dryers, Collette Ultima ‘One Pot’ Processors, Courtoy Tablet Presses and Gallay Systems).

**Milling – Reducing the Dust Hazard**
System designs incorporating containment valves will limit airborne dust, and may therefore assist in reducing area classifications. It is also possible to improve safety by using the containment valve interlocking features with a nitrogen purge system. Using similar principles it is possible to improve the operational conditions of a Roller Compacter.

**Vacuum Charging – Room Height Restrictions**
Where possible it is best to avoid vacuum transfer because of cleaning, segregation, contamination and dust exposure issues. Where this is not possible, for example where room height constraints prevail, a similar approach to Milling can be taken, by using a contained Vacuum Station. A typical application is charging a tablet compression machine.

**Mixing and Blending – Key process step**
Increased efficiency can be achieved by combining operations, e.g. integration of milling and sieving operations, and the addition of tablettng lubricants using contained charge vessels. Gallay IBC Blending technology is completely contained with the possibility of a technical maintenance area minimising the GMP process area. With the Gallay ‘Prism’ it is possible to improve mixing efficiency whilst maintaining containment, and prevent segregation during discharge using the Vibroflow™.

![Fig 2 Post Hoist Blending](image-url)
Compression, Coating & Capsule Filling – Contained Feeding

Generally there are three main approaches to feeding a tablet press, capsule filler or tablet coater; vacuum filling, direct charging from an IBC using a hoist, or ‘through the floor’ feeding.

Vacuum filling generally suffers from poor dust control and cleaning problems (as mentioned above). Considerably more operator intervention leads to reduced efficiency, and in addition, segregation can often cause quality problems.

Direct charging from an IBC is very effective for several reasons; it is quick and efficient, it limits any segregation, prevents the risk of chute blockages and simplifies any cleaning requirements. This does however require transport of the IBC in and out of the process room. The use of a post hoist (as oppose, for example, to use of a stacker truck) limits risk of damage to the process equipment and enhances operator safety.

Direct charging from either a mezzanine level, or ideally from an upper floor, offers a simple solution for handling an IBC, whilst avoiding the need to enter the process area with the IBC and thereby reducing the process room size. The segregation of powders can be avoided by using Gallay’s Decelerator technology, which is designed to maintain area segregation, CIP or ‘quick strip-down’ for rapid product change over. In addition, the upper floor can be designated a ‘grey’ area. This approach is particularly effective for larger plants with several discharging stations because of reduced overall capital costs, with this benefit compounded by the smaller ‘white’ process area.

Tablet and Capsules Handling

It is arguable whether containment can be reduced once the powders have been compressed into tablets, or after capsule filling or tablet coating. This applies in particular to the IBC valve technology. Consideration should however also be given to the value of the finished pharmaceutical product. Using stainless steel tablet containers significantly increases security, and reduces the risk of damage caused by spillage. The tablet IBC is washed after use in a contained manner. Tubs or plastic containers can contribute to problems with storage, washing and often add to ‘hidden’ operating costs.
When transferring tablets and capsules physical damage must be avoided. As with powders and granules, Gallay’s Decelerators will prevent such problems when feeding through floor levels. For example, discharging after compression when feeding into a tablet coater or packing line.

![Fig 3 Contained Tablet Handling](image)

**Washing Systems**

It critical to establish a cleaning philosophy for any new facility; this will depend on the products, processes and production demands. A multi product plant may look for quick changeover, where product dedicated plants adopt a CIP approach where possible. When handling hazardous or toxic materials CIP may be preferable, but this may also be combined with a contained quick change over solution. The cleaning philosophy is an integrated part of the design of the materials handling system and should not be look at in isolation. It is possible to specify simple yet contained wash systems, ensuring the operator is not at risk during cleaning.

**Automation**

The level of automation for a materials handling system requires careful consideration. Under-specifying automated control can increase operator safety risks, e.g. manually operating a containment valve above a tablet press. Obvious benefits of automation include; improved productivity and reliability (even after allowing for the increased validation requirement), also leading to reduced manning and operating costs.

Stephen Boswell  
Gallay Systems Ltd.  
Telephone: +44 121 765 5800  
E-mail:info@gallaysystems.com  
WWW.NIROPHARMASYSTEMS.COM