

Throughput totalizer

Application note



Supplier:

Bolder automation GmbH
In den Klostergärten 9
D- 65549 Limburg

Telefon: +49-(0)6431-9848-0
Fax: +49-(0)6431-984828
email: info@bolder.eu

1 The economic significance of quantity measurement

The high cost of raw materials, the sometimes even higher cost of disposal, and legal requirements have led to a more conscious handling of natural resources. After the service life of a product has expired, the question arises of how to recycle the raw materials, and there are incentives to use the returned good or recycled material to produce new products.

In industrial production, waste is reduced through improved process management. The waste that do remain are processed directly for reuse, wherever possible. There is an advantage here in keeping the value of the material high by sorting effectively and largely preventing contamination.

Used products from consumer goods such as PET bottles, window profiles, EPS, agricultural films/packageing, etc. are also now recycled. Since the purity of the material is no longer ensured, it only goes into production after extensive processing.

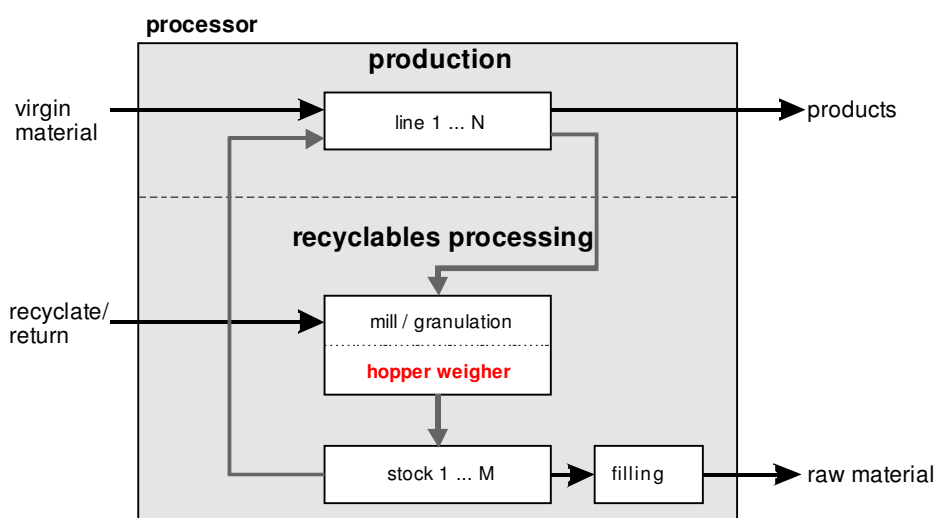


Figure 1: Material flows of a plastics processor

Figure 1 shows the material flows of a production operation. In addition to new materials, returned goods and recycled materials are also used once they have been processed. Excess quantities are processed and resold as scrap if the market allows. The value created here depends on market demand and the current state of order processing. Stock is a key component of planning optimization in the material flow system.

Production planning creates schedules based on the raw materials and quantities available in stock. Incoming quantities from the granulation process or the mill are therefore measured on the hopper weigher and allocated to a stock item. The current inventory is thus known. The automated CTW hopper weigher assumes the task of quantity measurement. It weighs batches and adds up the determined weights to arrive at a total quantity. The central control works with the order administration component of the MES and the ERP system to allocate the product to a stock item.

2 Integrating the hopper weigher into the processing system

The weighing system is part of an overall system consisting of:

- Grinding (mill)
- Preparation (sorting, washing, dust removal, etc.)
- Material conveyance (cyclone, vacuum creation, piping, etc.)
- Stock (silo, big bag, container, etc.)

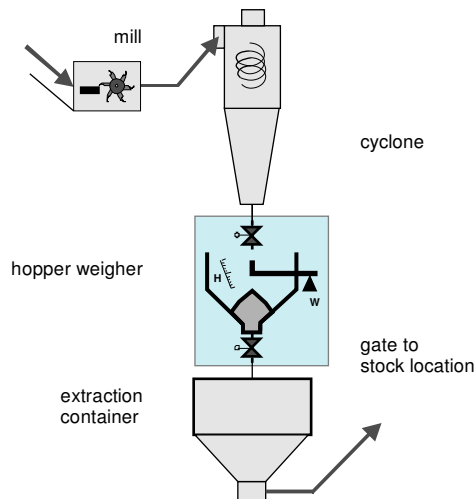


Figure 2: Integrating the hopper weigher into the material flow

As shown in Figure 2, the hopper weigher is loaded with mill material and unloaded into an extraction container after the weight is determined. From there, the material is divided further. This is a completely autarkic process in the sense of an independent hopper weigher. Only the beginning and end of a quantity measurement are specified from outside, so that the results can be referenced to a production order.

3 Sequence

The hopper weigher filling and emptying sequence, along with the associated control of the flaps and valves, is illustrated below.

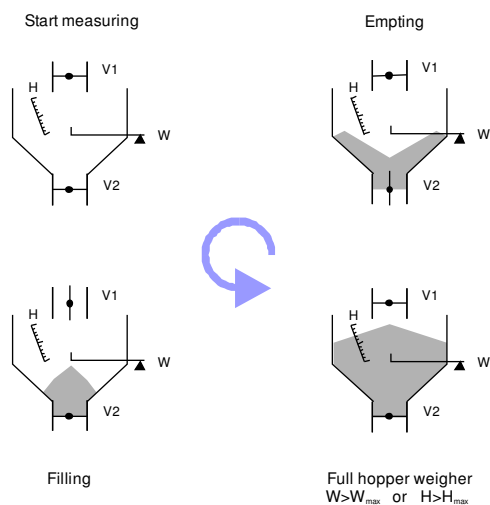


Figure 3: Measuring cycle of the batch weighing process

Measuring starts with an empty hopper and a weight of zero. In status "Measure Full", the weight of the filled material – W_{full} – is determined and the overall quantity is calculated:

$$\text{Quantity (new)} = \text{quantity (old)} + W_{full}$$

The emptying process is coupled to the two integrated flaps that symmetrically create an opening of 300 x 300 mm. Thus even very light or poorly flowing materials can flow out of the 600-x-600-mm hopper.

Valves, metering devices, rotary feeders, or other units can be used to fill the hopper. The unit has a capacity of up to 5 t/h or 12 m³/h. The unit is designed to suit the material according to the following criteria:

- Bulk density of the material
- Filling volume
- Weight measuring range
- Minimum cycle time
- Flow characteristics of the material

The various influences into account during design and the hopper weigher is equipped accordingly.

4 Mechanical design

The hopper weigher is installed in a frame of 1000 x 800 x 800 mm (H x W x D). The frame can be integrated into an overall structure for material feed and removal. In addition, a non-return valve or other feeding systems can be installed on the top.

The level measuring equipment also extends into the hopper weigher from above. The height of the probe can be adjusted so various target heights can be defined.

The control box and all necessary pneumatic elements are positioned on the right side. The remaining surfaces are covered by side walls that can be easily removed and reinstalled for maintenance purposes.

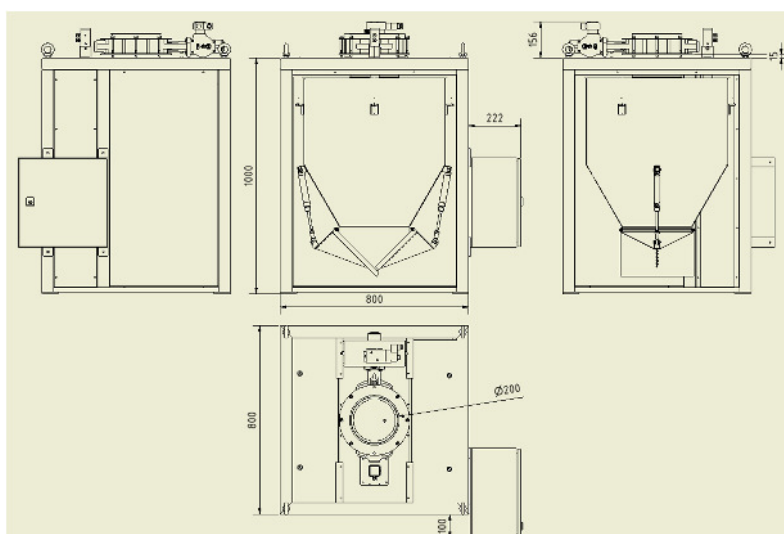


Figure 4: CTW-2001

5 Control

The control of the automatic hopper weigher is designed around the Simatic S7-1200. A SIWAREX module ensures precise weight measurement. All functions such as weighing, level monitoring, and valve control are autarkic. The operator can use the touch panel to start and finish the measurement. The material weight, current throughput, total quantity, and operating status are displayed as results on the central operating side.

Since quantity recording is seldom there for its own sake, a connection to a central PLC also allows active orders to be processed. All data are exchanged via standard Ethernet interface. To facilitate integration, a documented data interface and an example project are available for the master PLC.

The subordinate PLC can also assume tasks in the local environment. Program modules, which may function dependently or independently of the weighing process, are expanded for additional sensors, valves, or drives.

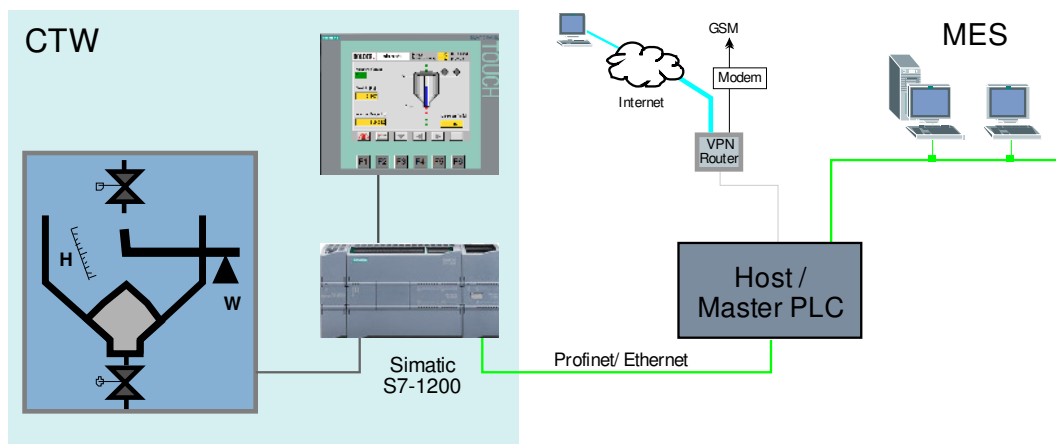


Figure 5: Integration of the CTW into the control strategy

A special monitoring system is offered for the electric and pneumatic supply. The material flow is blocked in the event of a supply failure. If the supply fails, a PLC function can help by terminating the weighing process, saving the last information, and switching the hopper weigher to flow-through. After the problem has been remedied, regular operation can be resumed.

The PLC also monitors the filling of the hopper weigher so that greatly varying bulk densities can be processed. The objective is to sufficiently fill the hopper weigher before the weight is measured. It must never be overfilled. A combination of weight measuring and level measuring allows the unit to adapt to the bulk density. With extensive equipment, a 2-to-3 decision is made to adjust the unit to a new target weight. This configuration variant is suitable for processing non-polar plastics such as PE and PP, and greatly varying bulk densities.

The accuracy of the display and the total quantities determined is so high that quantity limitations and resolution losses are not to be expected. Not even when the measurement is reset to zero every couple of years.

With the operation of a processing unit, a constant material flow cannot be guaranteed. A diagnosis function therefore determines how high the current throughput is. The weight difference is measured at fixed time intervals for this purpose. The calculated throughput is shown as a value, or it can be displayed in a trend diagram.

6 Expanding the area of application

Batch blender

The modular design of the hopper weigher lends itself to expansion with a batch metering system for high throughputs of 1 to 4 t/h and 2 to 6 components. Fast-acting valves or metering devices can be installed on the top to feed the individual components. The individual raw materials are precisely fed into the hopper weigher in succession according to a recipe and released together as a batch. A mixer below the hopper weigher ensures the sufficient mixing of all components before the mixture is extracted and processed.

The appropriate software available for this is based on the S7-1200.

MES with Siemens WinCC Scada

A manufacturing execution system (MES) tailored to the operation is required to administer material quantities, control material flow, and transfer order-related information to the ERP system. The WinCC Scada software tool, which can be freely programmed to the task, is well suited for this. It has interfaces to the process level, its controls, and the master level to exchange data with the ERP system. The database in the background helps to administer inventories and recipes, as well as to archive messages and process values so that manufacturing documentation can be maintained. All MES functions can thus be individually programmed.

An individual customer requirement specification must be created for these tasks.