Engineering White Paper

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INTRODUCTION

This White Paper discusses the challenges, options and solutions for transferring information and production orders from and to a weight indicator and/or to a process controller including, after execution, classifying and storing the production data from the process controller in a format usable for management purposes. This forms the basis of a system for complete process control in accordance with Industry 4.0, see figure 1. The information to be transferred to a controller from the supervising system can be, for example, formulas, package sizes and lot numbers, production orders including numbers of batches, packages to be filled and/or production totals. With a view to product safety (tracking and tracing), integral parts of the whole are the direct recognition of the exceeding of tolerances and any deviation from the prescribed methods. Other components are the processing of incoming goods and consumption data in the records of raw materials and, after shipping or packaging of finished products, the update of stock administration.

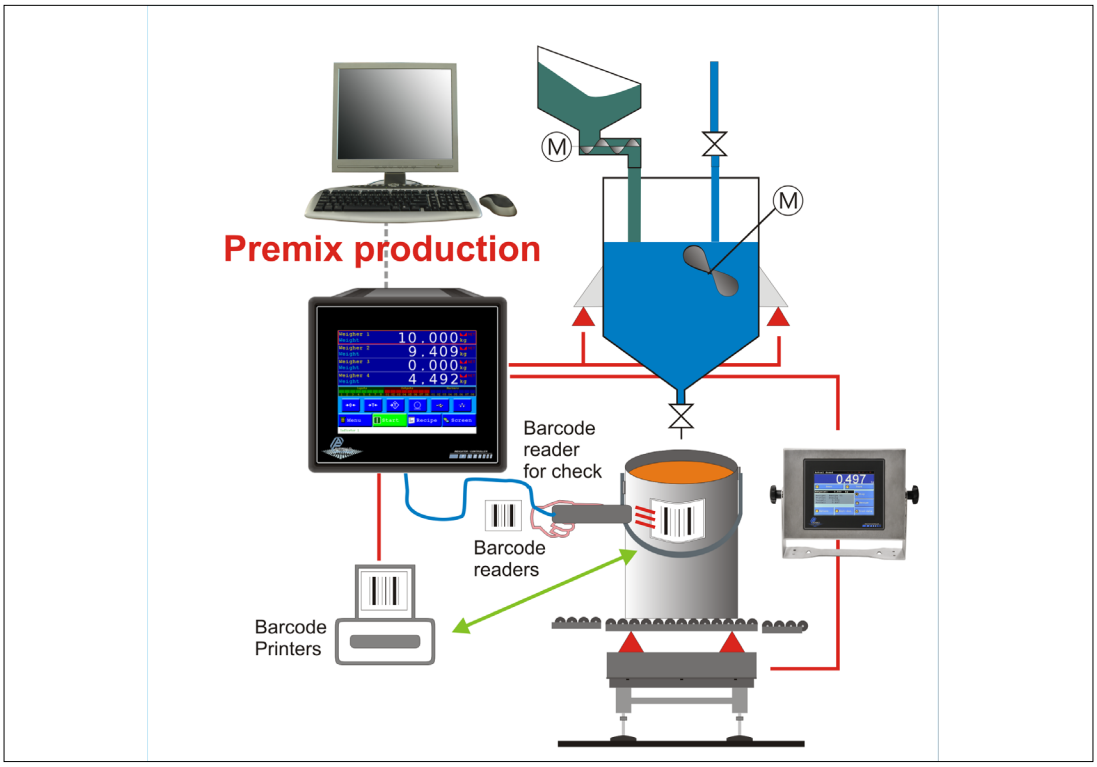

Figure 1. The preparation of a semi-finished product.

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PURPOSE OF WHITE PAPER

…- is to explain why it is important to monitor production processes directly and efficiently. See figure 2, whether it is the preparation of mixtures out of more than one components with the associated dosing, cooking or grinding processes, or the fast and accurate filling of large numbers of packages for trade applications or the loading of bulk material, whether the production system is automatic or non-automatic, of industrial size or simply a small system for testing purposes, similar challenges for the transfer, classification and storage of data arise. A failing view on production, stocks and the progress of a process has a direct impact on costs and profit margins. Insufficient availability of raw materials causes stagnation of your process, over or under dosing has an effect on the relationship between the components themselves and means an incorrect composition, so an end product with an inferior quality, insufficiently filled pre-packages lead to batch rejection. For example, insufficient process control results in product wastage, environmental pollution, delayed deliveries and dissatisfied customers. It might in some cases even constitute a legislative fallacy.

Apart of such losses, an additional argument is the functioning inside a quality assurance system within international standards and directives, with the need to implement tracking and tracing from start to finish.

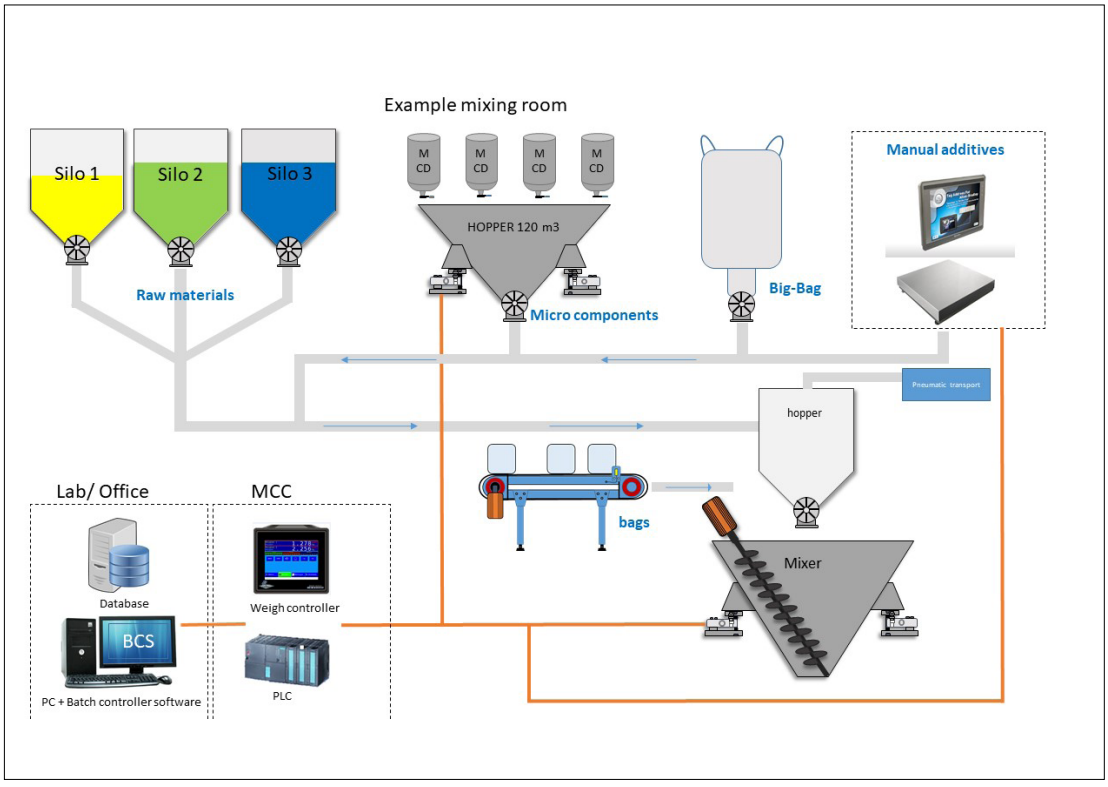

Figure 2. A production process, from the raw material stock up to the finished product

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BASICS

Supervising software serves a multitude of applications, see figure 3. Apart of generally applicable software, there are packages for specific purposes. That is why we make a distinction between:

- supporting packages
- communication software
- the collection of weighing/dosing information
- the registration of filling data of prepackages (e-mark) and
- management information software.

We will explain them one by one.

Figure 3. A supervising control system by means of a PC..

Supporting packages.

These packages ease the commissioning of the instruments. Due to the kind of the instruments we supply two types, namely for the indicators and those for controllers.

The first type is intended for adjusting and managing the weighing instrument. It includes the capture of metrological data, such as the weighing range, dead weight, number and type of load cells with the carrying capacity, scale interval and the like. It is also possible, for example, for installations meant for export, to provide a correction, based on the latitude and height, for the gravity field present on the destination. In addition, the possibility exists to make the weighing data visible in a mass-time diagram during commissioning. Thus, undesired influences of the weighing signal, such as a vibration, can be perfectly analyzed and suppressed with the correct filter.

As a second type, software is available for setup, monitoring and recording of metrological data, inputs and outputs with the program sequences for your controller. This makes the commissioning easier and ensures that a back-up of the essential technical information is available at all times, see figure 4. But even when the installation is in operation, these software packages prove their value. This way the service technician immediately oversees the situation, the way the weighing systems behave themselves and what the statuses of inputs and outputs are. For example, direct analyzing of an alarm situation makes maintenance and eventual repair easier.

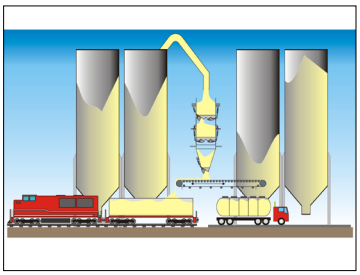

Figure 4. A discontinuous loading system for bulk material..

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Communication software.

Weighing instruments frequently are part of networks, see figure 5. That's why they have to communicate. This communication can take place between weighing instruments, with other controllers, such as PLCs, and with supervising control or administration systems. A number of these software protocols, such as Modbus, FINS, Ethernet-IP and ASCII, are standard in our instruments and because of that outside this scope. This also applies to the protocols for printers, web browsers and configuration software between PENKO instruments. The Profibus and USB Drivers, which can be installed in the supervising system, do fit in this framework.

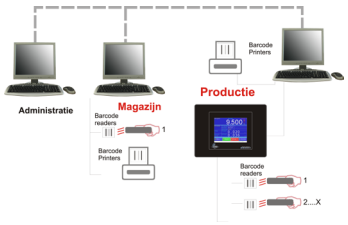

Figure 5. Tracking and tracing for the entire process.

Collection of process and weighing information.

By means of these software packages, you simply transfer the process information into the Cloud or, from a controller, into Windows-based software packages such as Word and Excel. This allows you to check the data anywhere or to process the information arithmetically including time and date and/or integrate it into the format of your standard documents. Of course, the information to be transferred depends on the application. Relevant information of dosing processes, blend preparation, includes the recipe code, component names with pre-set and really dosed weights, production line number, and optionally additional data for tracking and tracing and so on. For the control of incoming or outgoing, see figure 6, bulk materials, the weight with the supplier or customer and the product code is relevant.

For the collection of data from multiple weighing and/or measurement systems, up to 15 pieces, these packages are available.

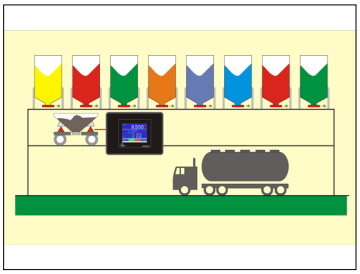

Figure 6. Loading of a truck with bulk material.

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The registration of filling data of prepackages (e-mark).

This software complies with OIML recommendation R87 from 2016 “quantity of product in prepackages” and EU directive 76/211/EEC “on the approximation of the laws of the Member States relating to the making-up by weight or by volume of certain prepackaged products”. For this purpose, there are two types of software packages, at first namely additional software for the filling controller or check weigher and secondly software collecting the relevant data in a personal computer.
For the first possibility, direct processing of the filling results by the filling controller or a check weigher, shows figure 7. Necessary is the presence of a printer.

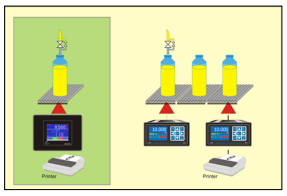

Figure 7. The, directly by the weighing controller, printing of the e-mark protocol.

Data about each quantity of prepackages, ≤ 10 000 pieces or one hour production, must be laid down in a report that has to remain available as a filling administration. In the second case, see figure 8, a personal computer collects and stores the data automatically. This especially may be useful for more than one machines, it makes a lot of paperwork superfluous. The filling information can be retrieved in multiple ways, such as on date, party code, product code, and so on.

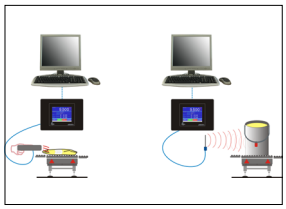

Figure 8. The control on weight and lot number of filled packages for trade applications

Management information software.

This software is an addition of the information in the white papers about mixing chamber controllers and mixing control in concrete plants. Essentially prevention is better than curing. This software, see photo 1, gives you complete control over your production, means for your production, stock of raw materials and the material flow through your company. It offers you tools for your:

- technical service
- stock control, raw materials and finished product
- production planning
- production control
- laboratory and quality control

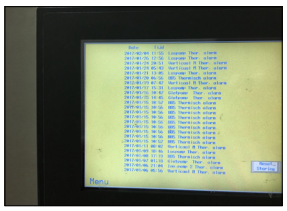

Photo 1. Information for the technician, available on the spot.

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The technical service is responsible for the proper functioning of your production equipment. Management information software makes this task easy with a direct overview of all settings, the statuses of outputs and inputs, and so forth. For example, in unwanted operating conditions, you know where the shoe pinches. You have an overview on:

- digital as well as analogue inputs and outputs with a cross reference for easy analysation of break downs
- markers per instrument/controller
- multiple indicators, external registers and, per instrument/controller, floating points
- multiple formulas per program sequence

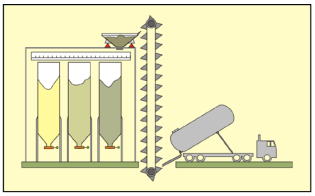

Figure 9. The check on weight of incoming bulk material. .

For the control of your stocks of raw material and finished product, you want to know what you have and where it is inside your company. This software gives you the answer. This allows you to plan your purchase optimally and direct the incoming raw materials, see figure 9, to the right location. You also know what has been manufactured. You have no shortages, and prevent yourself for too large stocks. You manage your stocks by:

- assigning a lot number, after a check at entry
- adding of incoming raw materials to the stock, see figure 10
- control based on the name of the raw material, the lot number and the location. The lot number is shown afterwards in the batch report
- automatic writing off of consumed raw materials
- batch registration including all relevant data such as component names, preset and actual dosed weights, lot numbers, mixing times, temperatures and so on
- totalizing the finished product by formula, batch number, lot number and stock position

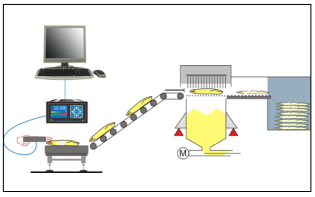

Figure 10. The check on weight of incoming raw material in bags.

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You know what you've sold and when it has to be shipped. This software supports your production planning. By defining the batch size in the formula, and then determining the number of batches, you are in complete control of your production. You plan your production with:

- scheduling your production orders per day
- an overview of the required raw materials with a report of possible shortages
- blocking the start when the stock of raw materials is insufficient
- dividing of the formula; for a smaller batch size, the preset weights are automatically adjusted within the installed weighing capacity/capacities
- a variable formula sequence. You select all formula dependent functions in the sequence you want. The program sequence then is automatically adjusted
- transferring, after the aforementioned operations, programs with the corresponding formulas to your dosing control system
- then start and stop the controller(s), if necessary per production line

For a proper control of your production process, you want to know what happens during the production and what the machine load is. This software offers you all this and more. It enables you to improve the efficiency and prevents for stress. In addition, you detect stagnations instantly, so you can act appropriately. You monitor your process step by step with:

- batch registration, see photo 2, including all relevant data such as component names, preset and real dosed weights, lot numbers, mixing times, temperatures, and so forth.
- variable correction formulas. After a check, you can create a correction formula out of the components of the existing formula in random order. The information of this correction formula will be added to the data of the original one into a common batch report.
- comments. During or after production, you can add additional information, such as alarm situations, manual corrections, and the like to the batch report.
- ”online” overview of the progress of your production. With your management information system you can control the screens of your dosing controllers.

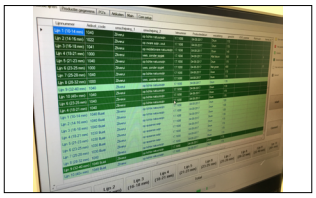

Photo 2. During production continuous online supervision is possible.

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The laboratory is responsible for the control of raw materials, semi-finished products and finished products. Adjustment of the recipe, see photo 3, to varying raw materials is easy with this software. Thanks to the tracking and tracing facility, you see where, how and what deviations did occur, so you can correct precisely. Adjustment of the recipe, checking the quality of your production and, if necessary, corrections with:

- the release of raw materials after a quality check by entry and the issue of a lot number
- batch registration including all relevant data such as component names, preset and actual dosed weights, lot numbers, mixing times, temperatures, and so forth
- analyzing facilities, such as
  a. per batch: retrieve the dosed raw materials with weight and lot number
  b. per type of raw material and lot number: retrieve in which batches and with what weights this raw material has been processed
- variable correction formulas: after a check, you can create a correction formula out of the components of the existing formula components in random order. The information of this correction formula will be added to the data of the original one into a common batch report

Photo 3. All information for direct analysation of the product is available. .

COMPETITIVE ADVANTAGE

The various software packages provide excellent communication between the indicators, controllers and supervising computer systems, one-sided as well as back and forth. This forms the basis for a production system according to Industry 4.0. The accuracy of the data is essential in this. The combination of high-speed measurement (1,600 conversions/s) with a high internal resolution (16 777 216), smart filters and sufficient computing capacity in all instruments guarantees this accuracy. By means of this software a closed, reliable chain is created for data transfer, processing and storage from the measuring points up to and including administrative processing and quality control.

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PRODUCT SOLUTION

Supporting packages.

Pi Mach II

is a program for configuring, monitoring and customer specific programming of PENKO controllers. Available components are the firmware manager, a manage tool for all parameters, an oscilloscope function to determine the filters optimally and a visualization tool for the FLEX and FLEX2100 series, including USB drivers.

Job Manager XE

is a supplement to Pi for version management of customer-specific programmed projects.

PDI Client

is a program, suitable for multiple control systems for easy monitoring and configuration of PENKO instruments. PDI Client is intended for the PENKO FLEX, FLEX2100, 1020, SGM700/800 and RIO/RIA700 series. Only USB communication is supported. Minimum requirement for a Java environment is version 1.8.0. PDI Client includes an installation manual and USB drivers.

Communication software.

USB Drivers

are available for the PENKO FLEX, FLEX2100, 1020, SGM700/800 and RIO/RIA700 series.

Profibus Drivers

are available for the PENKO FLEX, FLEX2100, 1020, SGM700/800 en RIO/RIA700 series.

The collection of weighing/dosing information.

DataReporter

exists of Visual Basics software, making it possible to transfer data from a PENKO controller into a personal computer with Microsoft® office Windows programs such as Word and Excel. Data reporter is available in versions, suitable from 1 up to 15 controllers.

The collection of data in the CLOUD

is so beautiful because all your process information is always and everywhere available. You log in by means of your smartphone, tablet or PC and you are up-to-date. With this Cloud package you can, for example, visualize the stocks in your silos. The main advantage of the Cloud application is, among other things, your supplier or another branch can check your stocks too. This way your supplier can, in consultation with you, update the stocks what makes both you and your supplier operate more efficient. Another example is the remote monitoring of machines. The user buys a machine which is equipped with various sensors (for example weighing, vibration-, heat- or current-measurement, position indicators and so on). With this package, the machine supplier can observe remotely if the machine operates inside the specifications. If something drifts, the supplier contacts the user in order to prevent him for problems, so for a time consuming interruption of the production.
The Cloud application is secured via a VPN server and 99.9% of the time online. The Administrator can create multiple accounts with the corresponding rights, what means only the applicable data is displayed.

The registration of filling data of prepackages (e-mark)

E-Mark
is additional software for filling controllers or checkweighers, compiling the statistics of the results during a certain time or a number of packages with the possibility to print or save this data as a complete E-mark protocol, such as required for packages for trade applications ≤ 10 kg.

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Management information software.

BCS management information system
offers you the control over the processes in your company: from incoming goods via internal storage, pre-processing, mixing, dosing and cooking processes, quality control and packaging up to and including the shipment of your finished products. You can enter and monitor the various production orders centrally, see photo 4. During your processes all weight information is collected for you and clearly presented. In this way you have complete control over your planning, it prevents you for incorrect mixtures and you know exactly what is happening everywhere. The management information system BCS (Batch Control System) provides you with tools for your:

- technical service
- control of the stock of raw materials and finished product
- production planning
- production control
- laboratory and quality control

Photo 4. For the production planning all information is there.

CONCLUSION

With these systems, Industry 4.0 is within reach. With the right instruments, controllers, communication protocols and/or supervising software packages you get a comprehensive quality system with tracking and tracing facilities. A properly functioning, watertight, quality system prevents you effectively for claims, based on product liability.
Fast and efficient exchange of data between process controllers and supervising computer systems remains a challenge in the process and packaging industry and will vary from company to company. Consideration not only needs to be given to the necessity of ensuring the quality of the end product, to ensure that production runs smoothly and to keep stocks at the desired level, but also to reduce losses.
To engineer the most efficient way per industry, per product, per manufacturer, there is no “one-size-fits-all” solution. Engineers at PENKO work out the best and most effective way this can be done. Following White Paper will discuss Load Cells, the installation of Load Cells, Non Automatic Weighing Systems, Maritime Weighing Applications, Check Weighing Systems, Filling Systems, continuous totalizing with Belt Weighing, continuous totalizing with Loss-in-Weight, discontinuous totalizing with Hopper Weighers, Grading Systems by means of Weight, Batch Control on Weight for Mixing Plants and Pre-Packages.

For information: www.penko.com