Spotlight on Gravimetric Blending and Control Systems

If you can extrude or mold it, we can blend it.

PROCESS CONTROL CORPORATION
Auxiliary Equipment for the Plastics Processing Industry
Precise Blends of Two to Eight Ingredients by Weight

X Series continuous gravimetric blenders are designed to produce precise, homogenous blends by weight, regardless of ingredient bulk density variations. The X Series control system incorporates the latest in microprocessor technology for total automation of recipe entry and storage, inventory control and process monitoring. All hardware and software has been developed in-house by Process Control with an emphasis on reliability and ease-of-use. Functions are menu-driven and step the operator through the required sequences of actions with simple instructions.

Superior Low Rate Metering Accuracy

For metering ingredients at low rates, the X Series blender offers unsurpassed weighing resolution and unique feeder designs to guarantee accurate and consistent feeding. The Process Control weighing system uses 20-bit A/D resolution which enables us to detect weight changes of one part per million. The patent-pending Tube Hopper has been shown to improve low-rate feed accuracy by as much as 48% over conventional feeder designs. We have wide experience with a variety of materials and applications and stand ready to assist you with your own requirements.

Benefits of Gravimetric Blending Systems

- Improved product quality and consistency
- Minimize use of expensive ingredients for reduced manufacturing cost
- Reduce inventory of blended material
- Allow faster startups and product changeovers “on-the-fly”
- Provide inventory and production reports for management
- Reduce labor costs through automatic operation
- Reduce scrap or off-spec product
- Communicate with other systems for complete plant level control

Steep Wall Hoppers Promote Flow

Materials which do not flow well, such as regrinds and flake, can create problems. With standard feeder designs, these materials feed inconsistently and can even “bridge” causing all feeding to stop. To solve these problems, Process Control utilizes steep wall hoppers with enlarged feed openings when necessary to promote consistent material flow.
The XU Series continuous gravimetric powder blender offers unsurpassed blend accuracy and blend homogeneity in a wide range of configurations to meet the needs of any application by incorporating the PF Series powder feeders. It allows gravimetric blending of non-freeflowing powder materials with freeflowing powder and pellet materials at unprecedented metering and mixing accuracy.

The powder feeders allow rates as low as 0.2 PPH and as high as 3,000 PPH. Metering augers are available in full pitch or 1/2 pitch configurations with helix diameters from 1/4 inch to 2-1/4 inches. The drive system of all blender components utilizes a PWM drive with a DC gearmotor and encoder for accurate motor speed feedback. This allows each of the individual feeders to maintain a constant weight throughput. The weighing system is designed with DSP (digital signal processing) technology (patent pending) to filter out unwanted noise and vibration which can wreak havoc with any feeding system, especially at very low feed rates.

Incorporated into the electro-polished stainless steel design is a patented round-to-trough feeding area which provides more consistent mass flow for better metering accuracy. The feeder is designed with a steep wall, removable hopper which features a dust-tight band clamp for easy mounting of hopper extensions and quick disassembly for clean out. The bottom trough design is optimized to provide maximum material exposure to the auger.

The XU Series Continuous Powder Blender is also available in food grade stainless steel.

The operator enters the desired blend recipe at the operator station. All ingredients are simultaneously metered in the correct blend ratios by augers from individual weighed PF Series powder feeders. The ingredients then flow through a cascade chamber which produces the best blend homogeneity.
Continuous Blender Features

Simple Installation
The X Series has been designed to make installation quick and easy, based on our experience with thousands of continuous gravimetric blender projects throughout the world.

Mechanically, the blender has been designed to mount directly to the throat of the extruder, on a mezzanine or on a blender stand. An integral loading support platform is included which allows most typical vacuum receivers and/or shutoff valves to be mounted without additional support.

Electrically, field wiring has been kept to an absolute minimum due to our unique distributed control system. All drive system and weigh system connections are factory wired. The operator station, which houses the central computer, may be located up to 1000 feet from the blender. Wiring between the blender and the operator station consists of a four-wire network and power connections. When standard Process Control vacuum receivers are used, they are designed to plug right in to the blender.

Superior Blend Homogeneity
The quality of your end product is influenced by many factors, including consistency of the blend being fed to your process. Each ingredient in your blend has a purpose and the best results are achieved when the blend ratios are highly consistent in the short term. Continuous blenders achieve superior blend homogeneity by precisely metering each ingredient simultaneously in the correct ratio. The individual material streams are brought together in a cascade mixer designed to thoroughly homogenize the blend. The resultant blend is then captured and preserved all the way to the process. This continuous approach produces more homogeneous blends than designs which rely on mechanical agitation for mixing.

Extruder Throat Mounting
When space is available, the blender with integral downcomer may be bolted directly to the throat. This is the simplest installation and provides excellent blend homogeneity and easy cleanout.

Mezzanine Mounting
For applications with an existing mezzanine structure above, this arrangement offers the benefits of throat mounting. This blender configuration uses a remote downcomer mounted on the extruder throat to capture the gravity-fed blend of materials from the mezzanine-mounted blender.

Off-Line Mounting with Pressure Conveying
For applications where the blender must be mounted off-line, the pressure conveying system offers the benefits of extruder throat mounting. As the blend is produced, it is conveyed via pressure continuously to the extruder throat-mounted remote downcomer. This prevents demixing and allows accurate calculation of extruder rate for gravimetric extrusion control applications.

Off-Line Mounting with Vacuum Conveying
For applications where there is not enough headroom for either throat or mezzanine mounting, or were more than one extruder is to be served by the same blender, off-line mounting is to be used. The blender is mounted on a stand with a vacuum pickup box below it to capture the material blend. On demand, the blend will be vacuum-conveyed to the machine(s) being served. Care must be taken to minimize the chances for blend separation during this conveying.
The Guardian® Series gravimetric batch blender was developed for processors who want the simplicity of operation combined with the most accurate dispensing and superior blend homogeneity at a low cost.

The outlet of each of the individual material hoppers is equipped with a fast acting V-gate valve. Each of the materials is dispensed sequentially into a common weighing hopper in the desired proportions. The weighed materials are then released into a separate mixing chamber which provides the most consistent homogeneous blend of any batch type blender.

Process Control engineers have produced a highly advanced metering and weighing system that accurately controls each ingredient of every batch to the desired amounts and is not averaged over multiple batches as is common in other batch blenders in the industry. At the blender's highest accuracy setting, each ingredient can be dispensed to an accuracy of +/-0.02%.

The metering gates are controlled with one initial dispense cycle and then the balance of the requested weight amount is fine tuned by “short cycling” the gate. Every batch is exact, batch after batch. The competition makes up for discrepancies on the next batch. Why assume that their next batch will correct the previous inaccurate batch? Do it right the first time, every time.

In addition to precise batch-to-batch dispensing, the performance of the mixer is just as critical to the end product. The mixer actually determines how uniform the blend will be. Process Control has spent many years of research and testing in developing the most thorough homogeneous mixer in the industry. Inadequate mixing can lead to inconsistent product characteristics such as color variations or other imperfections.

The mixer section of a Guardian blender is designed with total mixing action and NO dead spots. No other blender design comes close to this. No stratification, no matter how dissimilar the blended materials are in specific gravity or how they may vary in composition.

The Guardian® Series blenders have incorporated in the design a built in clean-out system. With a pull-out drain chute and manual slide-gate controls, the blender can be cleaned-out quickly and easily during product change-overs.

1. **Integral Loader Support Platform**
   - Supports vacuum receivers without the need for external support

2. **Segmented Material Hopper**
   - Blenders have four to eight elements in individual fixed hoppers that are welded together
   - Special configurations for up to 12 ingredients

3. **Touchscreen Microprocessor**
   - Color touchscreen operator interface that insures ease of use and quick startups
   - Standard ethernet port for communication ability and integration with remote systems
   - Ability to show in real time the actual throughput and the maximum throughput based on the current recipe running
   - Ability to show in real time the target dispense and the actual dispense achieved
   - Ability to perform automatic calibration when a new recipe is entered
   - Can be remote mounted
   - Ability to perform a test dispense for metering accuracy verification

4. **Weigh Hopper**
   - Rests on dual load cell platform
   - Includes integral batch dump valve
   - Easily removable with no tools for cleaning

5. **Mixing Chamber**
   - Agitator designed for waterfall type mixing to ensure every batch is mixed
   - Engineered for no dead spots and to achieve a consistent homogeneous blend
   - The proximity switch controls the mixer outlet gate to prevent classification of mixture

6. **Air Hose**
   - The attached air hose and nozzle ease the cleaning process

7. **Clean-out Dump Chute**
   - Fixed inside the blender behind the weigh pan for ease of material change

8. **Pneumatic Metering Gate**
   - Pulsing v-gate to achieve dosing accuracy of every ingredient in each and every batch

9. **The Guardian® Series Gravimetric Batch Blender**

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For processors who seek the benefits of both gravimetric blending and control of extruder output by weight, we offer a solution that combines both technologies in one integrated, easy-to-use system. In many applications, line speed control is also added for complete control of product weight per length. This feature can be retrofitted to most existing blenders in the field for both mono- and coextrusion applications.

**Benefits of Gravimetric Extrusion Control**

- Improved Product Quality
- Reduced Material Usage
- Quicker Startups & Product Changeovers
- Reduced Scrap
- Improved Product Repeatability
- Accurate Inventory Reporting
- Improved Identification of Off-Spec Product

**Part of a Complete Gravitrol® Coextrusion Control System**

For coextrusion applications, the PCC Blender is part of a complete Gravitrol® system for controlling product layer ratios and total line throughput. On a typical coextrusion line, layers which require blending use X Series blenders and single-component layers use HG Weigh Hoppers. Both the blenders and weigh hoppers report actual extruder usage back to the central Gravitrol® computer. This information is periodically compared to the desired layer percentages and adjustments are made to the extruder screw speeds. In addition, line speed can be adjusted for complete control over product weight per length.

### Control Extruder Output by Weight

The operator presses RECIPE and enters the desired blend percentages by weight and the desired extruder rate into the operator station. When RUN is pressed, the blender automatically maintains the desired blend percentages by weight. Simultaneously, the blender computer calculates the actual extruder usage rate and periodically adjusts the extruder screw speed to maintain extruder output to +/-0.5% by weight.

In applications which incorporate line speed control, the operator also enters desired weight per length as part of the recipe and the computer controls line speed in addition to extruder speed to maintain the desired product weight per length.
**Blend Homogeneity is Key to Product Quality**

Blend accuracy is a term commonly used by blender manufacturers to rate the performance of their systems. Accuracy is an important specification, but it is often stated over a long time period which has little relationship to the consistency of the process or end product. Blend homogeneity, which is just short-term blend accuracy, is much more important to your product quality. For example, the two boxes at right are each filled with 80% base material and 20% additive. Even if the blend contained in each box is accurate to 0.10% there is a big difference in the homogeneity. If these two boxes were fed to side-by-side extruders, significant differences in the end products would be seen. The more homogeneous blend will produce the superior product and allow you to adjust your recipe for lowest material cost.

**Batch Blenders Rely on Mechanical Agitation**

Batch blenders use mechanical mixers to transform the layered materials into a usable blend. There are many different mixer designs and some do a better job than others of homogenizing the materials. The resulting blend consistency is highly dependent on many factors – the mixer design, the blend ratios, the shapes and densities of the materials, and mix time. When mixed, smaller, denser materials tend to settle towards the bottom through the larger, lighter materials. For less critical applications or applications which run the same blend recipe and materials day-to-day, batch blenders can be a cost-effective alternative.

**Continuous Blenders Offer Improved Consistency**

With a continuous blender, each component is simultaneously metered by weight in the desired blend ratios. The individual material streams are combined in a cascade mixing section, which homogenizes the blend and directs it to the process. Below the cascade mixer, the resultant blend is typically stored in a plug-flow hopper which preserves the blend consistency all the way to the process. At no time is mechanical agitation relied on, so superior blend homogeneity is achieved across a wide range of materials and ratios.

**Comparing Continuous and Batch Blending**

**Continuous Blender Operation**

Materials are kept in separate weigh hoppers, each mounted on a load cell which measures the weight of the hopper and its contents. Target metering rates are determined for each material based on the recipe and the current blender total rate. As the materials are simultaneously metered by augers into the cascade mixing chamber, the actual metering rate of each ingredient is frequently calculated from the weight loss of the hoppers. These actual rates are compared to the target rates and the speeds of the augers are adjusted to correct for any variation, maintaining an accurate blend. The materials simultaneously flow through the cascade chamber, thoroughly homogenizing the blend. The resultant blend is then captured in a plug-flow hopper designed to preserve the blend all the way to the extruder throat (or other process).

**Batch Blender Operation**

Materials are kept in separate material hoppers above a central batch weigh hopper. The metering gates are controlled with one initial dispense cycle and then the balance of the requested weight amount is fine tuned by “short cycling” the gate. At this point, the materials are dropped into a mixer which agitates the material for a fixed time period, homogenizing the blend. At the end of the mix cycle, the blend is available for the process.
Continuous Gravimetric Blenders Require Proper Sizing of Loading System

With a continuous blender, it is very important that material be delivered in a timely manner to the ingredient hoppers. Process Control takes the guesswork out of this selection by providing a complete guaranteed system based on your usage and conveying distances. Our sophisticated computer models and experience with a wide array of real-world applications assures you of a vacuum conveying system that meets your requirements.

Blender Loading is Fully Automated

The blender ingredient hoppers call for material as required and a control system directs the operation of the pump and vacuum receivers to ensure that materials are loaded to the proper stations at the proper times. Standard PCC receivers utilize proximity switches mounted in a location that will deliver the optimum refill size. The receivers fill until the specified volume is reached, eliminating the need for setting fill times. Loading by volume is more precise than loading by time and maximizes the output of the loading system.

Continuous Gravimetric Blenders Alert Operators To Loading Problems

When a loading system problem occurs, early warning can avoid costly line shutdown. With the X Series Blenders, the first notification of a problem is typically a "SMALL REFILL" alarm which tells the operator that for some reason the last refill was smaller than normal. Then, if the problem is not corrected before the next refill, the operator will get a "RUNNING OUT OF MATERIAL" alarm. If the problem is not resolved, the third and final notification will be a "HOPPER EMPTY" alarm. In this case, the blender can be programmed to either shut down until the problem is corrected or to remove the empty hopper from the recipe and make an off-spec blend in order to keep the line running.

Vacuum Receivers

Process Control Vacuum Receivers come in a range of sizes and designs for handling pellets, regrinds or granular materials. Our vacuum receivers are designed to be mounted at any point where resin delivery is needed.

Inventory Manager

The Gravimetric Inventory Management System will accurately weigh re-pelletized materials prior to being re-processed or stored as inventory. The system can also be used to verify delivered resins before entering them into inventory. The Gravimetric Inventory Management System can provide totals for a given production shift, a complete production run or an overall running total of material. It runs automatically with little or no operator intervention logging shift weight totals.

Remote Manager

Remote Manager is a control/monitoring unit that can be used to remotely communicate with the X Series line of continuous gravimetric blenders, the Guardian Series line of gravimetric batch blenders and the Gravitrol extrusion and linespeed control systems. Management of processing machinery requires continuous monitoring and control of the plant machinery to ensure process liability and minimize downtimes. Remote Manager provides powerful, realtime control and monitoring of Process Control equipment to help meet these needs.

Material Manager

Material Manager is a data collection tool that analyzes the material usage of a blending system over time. It can accurately track the material usage of each component on a blender used on a production line. Tracking material usage allows the system to report on how much and which type of material was used on each job, shift, blender, and recipe. This system of recording material usage will provide processors with a better understanding of the costs incurred in processing an order.

Proper Loading is Key

Vacuum Power Units

Our Vacuum Power Units offer dependable and economical performance for a wide variety of conveying rates, distances and materials. Typical applications include in-plant distribution systems and machine/blender loading.

Each system is carefully sized using Process Control’s computer simulation to meet your conveying specifications.

AccuDispense

AccuDispense...an economical, single dose, gravimetric dispensing system. AccuDispense is a versatile product that can be used in not only the plastics industry, but also for pharmaceutical, chemical, and food applications. With precision metering, this system delivers a pre-selected weight of free flowing material, such as powdered, flaked, granular and pelletized ingredients, directly to the process. AccuDispense is used when it is necessary to obtain pre-weighted doses of material that do not need to be blended, but require an accurate dispense.

PCCWeb® Web Based Equipment Control System

PCCWeb® is a system that enables you to monitor and control Process Control’s Guardian® series gravimetric batch blenders, X Series continuous gravimetric blenders and/or Gravitrol® extrusion and linespeed control systems with a computer equipped with any standard web browser. Each of the Process Control mini-op control panels comes supplied with an embedded web server and a built-in Ethernet port. Using the Ethernet port, each of the mini-ops can be connected into an internal network hub and then accessed by any computer within the network using a different address for each. All of the screens have been pre-designed by Process Control software engineers and are used with any Internet web browser. There is no additional work required by users other than creating the link.

Director™ Sequencing Control Panel

The Director™ Sequencing Panel provides automatic control for your complete vacuum conveying system. The sequencing panel controls the vacuum pump and vacuum receivers to select which receiver is being loaded and the duration of the load.

Trend Manager

Trend Manager has been developed to assist in tracking and plotting production data to better serve our customer’s needs. Trend Manager can track the accuracy of blend percentages, layer distribution ratios, and overall line stability. By plotting and tracking information, the accuracy and consistency of blend percentages can be easily and quickly verified. Additionally, total machine throughput data can be charted to verify overall line stability on a mono-layer line and layer distributions on a co-extrusion line to assure a good, consistent finished product.

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Innovations in scrap reclaim, blending, feeding, turnkey material handling systems, and gravimetric extrusion control... 

...experience it at PCC!