The development of belt conveyor weighing

Ralph Closs, Product Manager, Weighing Technology

Siemens Milltronics Process Instruments designs and manufactures sophisticated weighing equipment, including belt scales, used by water and wastewater, aggregate, cement, mining, chemical, oil and gas, food and other process industries. For more than 25 years, strong technical support and applications knowledge have tailored belt scales to the best application-fit and customers’ special requirements.

Belt conveyor weighing

Weighing and controlling the rate of materials on a conveyor belt is one of the most common procedures in process automation. Belt scales help maximize the use of raw materials, control inventories, and aid in consistent manufacturing. A typical belt scale system has a weigh bridge structure supported on load cells, an electronic integrator, and a belt speed sensor.

The load cells measure the material weight on the belt and send a signal to the integrator. The integrator also receives input in the form of electrical pulses from a belt speed sensor connected to a tail or bend pulley. Using these two sources of data, the integrator calculates the rate of material transferred along the belt using the equation weight x speed = rate.

History of belt conveyor scales

The first belt conveyor scales offered were generally multi-idler types. It was thought that a high number of weighbridge idlers and a long weighbridge length were needed to weigh accurately. As a result most belt scales for conveyor weighing were at least two idler models used primarily for lower accuracy applications. To ensure higher accuracy three, four, six and eight idler weighbridges were required. This meant very expensive belt conveyor scales, that were time consuming and expensive to install, commission and maintain.

The first belt scale weighing mechanisms were marvels that mechanically integrated the applied conveyor load and conveyor speed to drive a rotating shaft that in turn drove a totalizer. The result was that the devices created an electrical rate signal representing tons per hour.

The introduction of strain gauge load cells changed the belt scale industry’s offering. The mechanical wonders were no longer required. However, the multi-idler, pivoted design continued to be the most common offering with load cells converting the forces of loading into a usable electrical signal. At the same time, the belt speed (although still using a rotating pulley shaft with the pulley driven by the belt) was then measured in digital.

Weighing Technology

Answers for industry.
Trends in Weighing

form by the use of electronic encoders, photo switch sensors, or low voltage synchronous AC generation. The load and speed signals were then integrated with electronic analog integrators with use of early digital components.

Digital integration

An important step in the development of belt conveyor weighing was the introduction of the first digital integrator, the CompuScale, by Milltronics in 1980. Using microprocessor technology, the programming, commissioning and calibration of a belt scale system became simpler. It was no longer necessary to run belt circuit after belt circuit to establish the zero and span calibrations and adjust for optimum setting using potentiometers, or mechanical adjustment positioners. The zero loading of the belt could be averaged over one, or a number, of belt revolutions and adjusted automatically at the operator's discretion. The span calibration could be established in the same way using the benefits of this microprocessor technology.

Today, the same ease of operation is available, along with signal processing and integration improvements, in the Milltronics BW100 and BW500 Integrators, which are current models offered by Siemens Milltronics, as well as the PLC based SWAREX FTC module.

Despite the advances in the load and speed sensing, and the integration of these signals through modern electronics, the belt scale load sensing weighbridges were still expensive, cumbersome to install, provided limited accuracy and expensive to maintain by the nature of their design.

Breakthrough scale

Milltronics saw an opportunity for simpler belt scale solutions by mounting the weighing idler directly on the load cell. Milltronics already experienced success in the marketplace with unique parallelogram-style load cells in the solids impact flowmeter business. Based on the flowmeter design and with a strong background in belt conveyor weighing, Milltronics developed and patented the MSI belt scale in 1985. The load cells not only provide a mechanical transduction, but also form the suspension of the belt scale. As such the live and tare loads are applied directly to the strain gauges – no pivots, no levers, just the load cells.

The load cells were originally designed for single point use, so to ensure that the two load cells created a balanced platform, a balancing circuit was added to the integrator input signals. This additional circuit allows the load cells to be balanced to one another. This unique balancing procedure, only available from Siemens, has been enhanced and simplified by digital electronics and ensures that Milltronics MSI provides the best available accuracy.

Through further refinements in the MSI design, state-of-the-art triple beam stainless steel load cells replaced the initial dual beam parallelogram load cells. The design improvements have added redundant protection from moisture ingress and closer sensitivity tolerances.

The MSI belt scale was and still is a breakthrough for belt conveyor weighing. Milltronics two-load cell concept provides a weighing accuracy advantage not seen in other designs. Milltronics' weighing accuracy advantage comes from directly applying the weighing idler to a true parallelogram-design load cell especially suited for the task. The load cells instantaneously measure only the vertical load applied through the belt and the supporting suspended idler. The load cells are so structurally sound that they can be applied to the most demanding applications. Drop-in installation makes alignment easy and economical.

Increased capacity and approved accuracy for belt scale system

As mentioned previously, belt scales are used to monitor and totalize bulk materials on belt conveyors. A common belt scale application is to load-out or transfer material such as sand or gravel in mining, aggregate and cement industries. This transfer of material from one customer to another requires trade approvals to ensure that the end customer gets the amount they pay for. The Measuring Instruments Directive (MID) is the European directive that defines this process for the European Union. Equipment supplies
The development of belt conveyor weighing

<table>
<thead>
<tr>
<th>Food and light-duty industry</th>
<th>Medium-duty industry</th>
<th>Heavy-duty industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milltronics MLC</td>
<td>Milltronics WD600</td>
<td>Milltronics MBS</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**Order No.**
- 7MH7126
- 7MH7185
- 7MH7121
- 7MH7123
- 7MH7125
- 7MH7122
- 7MH7122

**Typical industries**
- Animal feed, fertilizers, food processing, tobacco
- Food, pharmaceutical, tobacco
- Aggregate, gravel, animal feed, minerals
- Aggregate, agriculture, mining, steel, chemical
- Aggregate, gravel, retrofitting
- Cement, chemicals, coal, food processing, mineral processing, mining
- Cement, chemicals, coal, food processing, mineral processing, mining

**Typical applications**
- Secondary industries
- Process and load-out control, light- to medium-duty
- Aggregates, medium-duty
- Mobile crushers, aggregates, weighfeeder retrofits
- Industrial heavy-duty, for process and load-out control
- Heavy-duty, multiple idler for process and load-out control

**Accuracy**
- ±0.5 to 1%
- ±0.5% to 1%
- ±1%
- ±0.5 to 1%
- ±0.5 to 1%
- ±0.5% or better
- MMI-2: ±0.25%
- MMI-3: ±0.125%

**Approvals**
- CE, C-TICK
- CE, C-TICK, meets FDA/USDA requirements for food processing
- CE, C-TICK
- CE, C-TICK
- CE, C-TICK, ATEX, CSA, FM, IECEx
- CE, C-TICK, SABS, Measurement Canada, OIML, MID, ATEX, IECEx, CSA, FM
- CE, C-TICK, NTEP, Measurement Canada, OIML, MID, ATEX, IECEx, CSA, FM

Siemens belt scales combine simple drop-in installation, low maintenance (no moving parts), and repeatable accuracy for productive operation. They show minimal hysteresis, superior linearity, and ignore side loading. All designs feature overload protection. With hazardous trade approvals, Siemens belt scales can be used in almost any industrial environment or application.

Milltronics MSI and MMI Belt scales from Siemens Industry Automation Division are available for use on systems with flow rates of up to 12000 tons per hour, an increase of 7000 tons per hour. The MSI and MMI, combined with a Milltronics BW500 Integrator and a speed sensor, have OIML (International Organization of Legal Metrology) and MID ((Measuring Instruments Directive) trade approvals. These approvals guarantee the MSI and MMI belt scales meet strict requirements for weights and measures applications in accuracy and repeatability. In addition to trade approvals, the MSI has CSA/FM and ATEX hazardous approvals.

The Milltronics MSI, a heavy-duty single idler belt scale, is used for rugged applications in process and load-out control. MSI provides instant response to belt loading and overload protection to 300 per cent. The MSI measures only the vertical load applied through the belt and the supporting suspended idler, and is so structurally sound that it can be applied to the most demanding applications.

The Milltronics MMI is a heavy-duty, high accuracy multi-idler belt scale consisting of two or more MSI scales. Used for critical process and load-out control, the two idler MMI-2 offers accuracy up to ±0.25%. For even greater accuracy, the Milltronics MMI-3, a three idler belt scale, can be used on applications requiring accuracy to ±0.125%. The MSI and MMI models can be installed without the use of cranes or other high cost resources. Drop-in installation makes alignment easy and economical.

The capacity of the MSI belt scale was initially under-rated. Recent analyses of the MSI belt scale, through computer software programs, allowed the scale’s load cell capacity to be upgraded. This also results in a design rate increase.

Still “new” after over 25 years, the Milltronics MSI belt scale is still changing the belt conveyor weighing business. The MSI belt scale’s combination of accuracy, ease of installation, commissioning and maintenance are unparalleled in today’s industrial world.

*Accuracy subject to: on factory approved installations the belt scale system’s totalized weight will be within the specified accuracy when compared to a known weighed material test sample. The test rate must be within the specified range of the design capacity and held constant for the duration of the test. The minimum material test sample must be equivalent to a sample obtained at the test flow rate for three revolutions of the belt or at least ten minutes running time, whichever is greater.

The information provided in this brochure contains merely general descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of the contract.

All product designations may be trademarks or product names of Siemens AG or supplier companies whose use by third parties for their own purposes violate the rights of the owners.

Siemens AG
Industry Sector
Sensors and Communications
76181 KARLSRUHE
GERMANY

www.siemens.com/weighing