Weighing represents a vital core activity for most process plants. Not only is it fundamental to the quality of what is being produced, but also has a major impact on overall efficiency and profitability.

Significant changes across plant control are taking place and the field of process weighing is no exception. Weighing is now being seen as more than just a ‘means to an end’ and recent developments are bringing distinct advantages both to the manufacturer as well as the customer. Traceability, legislation and system integration are three of the main factors driving this, coupled with competitive issues such as pressure on earnings and changing customer requirements.

The major changes in process weighing are in the areas of signal conditioning and plant integration — in other words, how the weight data are collected, distributed and used throughout the plant. Modern instrumentation is now designed for optimum connectivity based on a range of protocols including Modbus, DeviceNet, Profinet and EtherCAT.

Process weighing systems can be divided into three fundamental sections: the weighing structure and primary sensors, the weighing instrumentation, and the main control system. Given the mechanical and performance restrictions, strain gauge based load cells continue to be the dominant measuring sensor. Over 99% of weighing systems are based on strain gauge load cells and the reliability, accuracy and consistency of weight data are all directly dependent on the correct application of these products.

Whilst changes in load cell technology have been relatively slow, by comparison developments in weighing instrumentation and control systems have been extremely rapid, especially over the past five years. In the 1980s and early ‘90s extensive plant automation was carried out, this being seen as the way to improve productivity and bottom line profitability. Even a modest level of automation brought significant savings in efficiencies and costs. During the second half of the 1990s it was recognised that many plants needed upgrading to take advantage of the explosive growth in computer and communications technology.

However, plants which carried out partial (and often isolated) automation five or ten years ago are now finding it difficult to upgrade or expand their system and integrating the ‘old’ with the ‘new’ is now a major headache for engineers. Many companies which concentrated on plant floor automation soon realised that they could not link their office environment with the

Further information can be found at www.siwarex.com

SIWAREX M developed by Siemens (see p34) has opened up a new dimension in the field of digital weighing technology. Through the use of the high resolution (one million parts) of the digital load cell, dosing applications – batch weighing or differential dosing – can now be achieved with extremely high accuracy. Existing applications can now use the full advantages of SIWAREX M without any mechanical changes. Recent trials have shown that batch run times and productivity have been improved by up to 20%.

Contact details of companies mentioned in this article are available to Industrial Bulk World subscribers.
manufacturing processes. Weighing is a prime example of this. Weight data are vital for many processes and the divide which exists between shop floor and office often had to be bridged by old-fashioned paper systems which resulted in laborious data entry and the inevitable human errors.

During this period only limited weighing system integration took place and such systems were often seen as a stand-alone part of any overall plant. The time honoured 4-20mA interface was the most widely used link between weighing systems and the control centre often based around large PLCs. Although this analogue interface gives reliable results, the ability to communicate with the weighing process itself is very limited.

Companies are now realising that full integration of weighing systems with their management systems such as MRP is very important. However, these companies want single source responsibility for such installations. Traditional software houses have very limited experience of weighing, while more traditional weighing companies often shy away from software integration. This leaves a gap for more forward-thinking companies which have the vision to see the overall picture where weighing is only one part.

A good example of the benefits of using digital systems is highlighted in vendor inventory management systems (VIMS). The use of VIMS is steadily increasing across many areas of process control. Typically suppliers of raw materials provide customers with both consignment stock and the storage vessels. The customer is charged on their actual usage with the responsibility of ensuring consistent supply placed with the supplier. Using modern links, weight data from the silos can be accessed on a regular basis providing real time details of actual contents and usage trends. These data allow the suppliers to optimise their delivery schedules, whilst still ensuring customers do not run out of vital raw materials.

Inventory management systems are not new, but most are based on analogue weighing systems. Unfortunately, dial-up systems based on this technology have distinct limitations.

By contrast digital systems can provide constant real time information on the contents of each silo and the health status of each and every load cell. If a problem arises it can be flagged up at the central PC and informed decisions can then be taken on what needs to be done to ensure minimum disruption to the process.

**THE RIGHT CHOICE**

The performance of any weighing system is dependent on a number of key factors, and ensuring the correct system is selected for a particular application is very important. However, understanding what is required from a system can be a complex and perplexing subject. Effective communication between client and supplier is essential but all too often ensuring this takes place in a clear formalised way may not be that straightforward – resulting in a gulf between what the customer thinks he wants and what the supplier is offering.

This is one of the reasons why the Weighing Group of the Institute of Measurement and Control have written their ‘Guide to the procurement and specification of process weighing systems’ (see insert story, opposite).

**LEGISLATION AND TRACEABILITY**

Meeting the requirements of growing legislation represents a major cost in time and resources for both suppliers and manufacturers in process control. Product traceability has had a major impact on process weighing especially in the food, pharmaceutical and animal feed industries.

In many weighing applications, bespoke software packages have drastically reduced the storage, manipulation and analysis of critical data. Such packages have been developed to meet the specific demands in areas such as Average Weight Legislation, FDA regulations and Medical Inspectorate requirements. They are designed to be integrated with existing management computer systems to provide a complete solution to the real time monitoring and paperless storage of data.

The new ATEX hazardous area requirements are of great significance in many process weighing applications. Although strict legislation has existed for some time, ATEX brings new implications for both suppliers and users alike.

**THE FUTURE**

Fundamental weighing technology, based on strain gauge load cells, is not expected to change dramatically in the next decade. The use of the digital load cell will increase as confidence in the product grows and
increased legislation for weighing equipment will place continuing and exacting demands on manufacturers. However, the advances in instrumentation, with the emphasis on communication, data processing and connectivity, will continue to grow rapidly, ensuring that weighing is very much an integral part of plant control.

In the drive for higher efficiencies and reduction in manpower, remote access to equipment is vital. Embedded web servers are now bringing almost limitless possibilities, allowing access via user-configurable interactive websites. Access to the critical parameters allows trouble shooting and system adjustments to be carried out remotely. In many cases any problems can be resolved without the need for an engineer to visit the site – which may be on the other side of the world.

Remote webside access can be achieved via Ethernet, standard PSTN modem, GSM or ISDN. Many analysts believe that Ethernet, whilst not being suitable for some of the more critical systems, may well leapfrog the current range of field busses as the preferred connectivity system within process control for a growing number of applications. Already proven in the office environment, Ethernet offers simple integration both at factory floor level and also up through the different control levels.

The new POWERDOS gravimetric small components metering system from m-tec (see p34) incorporates a new concept of hopper weigher. The cylindrical scale container is placed on a single-point measuring cell of hybrid design. The use of just one measuring cell makes the structural layout substantially simpler and the tare weight significantly lower, so one 50kg measuring cell is sufficient for a container volume of 40 litres. In practice there are two different options for installing the metering system. EBS 1 applies when there is sufficient space available near the mixer. The system is then installed so that the travelling weigher drives automatically to the docking position at the mixer, at which point the weighing container is emptied into the mixer. EBS 2 is chosen if access to the mixer from the inlet spouts is difficult or impossible. Under such circumstances the POWERDOS will not be installed near the mixer platform. Instead it can be placed on the platform below the mixer or also on the ground, depending on available space. www.m-tec-gmbh.de
Some recent technical developments in the field of weighing/weight measurement

**Tank and vessel weighing assembly:** Flintec has introduced its low-cost model 52-14 weighing assembly which is of all stainless steel construction. It is based around the low-profile stainless steel BK2 shear beam load cell and is available in capacities from 200 to 2000kg.

The mount is said to be very easy to install and the self-levelling wire rope suspension system ensures optimum load introduction, preventing unwanted side forces affecting weighing performance. This design also accommodates structural misalignment and movement caused by fluctuations in temperature. The IP67 sealed BK2 load cell is approved for use in both legal-for-trade scales (OIML) and hazardous area applications.

**DeviceNet weigh module:** Hardy Instruments of San Diego, CA, has released a new version of its HI 200DNWM weigh module which now provides easier programming and increased flexibility. A ‘command interface’ capability has been added to allow access to all parameters without the use of explicit messages. The module also features a selectable update rate of 10 or 55 per second.

This weigh scale module is designed for applications such as batching, blending, filling, dispensing and check weighing. It provides power for up to four load sensors, receives and digitises the weigh signal, and transmits gross, net or tare weight over the DeviceNet open network interface to other devices.

**Digital process transmitter:** New from GWT Global Weighing Technologies, Germany, is the PR 5210 ProfiBus Transmitter series which is said to combine reliable and accurate weight acquisition with extremely easy operation and setup. A wide range of strain gauge load cells can be connected and output is provided in the common ProfiBus-DP format.

Users are able to access directly all configuration and operation levels via the front serial interface using a Palm 105 PDA. A Windows Engineering Tool allows convenient configuration from a Windows PC or laptop.

**High-accuracy powder metering system with weighing range from 2g to 20kg:** In the autumn of 2002 m-tec mathis technik, Germany, unveiled its POWERDOS dosing and weighing system. This rapid gravimetric small component metering equipment includes a specially designed control system with a software module which can be implemented in the customer’s control computer.

One mobile metering station handles 10 or more raw material containers and all types of powder can be handled, include those with poor flow characteristics. The system offers an accuracy of plus-or-minus 1g. There are no internal moving parts and consequently the problem of wear does not arise (see also p33).

**Belt scales:** S-E-G Instrument of Sweden continues to develop its advanced belt scales and is believed to be the only manufacturer to hold European type approvals in all three OIML R50 classes - corresponding to a proven accuracy of plus-or-minus 0.25, 0.5 and 1.0%.

The company has recently supplied a triple idler system CK/Z-H13 to measure the raw material in a sugar processing plant at a specified accuracy of plus-or-minus 0.1%. The S-E-G modular system is said to be very reliable in harsh environments, particularly where long-term repeatability is required. The benefits of this system also include serial communication and a very simple maintenance scheme for increased productivity and accountability of the material flow within the sugar processing plant.

**Precision weighing and dosing:** Through the innovation of the SIWAREX M weighing and dosing system for SIMATIC, Siemens has opened up new possibilities in the sphere of digital weighing technology. Georg Angelov, based at the company’s Karlsruhe, Germany, plant says that in classic industrial weighing applications, load cells utilise the strain gauge principle with function modules such as SIWAREX M. For force and weight acquisition, different measuring principles such as vibrating wire transducers are used. With these types of load cells, no strain gauge is used, but depending on the type - one or two vibrating wires are used as the sensor.

Through the load cells’ internal electronics, the measuring wire is brought to a specific resonant frequency. When a load is applied to the cell, the length of the wire is changed, and with it the resonant frequency in proportion to the load. This change is then normalised to a weight by the integrated processor, with a resolution of one million digital parts.

To bring the benefits of digital load cell technologies in to the world of SIMATIC S7, the SIWAREX M module integrated weighing electronics has been developed, and can now also use digital load cells (see also p31).