

## Accurate liquid mass control through radioactive measurements

*Other industries are perfectly capable and able to use nuclear benefits.*

Ferret, Australia  
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Owners, distributors and processors of bulk materials are increasingly realising the requirement for accurate liquid mass measurement as opposed to volumetric measurement.

Coriolis mass flowmeters – a better way to measure liquid mass.

The emergence of enterprise resource planning (ERP) systems is one of the major factors forcing this change. The other driver is recent advances in process measurement instrumentation, which increase reliability and reduce inventory monitoring costs. There was little or no integration between the measurement of liquid mass storage and a company's computerised management systems.

Now, ERP systems access real-time measurements in the plant, not merely historical accounting figures derived from the value of opening stock plus stock added minus stock sold equals present stock value.

The development of digital Fieldbus technology offers ERP systems the ability to access information directly from the measuring devices.

Accurate inventory control increasingly requires that liquids be accounted for by weight and not volume, especially in custody transfer applications where product is sold by the kilogram.

Rising fuel and petrochemical prices are adding to the pressure on companies to accurately monitor their inventory levels.

In the past, the weight of the product manufactured in the plant and the weights of the component products in storage vessels were factored in, but they rarely took into account the factors that may affect the accuracy of a process measurement. The reason is that temperature and pressure affect volume but not mass.

Instrument manufacturers have risen to the challenge and found better ways to measure liquid mass. For solids, this has not been a problem, since it is still acceptable to convert a level measurement into weight by assuming an average density of the product.

Historically, liquid mass has been measured using loadcells or, more recently, strain-gauges which weigh the vessel or tank in which the liquid is contained.

Unfortunately these methods have limitations that generally render their measurements less reliable and repeatable than desired. For example, they require frequent recalibration, their installation costs are high and environmental factors, such as wind, rain and plant vibration can affect their accuracy.

It is far more practical to measure the mass of liquid, as the vessel is being filled or emptied, and this may be achieved through the use of Coriolis mass flowmeters such as Endress+Hauser's Promass.

A sensor is mounted at the inlet side of the tubes and another at the outlet. In its basic form, each meter consists of two metering tubes, which are oscillated at their natural frequency. Under no-flow conditions, the frequency signals monitored by the sensors are exactly in phase with each other.

As the mass of the liquid starts to flow through the meter, a distortion of the meter geometry occurs, resulting in a phase difference between inlet and outlet sensor.

The phase difference is directly proportional to the mass flow rate of the liquid. Accuracies to within 0.5% of reading are achievable and, in special cases, to within 0.1%.

Installing a Coriolis flowmeter on the inlet, outlet or both, enables management to accurately determine, in real time, the exact mass of material in stock and, therefore, its value.

In certain mass-flow applications with high flow rates or large-diameter pipes, it may not be possible to use a Coriolis flowmeter. **Instead, a radiometric measuring system, with an electromagnetic flowmeter, can be installed. The radiometric system consists of a radioactive source, such as caesium, or cobalt, and source container, a detector (or scintillator tube) and transmitter.**

**Extremely low levels of gamma radiation - emitted from the source - are attenuated as they pass through the material being measured. The highly-sensitive scintillator tube measures the relative degree of attenuation and converts the signal into a density measurement.**

This measurement, combined with the volumetric flow measurement obtained from the electromagnetic flowmeters, provides a mass value that is accurate to within 2% of the reading. This is generally acceptable in the mining and chemical industries.

It is these advances in technology and ERP systems, combined with the growing popularity of digital Fieldbus technology, which will give users complete access to, and control of, all plant and process data from measurement to management.

This will improve control over stock levels, allowing plant operators to optimise their operations and deliveries, reduce product losses through leakage or theft and ultimately lower their operating costs.