# New Measurement Method Increases Efficiency

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*The Fluxys LNG Peak Shaving in the back port of Zeebrugge (Belgium) dates from 1978. Here, liquid natural gas, supplied by trucks from the LNG terminal in the front port of Zeebrugge, is stored. When the gas demand is higher than the primary supply (through pipelines from Norway and Great Britain or LNG tankers, such as the Methania), the "supply" in the LNG Peak Shaving is "heated" to 2°C and sent into the network.*

The heating of LNG or Liquefied Natural Gas (kept at –162°C) to gaseous form (approximately 2°C), takes place in a regasification installation for which the energy is supplied by gas burners. To keep the exhaust gases of this installation as pure as possible (free of CO and $NO_x$), specific controls are used on the burners, whereby the amount of air supply to the burner basins is a key factor. To better control the supplied amount, the pressure measurement control on the air supply was replaced by a mass flow meter. This more accurate control increased the efficiency of the burners and ensured compliance with the local VLAREM exhaust regulations for CO and $NO_x$.

*Picture 2: The Fluxys LNG Peak Shaving installation in the port of Zeebrugge (Belgium), dates from 1978*

This article is about the replacement of the pressure transmitters and is based on an interview by the Belgian magazine Industrie Technisch Management with Mr. Jean Joris, technical responsible for the Fluxys Peak Shaving, and Mr. Gustaaf Schelkens, sales responsible for Magnetrol Belgium, the company that delivered the mass flow meters for this application.

## Centre

As with the Belgian energy sector, the market for natural gas distribution has separated the "network management" from the "commerce". In Belgium, Fluxys is the company responsible for the transport of natural gas. The LNG Peak Shaving installation dates from before this separation and was started in 1978. In those days, the installation was at the end of the gas line (natural gas entered Belgium from The Netherlands) and its single purpose was to gasify stored LNG in periods of high demand (winter), and send it into the network to maintain a constant pressure. In a period of low consumption (summer), natural gas was taken from the pipelines and liquefied for storage by means of a liquefier installation. Today the natural gas is supplied in liquefied form by trucks from the LNG-terminal.

*Picture 1: Magnetrol supplied the TA2 mass flow transmitters for this application*

Zeebrugge is an important transnational centre for the distribution of natural gas. It has the capacity to handle 15% of the natural gas consumption of continental Western Europe. Norwegian and British natural gas is supplied through pipelines, and LNG-tankers such as the Methania deliver gas via the front port of Zeebrugge.

## Evaporator

Today, the Peak Shaving installation consists of three parts. The first part is the "intake". Trucks transport 41 Nm³ of LNG at a time from the LNG terminal at the front port of Zeebrugge to the "intake". The second part is the LNG storage. This consists of two overground tanks, which each have a design capacity of 57.250 Nm³. The gas is preserved in liquid condition at –162°C. The cryogene boil off gas (LNG which evaporates at the surface) is diverted by compressors and pumped into the gas network.

*Picture 3: The LNG Peak Shaving installation has 5 LNG evaporators. In the background you can see the overground storage tanks.*

The third part is the evaporator. It is activated when users at the storage ask for it. When the installation is in standby (cryogenic pumps cooled, …), the evaporators can deliver natural gas within twelve hours. When the installation is not in standby, it takes twenty-four hours to deliver gas. This may seem a long time, but it is more than adequate. The gas distribution network with 3.800 km of conduit-pipes (600 or 1200 mm for 66 and 80 bar) is an important buffer. When the users of the natural gas distribution network require a capacity which makes it necessary to activate the LNG Peak Shaving installation, the buffer in the pipes provides enough time to start up the evaporators on the installation, without causing a spectacular pressure drop.

There are five LNG evaporators in the LNG Peak Shaving installation. They consist of a heated 40.000 l water basin and a gas spiral, which runs through it. This spiral is the heat exchanger in which the transition of LNG / gas takes place. Each evaporator can evaporate more than 80.000 Nm³/h of LNG at –162°C to gas of 2°C. This natural gas is then pumped into the conduit pipes. The energy (per evaporator) to evaporate gases is delivered by two burners with a capacity of 9MW each. Their exhaust gases bubble through the water basin and heat up the water while it improves the thermal dispersion between the heated water and the gas spiral.

## Control Through Air Flow

The burners are controlled by the air flow of the ventilators. The correct amount of air delivers a higher combustion return, but the air control also has its effect on the environment. VLAREM (Flemish Environmental Administration) makes it necessary to minimize the CO and $NO_x$, which requires a correct calibration of the combustion air supply. Too little air supply creates CO, and too much air supply results in $NO_x$. However, too much air, to a certain level, also cools down the flame and reduces the formation of $NO_x$ ($NO_x$ is formed at high temperature, starting at a flame temperature of 800°C).

Previously, a pressure measurement was used to control the air flow. This system was based on the classic pitot's tube over which differential pressure was measured. The maximum air velocity is about 60 m/sec in a 400 mm diameter tube. The created overpressure is limited to 235 mbar and the differential pressure, used for control, is not higher than 6,5 mbar. Based on such a small measurement window, it is difficult to measure or control accurately, but this was the only measurement principle available at the time. At Fluxys, evolutions in measurement are carefully followed up and, within budgetary agreements, the installations are kept up to date.

Tests had been conducted with positive displacement meters, a measurement system based on a little paddle rotated by the flow. This worked very well in the summer, but in the winter it had a tendency to freeze up. In 2002 Fluxys tested the Thermatel TA2, provided by Magnetrol. The unit passed the test and TA2's were installed on all burners. The Thermatel TA2 is based on thermal mass flow measurement. The choice of Magnetrol's Thermatel TA2 is based on good experiences with the material and the supplier (Echotel ultrasonic level switches are already used on the oil reservoirs of the boil off compressors), but also on technical features such as the wide application range of the instruments (they are calibrated for a range between 12.000 and 19.000 Nm³ and have a turndown ratio of 100:1).

*Picture 4: The Thermatel TA2 is based upon thermal mass flow measurement*

## Thermal Mass Flow Meter

With this type of measurement, two RTD's (resistance temperature devices) at a fixed distance from each other, are placed in the tube through which the gas flows. One RTD measures the ambient temperature (the gas temperature), and the other one is heated to exactly 20°C higher than the process temperature. The gas flow cools down the heated RTD

*Picture 5: The instruments are installed in a hazardous environment zone 2. Therefore they are equipped with an EExd housing.*

and makes it necessary to continuously add heat. The energy, necessary to keep this delta of 20°C, is the measure for the gas flow, which is the mass flow that passes by the sensor. The microprocessor in the meter compares the consumed energy with a calibrated curve and translates the energy consumption to mass flow. This measurement is insensitive to vibration and therefore very useful. It is insensitive to pressure and temperature because it is a comparative measurement. The TA2 sensor measures the process temperature and compensates the mass flow in function of this temperature because the heat transfer at various temperatures can be different. A limitation of this type of meter (independent of the brand) is that the instrument does not react to sudden flow changes (the temperature stabilization takes a while), but this limitation is not important for this application.

This mass flow meter requires energy, and is installed in a hazardous environment zone 2 (presence of gas possible). Therefore, this instrument is equipped with an Exd housing. Exd means that gas may penetrate the housing, but an explosion must be contained within the housing and the flame path or the gases that leave the housing, must have lost energy to such degree that they cannot ignite possible gas in the environment. (Exi can be another requirement within hazardous environments, whereby the internal power, which supplies the instruments within the housing or the energy accumulated via capacitators and condensers is too small to deliver enough energy to ignite gases in the environment. Also known is EExp, whereby the housing is kept in overpressure so no gas can enter). In general, Fluxys' experience with Exd housings is that they can give condensation problems (moisture seeps into the housing, and is difficult to evacuate), which causes the internal electronics to corrode and – sometimes due to short circuiting – fail. However, experience with the Thermatel TA2 shows that this instrument does not suffer from this problem.

## Stack Gas Flow Metering Systems Brochure


A new 6 page brochure entitled Torbar and SG2000 Stack Gas Flow Metering Systems has been produced by **Torbarflowmeters Ltd** (UK).

It explains how the Torbar Averaging pitot flow meter is used with the new SG2000 metering package to measure the flow of stack gas which is emitted into the atmosphere.

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## New High-Accuracy, Space-Saving Flow Meter Measres Gases In Crowded Installations

Engineers and technicians seeking a highly-accurate, reliable mass flow measurement solution for hydrogen, natural gas, and other gases in small line processes and for skid-mounted equipment assemblies will find the new ST75V™ Air/Gas Flow Meter from **Fluid Components International** (USA) delivers breakthrough performance in a space-saving design that simplifies installation and reduces costs.

The ST75V combines highly reliable, no-moving parts thermal mass flow sensing technology with built-in precision Vortab® flow conditioning to achieve +1% rdg, +0.5% fs accuracy, in line sizes from 0.25 to 2.0 inches (6 to 51mm). It sets a new industry price-performance standard for mass flow measurement accuracy at an economical installed cost--with low maintenance and low lifecycle costs as well.

In many applications, either space limitations or other devices, such as valves or elbows, make it impossible to install a flow meter with the required upstream/downstream straight-pipe run. This results in swirl and flow profile disturbances that invalidate the flow meter's accuracy. The ST75V solves this problem with built-in flow conditioning that eliminates media disturbances while reducing the needed pipe straight-run by up to 70%.

The ST75V's integral Vortab flow conditioner features a unique, engineered array of tabs. They provide rapid cross-stream mixing to remove swirl and velocity problems, creating a smooth, fully developed flow profile for accurate measurement. There is also virtually no pressure loss with Vortab technology, which reduces plant energy costs by optimizing throughput.

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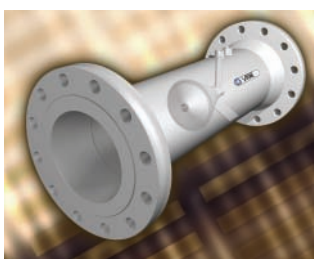
## Rugged V-Cone Flow Meter Ideal For Gritty Oil Sands Separation Processes



Oil Sands process engineers looking for a rugged all-purpose flow meter that delivers high accuracy measurement in dirty liquid, natural gas or steam media will find the versatile V-Cone Flow Meter from **McCrometer** (USA) is the right fit for extreme process environments.

Extracting oil from tar sands, which include a combination of crude bitumen (a semi-solid form of crude oil), silica sand and clay minerals, requires three processes - extraction, separation and upgrading. The tar sands are typically mined from open pits and sent to a plant, where a hot water process and agitation are used to separate bitumen droplets that are later upgraded into synthetic oil.

Other alternative oil sands processes inject heated steam directly into the sand for the purpose of separation where bitumen deposits are deep below the surface. No matter the process, large amounts of water and energy are required for heating and pumping purposes. Flow meters that can accurately and reliably measure liquids, natural gas and steam play an important role in controlling and optimizing these processes to produce oil with the highest efficiency.

McCrometer's V-Cone Flow Meter provides a high accuracy, dependable flow measurement solution for oil sands production and refining in all media. It operates in the most demanding conditions—including dirty flows, high temperatures and high pressures with superior accuracy of +0.5% of flow rate and repeatability of +0.1%.

The precision V-Cone's unique no-moving parts design provides built-in flow conditioning, which also nearly eliminates the upstream/downstream straight pipe runs required by nearly all other flow meter technologies. Typical flow meter installations require 10 to 40 straight pipe diameters upstream from the meter and 5 or more straight pipe diameters downstream to eliminate the effects of swirl and other pipeline disturbances caused by valves or elbows that negatively affect measurement accuracy. The space-saving V-Cone reduces typical flow meter straight pipe run requirements by up to 70 percent or more and needs only 0-3 straight pipe diameters upstream and 0-1 downstream to operate effectively. It fits in crowded separation plant layouts as well as in refineries, while also reducing pipe material costs and installation labor costs dramatically.

The versatile V-Cone operates over a wide flow range of 10:1 and supports line sizes from 0.5 to 120 inches. Oil sands process engineers can rely on the V-Cone Flow Meter for long life and low cost of ownership because it requires virtually no recalibration or maintenance over an exceptionally long life. McCrometer's versatile V-Cone Flow Meter is compatible with the demanding standards set by the oil/gas production, delivery and refining industry. The testing of the V-Cone Flow Meter now conforms to the American Petroleum Institute's API 22.2 Testing Protocol for differential pressure flow measurement devices.

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## Non Electric Liquid Level Indicator Replaces Dirty or Cloudy Sight Windows

A patent has been awarded #5,425,271 on **Thomas Products** (USA) newly invented model 5100 liquid level indicator. This model installs in the side of the tank into a ¾" NPT boss at the points of indications. It gives safe and positive indication of levels.

Operation is simple: A magnet equipped float pivots on an axle in direct response to the liquids level. In a separate chamber, and not in contact with the liquid, is a two-colour indicator also housing a magnet. Both are magnetically coupled. As the liquid level lowers, the float responds by turning the indicator towards the red side, indicating the liquid level is OK.

Maximum temperature of 225ºF and pressure to 400 PSI. All wetted parts are Brass and SST or all SST.

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