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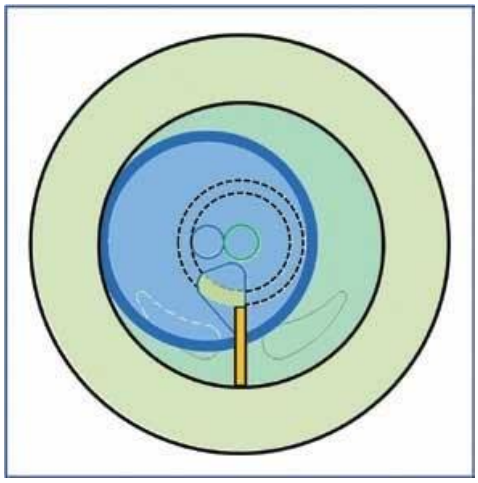
Titan Enterprises Reviews Flow Meters for Petrochemical Applications

This **technical review** by Titan Enterprises discusses the flowmeters used within the petrochemical industry, particularly for chemical additive injection.

Rotary Piston Flow Meters

Rotary piston meters contain a circular cavity inside which "rotates" in a circular disc. With every rotation, a known amount of fluid is displaced. While a spindle circulates a central boss, the actual piston motion could be referred to as "nodding" as the circular element only describes an oscillation bounded by the circular spindle track and the linear divider that makes the piston to slide in a "circular" motion within a round chamber.



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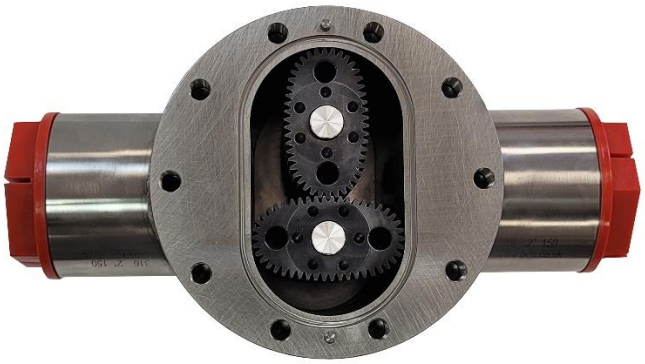
A fluid of fixed volume is transferred both inside and outside the piston, from the inlet to the outlet. Rotary piston meter manufacturers carefully choose materials that have both low friction coefficients and limited sliding areas. Besides enhancing the linearity of flow meters, these techniques also extend the operating range. By definition, these are characteristically low-resolution meters. Their central spindle usually has a single magnet, but certain devices will have multiple magnets in an oval pattern to boost the resolution of the meter. Unfortunately, metering of petrochemical additive injection fluids implies that the rotary piston meters are extremely sensitive to wear and contamination and have a lot of sliding surfaces.

Spur Gear and Oval Gear Meters

Although these two types of gear meter are superficially the same, they operate in very different ways. Typically, a standard gear meter has a few very large gear teeth meshed in a chamber with close clearances on all surfaces. As the teeth themselves form a seal along their length, the only possible leakage path is around the outside of the meshed cogs to the chamber walls. The pressure imbalance across the gears causes the rotation of the gears, displacing a volume of fluid about equal to one gear tooth volume. A sensor is normally used for counting the passing of each tooth, producing a high-resolution pulse train.



Titan Enterprises' Oval Gear Flowmeters

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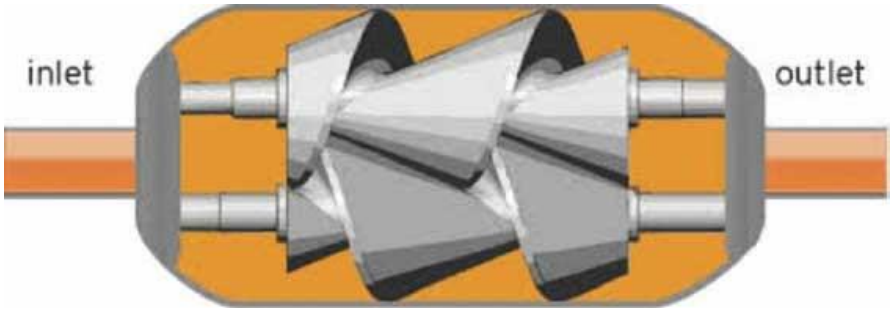
Oval gear meters work based on a completely different theory. The teeth in an Oval Gear meter are still used for driving the gear and sealing the central path but the differential force is developed not by the shape of the gear teeth on the lobe, but that of the ovals. Oval Gear flowmeters can include gears of varying oval shapes according to the flow requirement and resolution of the target application. It is possible to generate a much greater driving pressure by using an oval shape which results in lower pressure drop and in a wider flow range compared to a standard gear meter.

This also allows adequate operation of the meters with lower viscosity fluids. The volume which is displaced is a product of the oval shape, not the gear profile. Generally, the sensor is magnetic and has a detector at the face of the gear. While the resolution is lower than the standard gear meter, multiple magnets can sometimes be integrated.

Helical Flow Meters



Helical flow meters use a pair of helical gears rather like two Archimedes screws intermeshed. Hence, the cross-section of the chamber is similar to a figure of eight. The two rotors are “meshed” along their length and synchronized using a pair of ordinary gears at one end. As the fluid passes down the chamber, it rotates the gears. These devices are very accurate, and thanks to the detection of motion taking place on the meshing gears, provide high resolution. However, they are sensitive to contamination.

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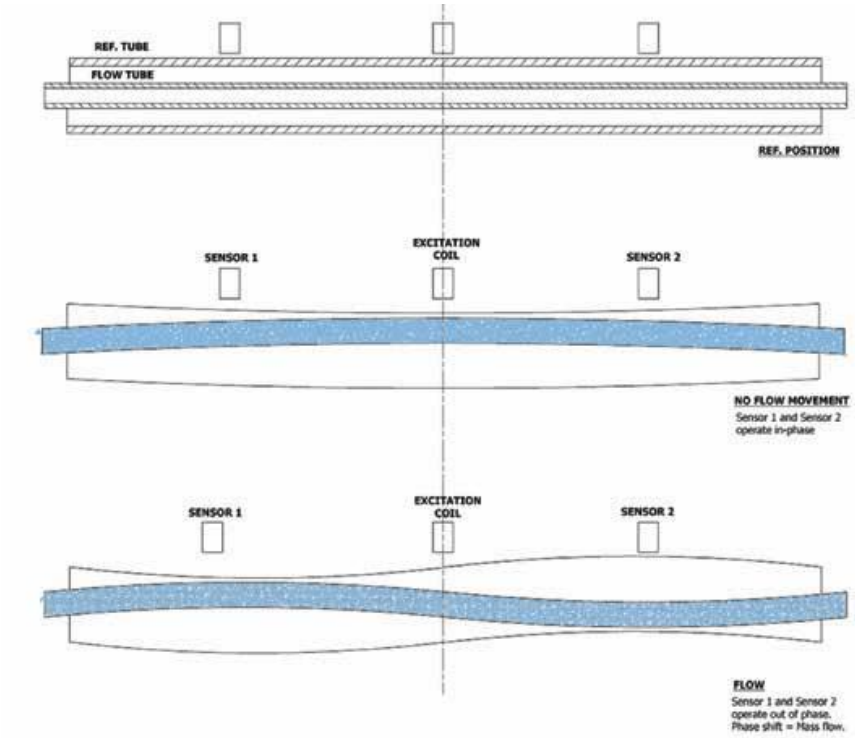
Coriolis Flow Meters

Coriolis flow meters for petrochemical applications still use moving parts but only minutely and on the outside of the flow tube. They use the fact that if a tube full of moving fluid is vibrated, it will cause a reaction to the fluids' movement that is proportional to the mass of fluid flowing in the tube; the faster the flow, the greater the reaction. Since Coriolis meters detect the reaction of mass flow, they are inherently mass flow meters and will meter both density and volume. It is rather like trying to rotate a gyroscope at 90° to the spin axis where the external force will induce a reaction at 90° to the applied force. Such meters are very sensitive and will meter very low flows even with some contaminants very accurately. However, typically Coriolis flowmeters are also relatively expensive.

Ultrasonic Petrochemical Flow Meters

Ultrasonic flow meters are yet to join the armoury of petrochemical low flow metering tools in a substantial way, but very low-flow high-pressure products, which will handle both the flow rate



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and very high pressure, are presently under development. Ultrasonic flow meters show a very promising prospect, as their manufacturing costs should allow a much lower installed cost than the Coriolis flow meters although without the mass flow and density outputs which are not always necessary.

These will be the preferred time of flight devices, such as Titan's Atrato® ultrasonic flowmeter, as Doppler shift meters are not likely to ever achieve the required performance.

Conclusions

With each of the petrochemical flow meter technologies reviewed here having its own advantages and disadvantages, the selection will greatly depend on personal experience and financial constraints. The rotary piston meter has plenty of sliding surfaces and is very susceptible to contamination and wear. The standard gear meter has a comparatively high pressure drop and demands a completely lubricating fluid. Although oval gear meters have a relatively low resolution, this may not be a problem where the consumption and control of a fluid over 24 hours is essential.

When compared to the other gear meters, helical meters are bulky, more expensive, and require lubricating fluids. Coriolis meters, which are apparently the panacea for additive injection, are prohibitively expensive allowing a compromise in flow meter choice.

It is believed that future developments in ultrasonic metering will close the gap with an acceptable performance at an acceptable price. Ultrasonic flow meters will certainly be a welcome addition to the low flow metering armoury.