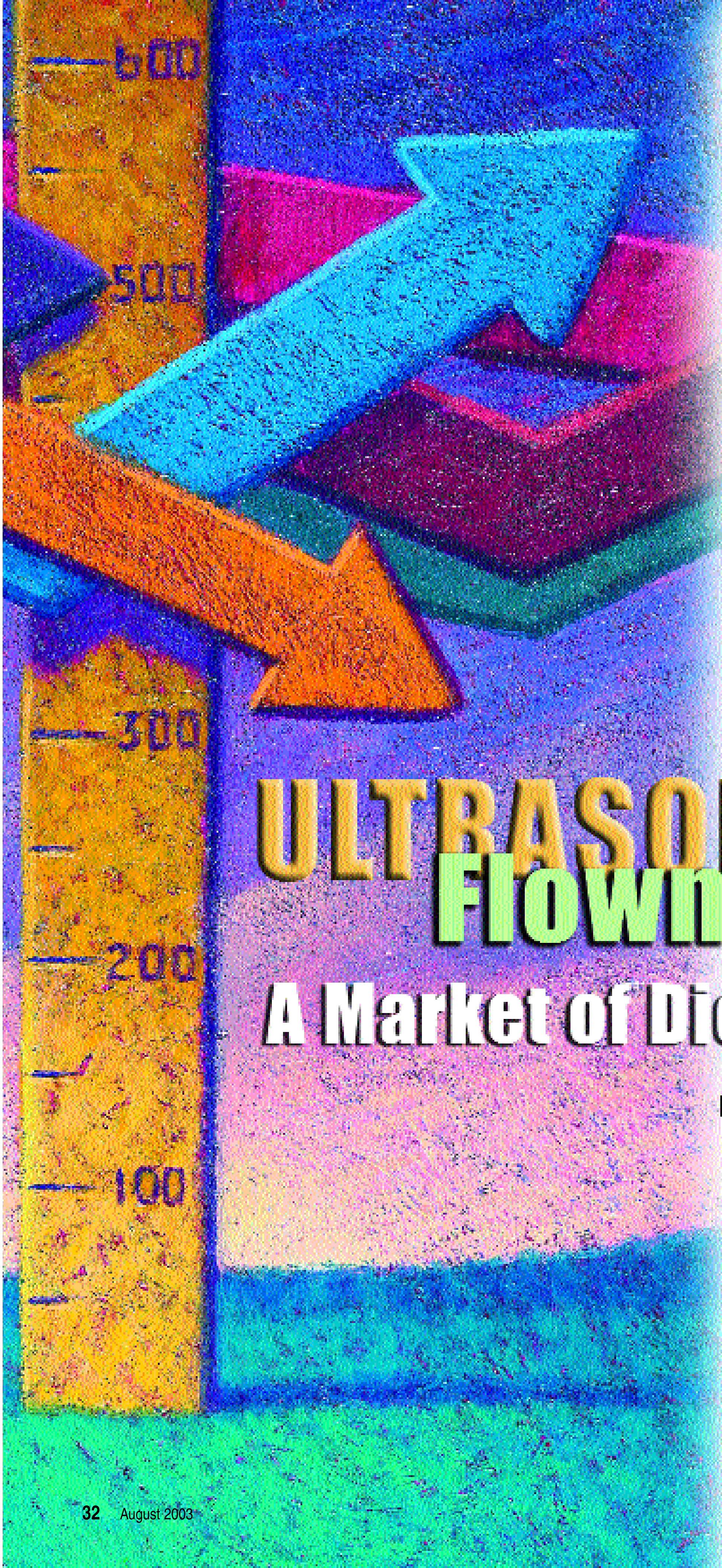


ULTRASONIC Flowmeters: A Market of Dichotomies

By Jesse Yoder

The history of ultrasonic flowmeters goes back to 1963 when Tokyo Keiki (now Tokimec) of Japan introduced the world's first commercial ultrasonic flowmeter. Ultrasonic flowmeters were first introduced into the United States in the early 1970s. In the late 1970s and early 1980s, ultrasonic flowmeters were tested for use to measure gas flow. A surge in their use to measure gas flow occurred in 1995, and continues today. In the meantime, many advances have been made in the use of ultrasonic flowmeters to measure the flow of liquids.

There are a number of dichotomies associated with ultrasonic flowmeters. These include transit time vs. Doppler, clamp-on vs. inline, gas vs. liquid, and single path vs. multipath. These dichotomies mark important differences in the application and performance of ultrasonic flowmeters. Likewise, the growth rate of different segments of the market varies, depending on which side of these dichotomies is involved. For example, the market for measuring gas flow is growing significantly faster than the market for measuring liquid flow.

Transit Time vs. Doppler

While transit time and Doppler are both types of ultrasonic flowmeter technology, the measurement methods are quite different. Transit time flowmeters use two transducers to send an ultrasonic signal from one side of the pipe to the other. One transducer is a sender and the other is a receiver. The ultrasonic signal is sent both with the flow and against the flow. When the signal travels with the flow, it has higher velocity than when it travels against the flow. The difference between these two velocities is proportional to flowrate.

Like transit time flowmeters, Doppler meters use transducers to send an ultrasonic signal into the flow. However, instead of sending the signal to a receiver on the other side of the pipe, Doppler meters bounce the signals off of bubbles or particles in the flowstream. As the signals are deflected, a frequency shift occurs. This frequency shift is proportional to flowrate.

Transit time flowmeters work best with clean fluids, although advances in electronic processing technology have enabled them to be used with fluids containing some impurities. Doppler flowmeters, by contrast, require the presence of impurities in the flowstream. The accuracy of transit time flowmeters is better than that of Doppler flowmeters. However, measuring the flow of dirty fluids is a more difficult measurement than measuring the flow of clean fluids.

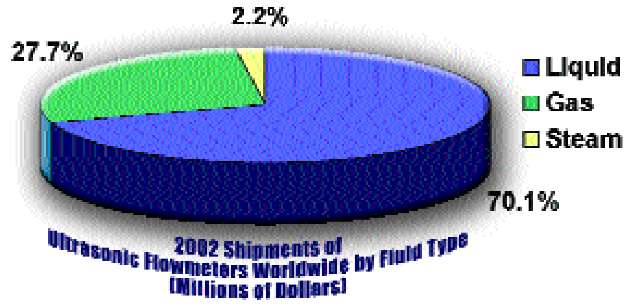
Clamp-on vs. Inline

Another important distinction within the ultrasonic flowmeter market is the difference between clamp-on and liquid flowmeters. Clamp-on ultrasonic meters clamp onto the outside of a pipe and send the ultrasonic signal through the pipe wall to a transducer mounted on the other side of a pipe. One advantage of these meters is that they are completely non-intrusive, since the transducers do not actually penetrate the pipe wall. They are also very easy to move from one pipe to the other, and they can be mounted without cutting into the pipe.

For spoolpiece ultrasonic flowmeters, the transducers are mounted on a section of pipe called a spoolpiece. The transducers are mounted in the pipe wall, and may penetrate slightly into the flowstream. The transducers use what are often called wetted sensors, since the sensor assembly may come into contact with the fluid. Spoolpiece ultrasonic meters are used to measure both gas and liquid flow.

While clamp-on ultrasonic meters have their advantages, they also introduce some uncertainties into the flow measurement. The material in the pipe wall deflects the sound wave, so it is helpful to know the composition of the pipe wall material when mounting a clamp-on flowmeter. The pipe wall material may also weaken the ultrasonic signal. In addition, inside diameter of the pipe may be diminished by buildup in the pipe. Understanding and compensating for these factors, where appropriate, is important.

While clamp-on meters have traditionally been used to measure liquids, GE Panametrics has introduced a clamp-on meter for measuring the flow of gas. Spoolpiece ultrasonic flowmeters are used to measure custody transfer of natural gas. The use of ultrasonic flowmeters to measure steam is still in the early stages.

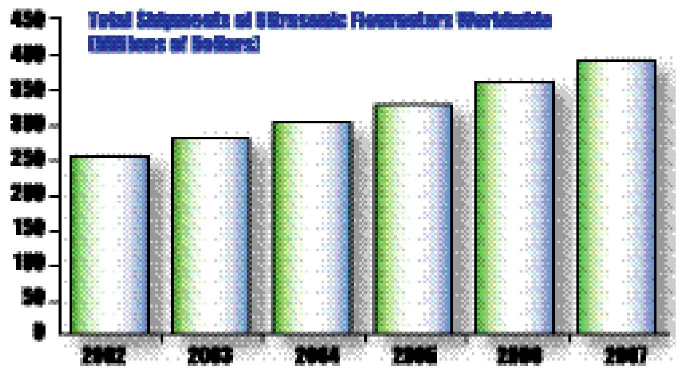


Gas vs. Liquid

The use of ultrasonic flowmeters to measure gas flow got a boost in 1995, when Groupe Europeen de Recherche GaziSres (GERG) published Technical Monograph 8. This document laid out criteria for using ultrasonic flowmeters for custody transfer of natural gas. It caused an upsurge in the use of ultrasonic flowmeters in Europe for custody transfer. In June 1998, the American Gas Association (AGA) followed suit by issuing AGA-9, which also listed criteria for using ultrasonic flowmeters for custody transfer of natural gas.

Since 1998, the ultrasonic custody transfer gas flow market has become the fastest growing segment of the flowmeter market. While this growth is continuing today, special factors influenced the market in 2002. This winter was abnormally warm in 2002, reducing the demand for natural gas and for heating oil. This had a negative effect on the sales of ultrasonic flowmeters in 2002. In 2003, by contrast, the winter in the United States was very cold, and natural gas prices have increased dramatically. Oil prices also climbed over the $30 per barrel figure during the winter. These factors are favorable to the sales of ultrasonic flowmeters for measuring gas flow.

While much of the attention has been on gas flow measurement, important advances have also been made in the measurement of liquid flow by ultrasonic meters. Krohne has introduced a five-path meter for measuring liquid flow and, more recently, a three-path meter. The American Petroleum Institute (API) has published a draft standard for the use of ultrasonic flowmeters for liquid flow measurement. These developments are likely to cause an increase in the sales of ultrasonic flowmeters for measuring liquid flow.



Single Path vs. Multipath

Increasing the number of paths used to measure the flowrate significantly increases the accuracy of ultrasonic flowmeters, up to a point. The ultrasonic flowmeters used for custody transfer of natural gas have four, five, or six paths, depending on the manufacturer. Some ultrasonic meters also have two paths. While these are not as accurate as the four, five, and six path meters, they are more accurate than the single path meters. Faure Herman has introduced an ultrasonic flowmeter with 18 paths.

While there is not yet a consensus on the effects on accuracy of increasing the number of paths beyond six, an increased number of paths does provide more information about the process. Thus manufacturers can be expected to continue to do research on the merits of having more paths in their ultrasonic flowmeters. One potential downside of having more paths is that it provides an additional potential source of error.

Summary

While the ultrasonic flowmeter market is a market of dichotomies, it is clear that the strongest growth in the market has been coming from multipath transit time flowmeters used to measure natural gas flow. At the same time, new products and industry approvals are giving a boost to ultrasonic flowmeters used to measure liquids. And while Doppler flowmeters may seem to get left behind in all this discussion, they do excel at a very difficult measurement: the measurement of dirty liquids.

About the Author

Dr. Jesse Yoder is president of Flow Research, which he founded in 1998. He has been a writer and analyst in process control since 1986. Dr. Yoder has written over 40 market studies and is currently completing a 12-volume series of studies on the worldwide flowmeter market. Included in this series is The World Market for Flowmeters, *which includes all flow technologies. Flow Research (*www.flowresearch.com*) offers a quarterly update service called the* Worldflow Monitoring Service. *You can contact Dr. Yoder by phone at 781 245-3200 or by e-mail at* jesse@flowresearch.com.