

When Do You Measure Mass Flow?

I gave a class in basic flow measurement the other night, and one of the attendees asked me a question that should have made me pause. He said that one of his clients had given him a requirement to write a specification for a flowmeter to be installed downstream from a pump. It was a Coriolis mass flowmeter. I asked him what the fluid was, and he said that it was plain water at ambient temperature and reasonable pressure.

It should have made me pause, but it didn't because for years I've heard the same thing. I once visited a pharmaceuticals plant in Pennsylvania where the chief I&C engineer proudly told me that he didn't use anything but Coriolis meters in his plant. I asked him what he did for water flows, and he said he used Coriolis. I asked him what he used for steam, and he said vortex, but if a Coriolis meter would work, he'd use that. Stunned, I asked him why. "Simple," he said. "I know that Coriolis meters work, and they are real accurate. And now I only have to train my techs on one kind of meter."

Measuring Mass Flow

If you are batching by weight or mass, you should measure mass flow. If you are measuring critical quantities, especially if the quantities involved are small, you should measure mass flow. If you are measuring gases, you should measure mass flow. Any critical blending operation should be mass flow. Chemical reactions generally require mass flow.

Basically, if you are working with molecules, you should measure mass flow. If you are working with a recycle loop, or the flow is steady state, volume will likely suffice. If you are filling a tank, you should be measuring volume, unless it is for custody transfer, and then you should measure mass.

So then, what do you use to measure mass flow?

You can use a Coriolis mass flowmeter. But there are other ways to measure mass flow.

In gases, you can use a Coriolis meter, but more commonly, the mass flowmeter of choice is a thermal mass flowmeter. In this device, the principle of measurement is based on the fact that the rate of heat absorption by a flow stream is directly proportional to its mass flow. Thermal mass flowmeters are available in many different styles, for many sizes of pipes and flow rates, including insertion styles for large diameter pipes and ducts.

In thick slurries, such as you would find in a mining operation or dredging, you can use a Coriolis meter, but more commonly, the mass flowmeter of choice is a combination of a magnetic flowmeter or Doppler ultrasonic flowmeter, and a gamma densitometer.

Why would you use these in preference to a Coriolis meter? Simply that the pipe sizes are generally larger than four inches, and the material is generally abrasive. Magnetic flowmeters have abrasion-resistant linings, and gamma densitometers are non-invasive. Here measuring volumetric flow and density and multiplying the two values produce the mass flow measurement.

Volumetric flow multiplied by density can be done with many different volumetric flowmeters, and with many different ways to measure density. You can temperature- or pressure-compensate any velocity-based flowmeter or inferential flowmeter (orifice plate). Each will produce a mass flow value. Each of them has a particular accuracy, reliability and cost. Which technique should you choose? Well, how much do you want the measurement to cost?

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