Mass Flow Metering – An Alternative Approach

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Abstract

Most flow meter designs are volume flow meters that require accurate knowledge of the fluid properties from an external source in order to convert the volume flow prediction to a mass flow prediction. Volume flow meter designs are wholly dependent on the independent fluid density prediction being available and trustworthy. Mass flow meters can be defined as flow meters which do not need the fluid density supplied from an external source in order to meter the mass flow rate. With no external density prediction required there is an advantage to direct mass flow metering.

There are significantly fewer mass meter designs than volume meter designs. There is the Coriolis mass meter used across industry and niche markets for the thermal mass meters and laboratory sonic nozzles for gas flow. However, industry has long had an alternative generic mass flow meter design, it has just never been developed into a product.

The mass flow meter concept of combining density sensitive meter technology (e.g. a DP meter) with density insensitive meter technology (e.g. turbine or vortex meters) to produce a mass flow, volume flow and density output has been about for sixty years. However, this superficially simple concept has until now never been successfully developed. The various prototypes over the years all had practical difficulties. Beyond the early computation limitations most hybrid designs suffered from the two meter technologies interfering with each other, and having different flow ranges.

VorTek Instruments and DP Diagnostics have now overcome these obstacles and have developed a practical simple mass flow meter based on this general concept. The design of a combined vortex and cone DP meter system installed in one compact spool has now been proven to operate as a mass flow meter, volume flow meter and densitometer, without any external fluid density input being required. The cone DP meter sub-system also has the latest DP meter diagnostic package (“Prognosis”) developed by DP Diagnostics.

In this paper, data from multiple meters tested at CEESI with air and with water are shown. Data from one of the commercial meters on site will also be shown. A 4” mass meter was installed on an oil truck in the US where oil density was not always precisely known. The data from this meter will be presented compared to the truck loading reference meter.