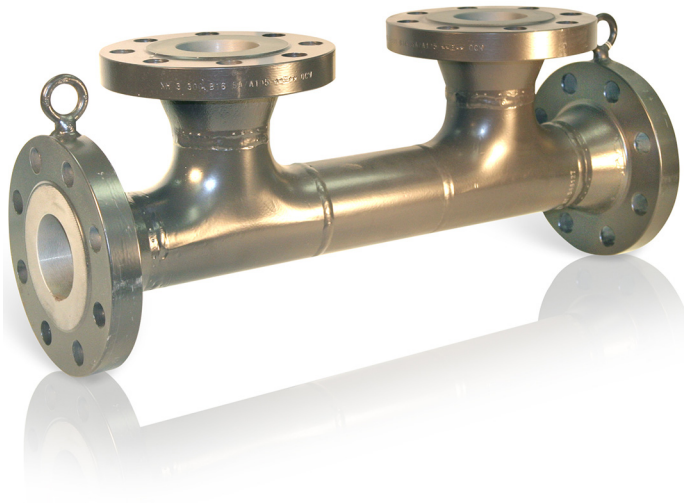
Application note AN/FLOW/002–EN

ABB Measurement & Analytics
Wedge in molten sulfur applications

Overcoming the challenges when measuring the flow of high viscosity fluids such as molten sulfur

Measurement made easy



Introduction

Most flow metering devices present challenges for accurate measurement when used on high viscosity fluids. Many devices are limited to low viscosity fluids, either by the nature of the metering technology used or by the effect that a high viscosity process may have on any moving parts.

ABB's FPD470 Wedge flow meters can overcome these limitations by combining Wedge's unique measurement technology with ABB's unrivaled remote seal transmitter technology. The application solutions described in this document can be extended to many processes using ABB FPD470 Wedge flow meters.

Molten sulfur

Molten sulfur, a by-product of crude oil refining and natural gas processing, is used in the production of insecticides, synthetic fibers, plastics, fertilizers, solvents, pigments, resins and many other products. Depending on the location of the measuring point within the process, viscosities can vary between 6 and 100 cSt. Maintaining a steady flow is challenging as the process can plug lines and cause production outages.

Wedge flow elements – when coupled to a suitable secondary transmitter – offer a solution using high temperature, remote seal technology. The unique shape of the wedge restriction enables linear and accurate flow measurement from Reynolds Numbers (Re) of 500 and above; whereas most differential devices are limited to Re values of 20,000 and greater. Integrating the remote seals eliminates the problems of plugging associated with conventional impulse lines and enables higher process temperatures to be used, thus preventing the fluid from solidifying.

The measurement of molten sulfur occurs at the recovery stage (refiner), during transportation and during tank loading / unloading. Meter sizes are usually in the range DN50 to DN150 (2 to 6 in.) for recovery stages; those used on transportation and terminal loading may range from DN100 to DN300 (4 to 12 in.). At this stage flows are generally between 1,500 and 8,000 tons/day. Loading points may have facilities to store between 80,000 and 300,000 tons of material.

Fig. 1 shows the placement of Wedge elements for both unloading and the initial processing stages in an application using molten sulfur. In all cases the piping and associated components are heat traced to maintain the temperature required to keep the sulfur in its molten state.

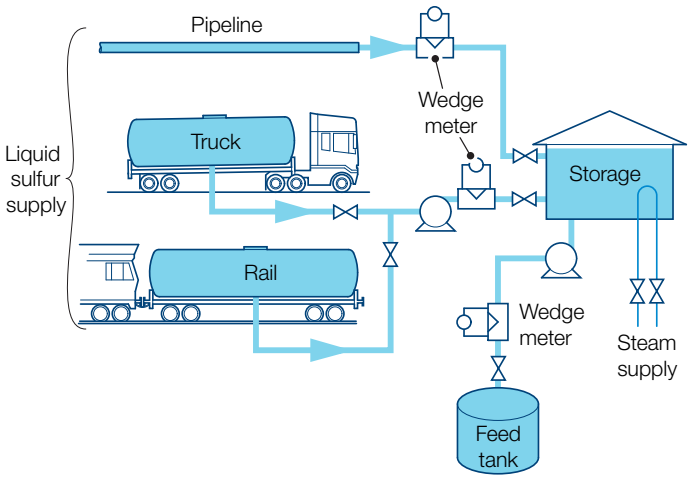


Fig. 1 Molten sulfur tank loading

Wedge meters are used in this application due to their ability to measure at low Reynolds numbers while maintaining linearity. Most differential producers operate within a 4:1 flow range, but Wedge technology extends this to 8:1 by nature of its design and the fact that each meter is calibrated to determine its precise meter factor. Figs. 2 and 3 show typical laboratory calibrations, over a wide flow range, for products applied to a slurry application. For the low flow calibration, special consideration was given to the glycerin / water mix used to achieve the proper viscosity to meet target Re numbers.

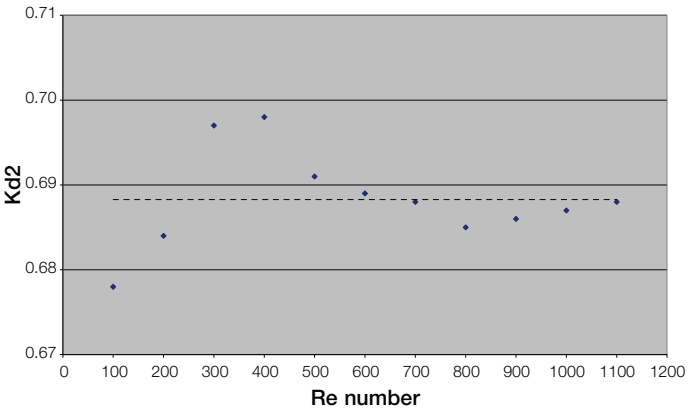


Fig. 2 Wedge viscous calibration

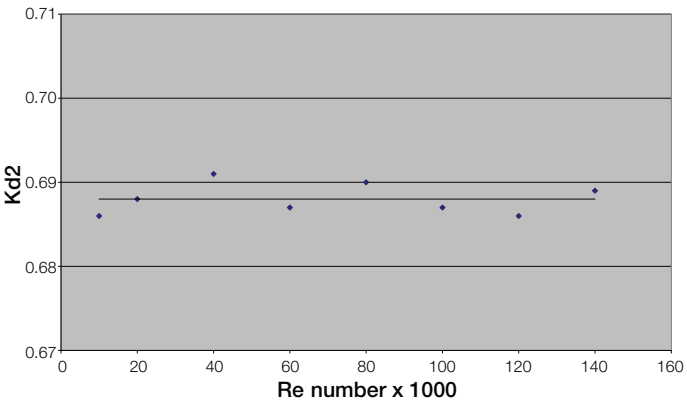


Fig. 3 3.6 in. Wedge kerosene calibration

Using an example flow rate of 450 tons/day, a 2 in. meter operates at an Re range of 4950 down to 500 or from 38000 to 4000 lb/hr under typical conditions for molten sulfur processing. An orifice plate of the same size and equivalent beta ratio would not only generate a higher differential (equating to higher pumping costs), it would be operating below the requirements of international standards for minimum Reynolds numbers.

The full Wedge solution requires the following:
— Wedge flow element
— secondary transmitter with remote seals
— isolation valves (optional – for ease of future servicing) between the meter tappings and the transmitter seals

The horizontal installation profile as recommended in Fig. 4 enables free passage of liquids, solids and entrained air through the Wedge restriction – an advantage over conventional orifice plate technology that causes a damming effect, leading to buildup of process material on the measurement face. Vertical installations are possible with flow in an upwards direction; this ensures the meter remains full of fluid at all times during measurement. Materials of construction used for the Wedge should match those of the pipeline, for erosion and corrosion compatibility.

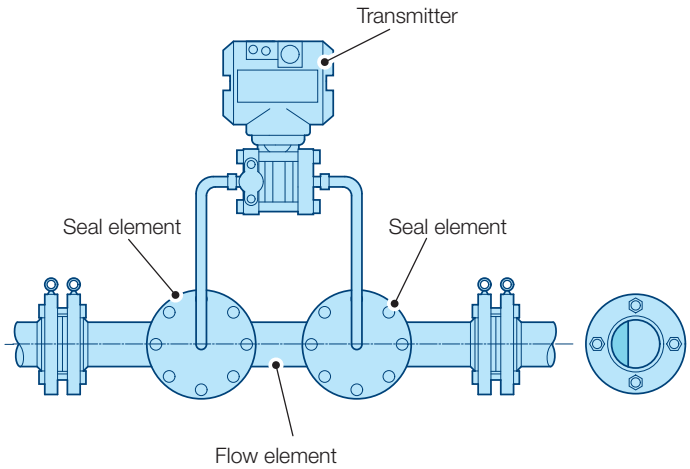


Fig. 4 3.6 in. Wedge horizontal installation

Key considerations when applying ABB's Wedge meters to slurry applications (such as molten sulfur and others) are:
— Wedge offers an extended flow range, beyond that of conventional DP primaries
— Problems with, and maintenance of, plugged impulse lines are removed by the use of remote seal technology
— V-shaped restriction reduces the possibility of process build up and enables free passage of multiphase fluids
— The measurement edge of the flow restriction does not rely on critical (sharp) edges for accurate performance
— No moving parts means reduced wear and maintenance

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Sales Service

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