Interface Measurement

Technology: Pressure

INTRODUCTION

Differential pressure (DP) transmitters are used to measure the interface of two fluids that have different specific gravities (S). To make an interface measurement, the overall level must be at or above the low pressure tap at all times. It is important that the level be large enough to create a reasonable DP between the two specific gravity extremes. This measurement can be done with or without remote seals. However, from a maintenance standpoint, it may be easier to use a remote seal assembly; keeping the wet leg at a constant height can be difficult in some applications.

SITUATION

A vessel requires an interface measurement where the level is 150 inches. The vessel has two fluids with specific gravities of 1.0 and 1.08.

To determine the calibrated range for the transmitter, four assumptions need to be made:

1. At the lower calibrated value, 4 mA point, the tank is filled with the lighter fluid.
2. At the upper calibrated value, 20 mA point, the tank is filled with the heavier fluid.
3. The taps leading to the transmitter are flooded at all times. The overall level should be equal to or higher than the upper (low pressure) tap.
4. There is always a reference level seen by the low pressure side. This can be accomplished with either a remote seal system or a wet leg. The reference level must have a constant height and density. The calculation is modified slightly for wet leg systems when the density of the high and low pressure wet legs differ.

The measured level is composed of a combination of the two fluids:

$L = L_1S_1 + L_2S_2$

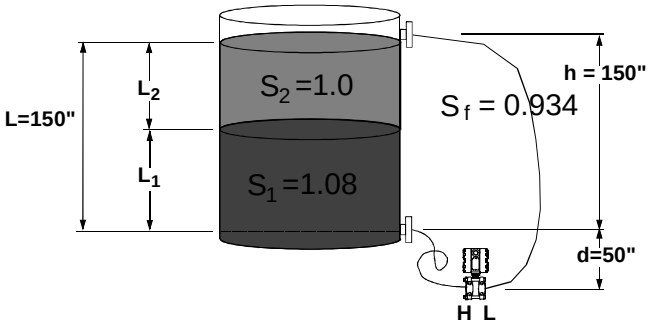


FIGURE 1. Calculation of interface measurement

- When the tank is filled with the lighter fluid, the transmitter will be at 4 mA (or 0% of span) and $L_2 = L$:

$HP = L_2S_2 + dS_f$

$LP = dS_f + hS_f$

$4\ mA\ DP = HP - LP = L_2S_2 - hS_f$

$DP = (150 \times 1.0) - (150 \times 0.934)$

$4\ mA = 9.9\ inH_2O$

- When the tank is filled with the heavier fluid, the transmitter will be at 20 mA (or 100% of span) and $L_1 = L$:

$HP = L_1S_1 + dS_f$

$LP = dS_f + hS_f$

$20\ mA\ DP = HP - LP = LS_1 - hS_f$

$DP = (150 \times 1.08) - (150 \times 0.934)$

20 mA = 21.9 inH2O

The calibrated span is 9.9 to 21.9 inH_20. When the transmitter reads 9.9 inH_20, the tank is filled with the lighter fluid. When the transmitter reads 21.9 inH_20, the tank is filled with the heavier fluid.

To determine where the interface of a mixture of fluids is, use the DP reading as a percent of span. For example, if the transmitter output is 18.4 mA or a DP of 20.7 inH_2O, the interface is calculated by using the formula:

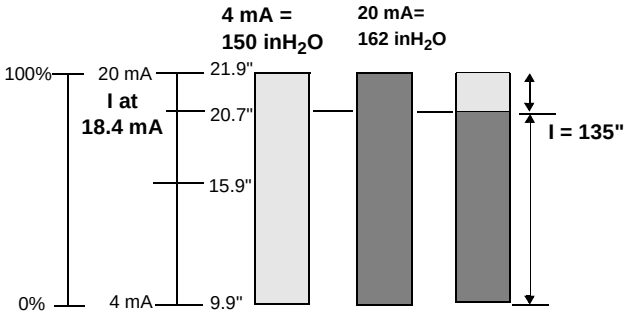
$$I = \frac{DP - LCV}{span} \times L$$

(where LCV= lower calibrated value)

$$I = \frac{20.7 - 9.9}{12} \times 150$$

I = 135" (physical height)

To show this graphically:



At 4 mA, tank is filled with lighter fluid

At 20 mA, tank is filled with heavier fluid

At 18.4 mA, tank is partially filled with heavier fluid and partially filled with lighter fluid

FIGURE 2. Interface measurement shown graphically

APPLICATION CONSIDERATIONS

Interface applications typically result in a small, non-zero based span. Size the transmitter appropriately to cover this span. For example, if the span is 22 to 25 inches, the transmitter needs to be able to handle a span as small as 3 inches and an upper range limit of at least 25 inches.

To increase the span, either the level (distance between taps) must be larger or the specific gravity difference of the two fluids must be greater.

Because of the typically small spans associated with interface measurement, carefully select the remote seal assembly and install it for optimum performance. Otherwise, the errors associated with the seal assembly could overwhelm the desired measurement. For example, if the DP is only 1 to 2 inches and the seal assembly contributes a 0.5 inch error with changes in ambient temperature, then the interface measurement could be in error by 25 to 50 percent. See TDS 3064, *A Guide to the Selection of Remote Diaphragm Seals,* for additional information on selecting remote seal assemblies.

Using a wet leg system can also create errors if the fluid does not stay at a constant height or density. For example:

- The height can change if the system is emptied and refilled, or if it is subjected to vacuum conditions.
- The wet leg fluid can also get mixed with process fluid and its density may change.
- The density of the fluid can also change as the ambient temperature changes.

When a wet leg system is used with the transmitter mounted below the tap, the fluid in the impulse piping on the high pressure side is subject to variation. Fill the piping with the denser fluid to maintain some uniformity and minimize mixing. It is preferable to use a direct mount transmitter on the lower tap.

Interface Measurement using DP Transmitters

Advantages

- Low cost
- Simple to install
- No additional components required

Limitations

- Span must be sufficiently large enough to measure; either the distance between taps or the specific grabity difference must be large
- Upper tap must be covered at all times.
- Small spans are susceptible to temperature induced errors.

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317
USA
Tel 1-800-999-9307
Fax (952) 949-7001

00816-0100-3207 Rev. BA, 5/01

Product documentation available at...
www.rosemount.com

ROSEMOUNT®

EMERSON™
Process Management