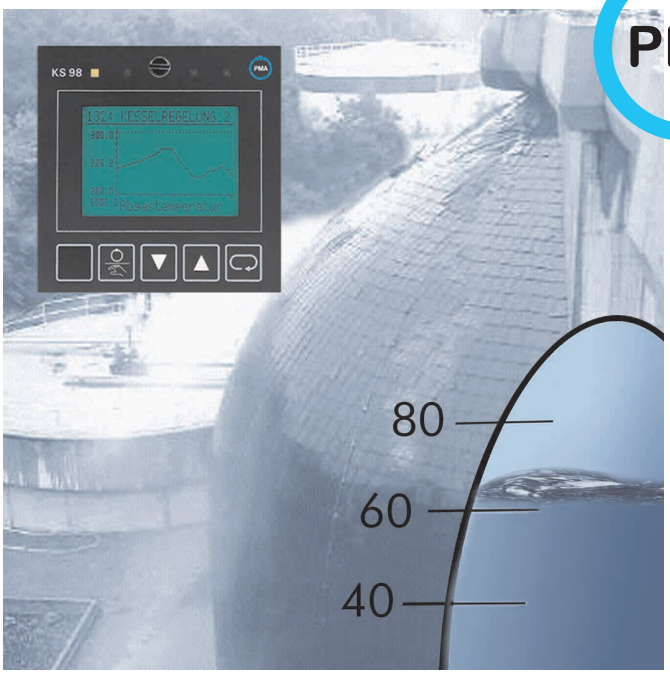


Level measurement

KS 98 application

Measurement of filling level in tanks with irregular cross section

Calculation for symmetrical conical vessels

Linearization with configurable segments (500)

Other signal types (pressure, potentiom., float switch, radar, etc.)

Display with large characters

Display in absolute and percentage values

Expandable for inflow/outflow monitoring (control)

KEY WORDS

Level measurement, volumetric calculation, irregular tank cross section, stock levels, Vendor-Managed-Inventory, level control

DESCRIPTION

On tanks with irregular cross section over the height, the volume is not proportional to the filling level. Therefore, the tank contents cannot be measured directly, but can be calculated from the level signal provided from a wide range of sensors. The most common types are: immersion sensors, resistive sensors, pressure sensors, radar, ultrasonic and microwave measurement, as well as float switches.

With a non-linear relationship between filling level and volume, the correlation for rotationally symmetrical vessels (spherical, elliptical, conical, etc.) can be calculated. However, in spite of very precise computed results, deviations from the theoretical volume can occur, e.g. as caused by slight deformations of the vessel's walls and/or through small deviations from the perpendicular (except with spherical tanks).

Therefore, it can be advisable to use a configurable linearization curve when calculating the volume of irregularly shaped tanks.

IMPLEMENTATION

The KS 98 controller is able to calculate every complex formula, as well as defining a linearization curve with up to 400 segments for a precise correlation of filling level and volume.

Simultaneously, this also enables non-linearities and systematic deviations of the level sensor to be compensated. Frequently, tanks with easily calculated rotational symmetry are used.

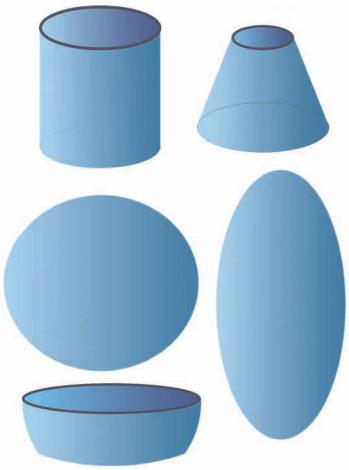


Fig. 1: Vessel shapes that can be calculated

But the tank volume can only be calculated precisely, if the tank has been mounted with an exact vertical and horizontal orientation.

Problematic and difficult to calculate are forms whose horizontal orientation and filling level can vary at the same time, e.g. with tanktainers or tanker trucks. In this case, an interpolation with 2 dependent variables must be carried out, which is possible with a special Engineering for the KS 98.

For the application described here, the formulas listed below are provided for standard shapes in the Engineering. Apart from the standard shapes, a configurable linearization can also be selected:

- Cuboid :V = h*a*b
- Constant cross section : V = h*a
- Ellipsoid/sphere :V = $p*a^2(h^2/b-H^3/(3b^2))$
- Spherical segment :V = basic spherical volume
- Truncated cone :V = $h*p*R^2/3H^2$ H = hmax*R/r
- Configurable table of values

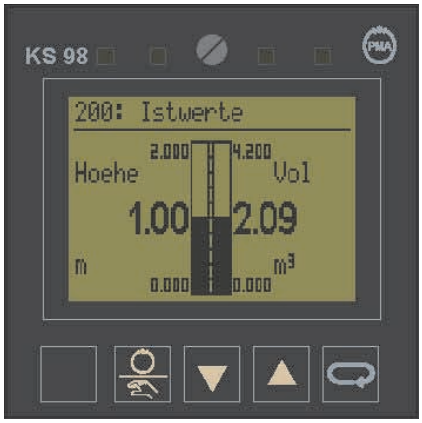
Should the required calculation not be available in the Engineering, additional formulas can be defined without problems. Of course, this Engineering can also be used as an application example for more complex calculations or similar applications.

The computing function described here can serve as the basis for a superordinate, more extensive Engineering, e.g. as a level, flow, or discharge control algorithm, for stock level monitoring or a reactor control system.

CONFIGURATION

As usual, the features of the KS 98 are used to produce a user-friendly operating display. For this, a selection screen offers the required functions (vessel shapes). The selected shape is marked, and the corresponding parameter page is displayed. Here, the shape-specific parameters such as diameter, maximum height, or base surface area are entered. If required, access to this page can be protected with a password. Parameter pages of the remaining vessel shapes are not shown.
By means of two bargraphs, the starting page then shows the process value (level) and the calculated volume together with the associated numeric values. Alternatively, these values can be displayed as percentages. Selection of the display mode is done by means of a hardware switch on the controller's main circuit board.

The user enters the 100% value on a separate configuration page, where he can also select a different display mode with extra large characters, or a combined display with absolute or percentage values, or as bargraphs.



UNLIMITED VERSATILITY

The flexible configurability of the KS 98 enables the above application to be extended with pre-configured library functions such as password protection, timer, programmer, etc., or even „homemade" partial Engineerings. With additional operating screens, for example 6-line text display, trend display, and bargraphs, the projecting engineer is able to increase the plant's operational functions. Moreover, by means of a user-specific menu structure, the transparency of the process data can be adapted precisely to individual requirements.

PMA
Prozess- und Maschinen- Automation GmbH
P.O Box 31 02 29
D - 34058 Kassel
Tel.: +49 - 561 - 505 1307
Fax: +49 - 561 - 505 1710
E-mail: mailbox@pma-online.de
Internet: http://www.pma-online.de

Your local representative

Printed in Germany - Edition 0103 - Subject to alteration without notice - 9498 737 42114