Inline-blending

KS 98 application

Batching control for mixing liquid, gaseous, and solid ingredients

High-precision batching

Continuous and batch-specific processes

Control of the ratio sums

Start-up and finishing gradients of total flow

Selectable master set-point

Monitoring of valve operations

Optional sum equalization control

KEY WORDS

Inline blending, flow ratio control, batching, recipe handling, mixture control, additives control.

DESCRIPTION

In oil refineries, the final composition of a product is achieved by a special process known as „inline blending". The end product is obtained by mixing various oil qualities and additives continuously and in precisely defined quantities. Due to certain variables during this process, such as reaction times in the control loop, changed mechanical settings, contamination of the control valves, or similar disturbances, deviations from the intended result can occur. These deviations can be detected by integrating the actual flow values, thus enabling the set-values to be corrected by a corresponding factor during the blending process. As a result, the final product that reaches the storage tank will have the exact required composition.

The inline blending process is not limited to oil refineries, but is also used in the chemical and pharmaceutical industries, foodstuffs and animal feed industries, and in any other process where different ingredients are mixed according to a defined recipe.

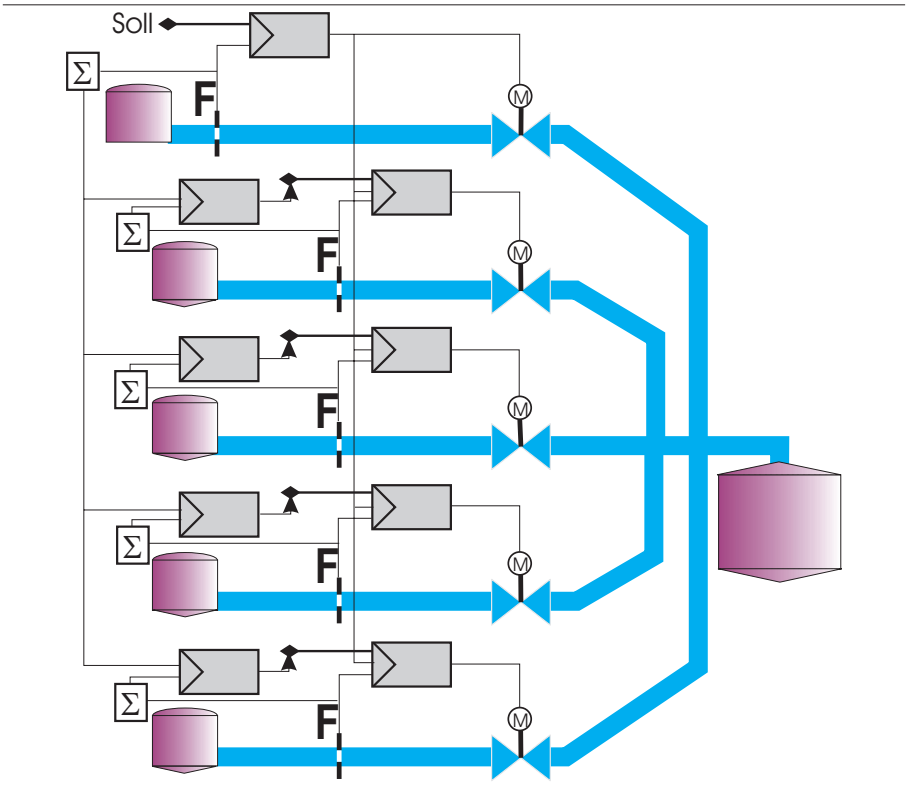

Fig. 1: Operating principle of an inline blending application

IMPLEMENTATION

The KS 98 Engineering developed for this application contains nine control loops for a total of five blending lines. Every line is fitted with its own flow controller. The set-point of the first line is used as a reference for the ratio controllers of the other four lines.

Furthermore, the four (slave) lines have an integrator and a correcting controller. The resulting sum correction function can be disabled in a central configuration page. Set-point changes are carried out by means of gradients whose parameters are defined in the controller function block.

Gradients are used during start-up and at the end of the blending process. This enables the controllers to handle disturbances quickly and effectively. Via a maximum flow value for line 1, the total filling quantity can be defined. Together with the gradient parameters, the KS 98 uses this value to determine the exact flow quantities for each (slave) gradient, thus ensuring that the exact final quantity is reached.

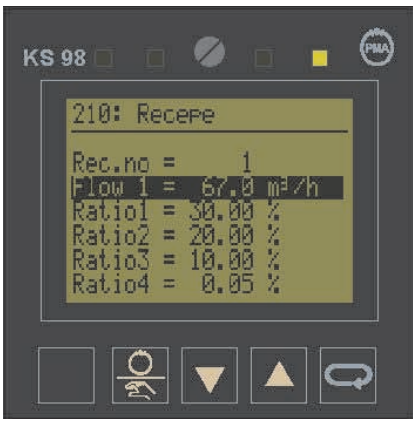

Fig. 2: Recipe handling

With low-viscosity liquids, disturbances of the flow control valves can occur easily. The valves can get clogged partially or completely, or can fail to close properly due to contamination. Such malfunctions can be detected by checking that the valve positions at 5% and 95% respectively are exceeded. The valve positions are also displayed, whereby de-bounce circuits ensure that only such limits that are definitely not reached are evaluated in more detail. Depending on requirements, the evaluation of a limit signal can trigger an alarm or even stop the process.

A disturbance caused by a jammed valve can be compensated without loss of product quality, by designing all the lines with ratio controllers, and referring the individual ratios to the total quantity (sum of all lines).

Contrary to the procedure described at the start, the reference value (first line) is not fixed, but varies dynamically according to the instantaneous plant conditions.

For example, if a valve has opened too far due to a disturbance, the other lines compensate for this by opening their valves accordingly, thus ensuring a correct total flow. Because of the numerous dependencies and feedbacks, it is obviously more difficult to keep such a system under control. Oscillations can occur easily, and the selection of the control parameters is critical. In practice, the Engineering of the KS 98 requires an additional circuit that provides sufficient decoupling between the set-point (total flow) and the various control outputs, e.g. calculation of the total quantity based on the flow in the disturbed line.

CONFIGURATION

The operating display can be adapted to plant-specific requirements. Apart from the screen displays for recipe handling and display of process values, the characteristics of the sequence controller can be defined in the configuration displays (Fig. 3).

UNLIMITED VERSATILITY

The flexible configurability of the KS 98 enables the above application to be extended with pre-configured library

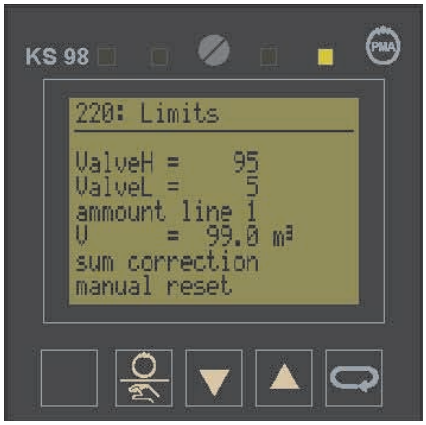

Fig. 3: Configuration via a screen page

functions such as password protection, timer, programmer, etc., or even „home-made" 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.

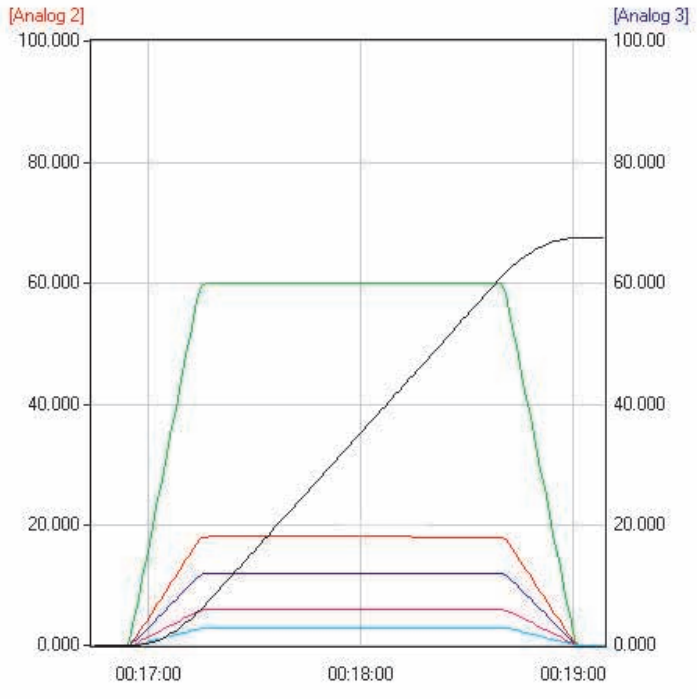

Fig. 4: Simulated sequence of the batching function

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