Digital Dosing – A Solution-Oriented Concept From Grundfos

Precipitation, flocculation, neutralisation and disinfection are essential physico-chemical processes used in the treatment of water and wastewater. Application of the highly effective state-of-the-art chemicals now used in these processes needs to be precise, cost-effective and eco-friendly. Some of the chemicals are also very difficult to dose. Conventional dosing pumps are often unable to cope, but digital dosing pumps with cutting-edge drive technology and user-friendly operating software offer a solution.

The treatment of drinking water, industrial water and wastewater has come a long way in recent years. The chemicals used are now more highly concentrated or have higher viscosities. In addition to making the chemicals more effective, this also cuts users' transport and storage costs. These developments throw up major new challenges for dosing technology and the companies using it:

-Smooth dosing of disinfectants and biocides subject to strong outgassing without interruptions due to the formation of air bubbles
-Cavitation-free and thus reliable dosing of viscous polyelectrolytes
-Reliable and highly accurate dosing of flocculants to keep chemical costs in check and avoid unnecessary environmental pollution

Conventional dosing pumps are often unable to meet these challenges, which has a negative impact on process quality and reliability.

There is a solution for these increasingly complex dosing applications – intelligent dosing pumps with new drive and adjustment mechanisms that keep processes operating precisely, reliably and cost-effectively, thereby making life easier for users.

The flow of traditional dosing pumps has always been adjusted by changing the stroke length or frequency. The stroke length can be changed either manually or electrically. The stroke frequency is adjusted electronically through the speed of the motor or start / stop operation, switching the motor or drive magnet on and off. Various combinations of these adjustment options are also possible.

Users often find it difficult to select the appropriate flow adjustment method and calculate adjustment parameters such as stroke rate, length, volume and frequency. What's more, these methods are not without their problems. An inadequate stroke length can result in air voids or impair suction. Dosing gaps can occur at low stroke frequencies or during start / stop operation. This leads to non-continuous dosing.

The market has indicated that, difficult as it may be, it is time to move on and bid farewell to the current mindset in order to bring real innovations onto the market.

Grundfos ALLDOS introduced Digital DosingTM 10 years ago. Its latest generation of digital dosing pumps offers users state-of-the-art dosing and the ultimate in user-friendly operation with patented technologies, while still ensuring process reliability and energy savings.

The use of stepper motor/EC drives optimises control of the stroke speed and makes it extremely accurate. The duration of each pressure stroke varies according to the flow setting. The suction stroke time always remains constant but can be lengthened using the anti-cavitation function and thus adapted to the relevant needs. The decisive advantage here is that suction always takes place with the full stroke volume. This results in continuous dosing and lower pulsation in the dosing system – important factors in ensuring smooth pumping of outgassing media and in installations requiring longer suction lines. (Fig. 1)

Making Light Work of Complex Control tasks

In manual mode, the dosing rate is set directly in [l/h] or [ml/h] with maximum turn-down ratios of 1:800, 1:1000 or 1:3000. This information is shown on the display.

With flow-proportional pulse signal control, the required flow per input pulse is entered directly in [ml]. Laborious calculations are no longer required. The frequency of the input pulses is recorded on an ongoing basis and the dosing speed adapted accordingly. This overcomes the problem of dosing gaps between the pulses that often occurs with conventional drive technologies (see above).

With analogue signal control, the dosing rate is changed in line with the current input, i.e. a specific flow is assigned to a milliampere signal. Flexible adjustment options make this a key function for applications involving pH correction and cascade control of several dosing pumps.

With batch dosing, the batch quantity and dosing time/speed are set. This enables dosing to be adapted to the precise requirements of the task, for example rapid dosing for filling tasks or continuous dosing during the batch period. Batch dosing with a timer function rounds off the options for this control method.

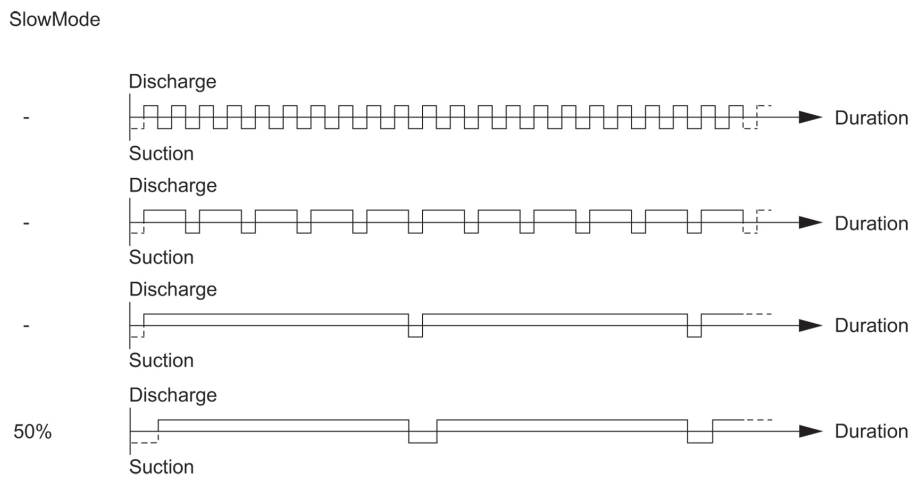

Figure 1.

Lower Investment Costs and Consumption of Chemicals

Digital input of the dosing rate (without stroke adjustment) combined with the calibration function to accommodate different dosing media, the positive drive of the diaphragm, and the optimised dosing head and valve geometry deliver a very high-precision performance of ±1% for diaphragm pumps. These are key factors in achieving environmentally sound, cost-conscious chemical dosing.

A further advantage is the maximum turn-down ratio of 1:3000, 1:1000 or 1:800. The fact that just three pump sizes can cover dosing rates of 2.5 ml/h to 940 l/h significantly reduces the number of different models required.

Precision Dosing of Viscous Media

Viscous polyelectrolytes are increasingly used as flocculants in wastewater recycling processes. Deliberately slowing down the suction stroke during anti-cavitation or SlowMode stages is helpful here, as is the use of spring-loaded valves/large nominal widths and the positive drive of the dosing diaphragm.

This results in smooth operation and accurate dosing without numerous gear reductions. Media with high viscosities of up to 3000 mPas can be dosed precisely and reliably.

Intelligent Flow Control and Monitoring of Dosing

The FlowControl system developed by Grundfos sets new standards when it comes to intelligent flow control. The focus is on process reliability. Even with variable process parameters, such as fluctuations in system pressure, it is possible to detect and prevent unwanted interruptions, inadequate or excessive dosing and even dangerous situations resulting from leaks or line breaks.

Digital drive technology with precisely defined diaphragm positioning uses a pressure sensor in the dosing head to provide an accurate depiction and diagnosis of the pressure profile and thus the dosing profile (see indicator diagram). Deviations from the norm result in a fault-specific change in the pressure profile.

This enables reliable diagnosis of the most common causes of faults that occur during dosing with diaphragm pumps. These faults are displayed in plain text in the alarm menu. Depending on the fault, the pump either reacts with a warning or an alarm (= stop). For example, if a line break causes the pressure to drop or it exceeds a freely selectable value, the pump automatically switches off. This prevents dangerous situations associated with chemicals escaping.

What's more, the AutoFlowAdapt function ensures that the dosing process continues with the required flow, even when subject to external influences. When dosing outgassing media, for example, motor control is automatically adjusted as soon as air bubbles are detected so that they can escape out of the dosing head. Fluctuating system backpressures no longer impact on the required flow either – deviations are automatically corrected by the stepper motor's speed regulation mechanism.

The integrated flow measurement function, which is also based on the indicator diagram, makes costly additional measuring equipment unnecessary. The current flow measurement is shown directly on the display and can also be integrated in the control room via the analogue output or bus protocol if necessary.