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WATER QUALITY CONTROL

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Quality Endorsed Company ISO 9001 Lic 5403

On/Off Control

There are different types of control: On/Off, Proportional, PI, PD, PID and fuzzy logic. On/Off control is the simplest control method and hence the cheapest to implement. The following provides a description of how On/Off control works.

On/Off

On/Off control is the simplest form of control. The output from the device is either 100% ON or OFF, with no middle state. An On/Off controller will switch the output only when the reading crosses the set point.

For pH acid control, the output is ON when the pH is above the set point, and OFF below the set point. Since the pH crosses the set point to change the output state, the acid pump will be continually cycling, going from above the set point to below, and back above.

Figure 1 represents the operation of an On/Off system for pH control using an acid pump. The acid pump turns ON when pH is above the set point and turns OFF when the pH is below the set point.

The disadvantage of On/Off control is that dosing pump doses the same amount at both points A and B on Figure 1. As can be seen from the diagram less acid would be required to be dosed when the pH is at point B as it is heading towards the set point. When pH is at point A, potentially the maximum amount of acid injection is required to prevent extra deviation from the set point, whilst at point B minimal to no injection may be required to reach the set point. More sophisticated control systems include the rate of change in the system to adjust the dosing rate providing better control. However due to the simplicity of On/Off control it is unable to do this and always doses at 100%.

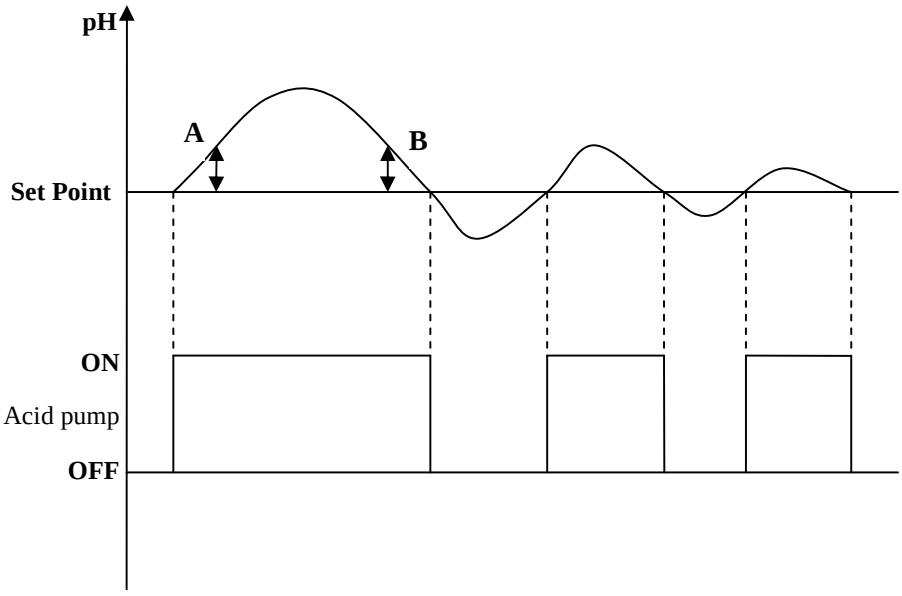

Figure 1. The operation of an On/Off system in controlling the pH below or equal to the set point

In cases where cycling around the set point occurs rapidly, and to prevent damage to contactors and valves, an On-Off differential, or "Hysteresis", is added to the control parameters. Figure 2 shows how hysteresis works. The pH must exceed the set point by a predefined amount (hysteresis) before the output will turn

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ON or OFF. Hysteresis prevents the output from "chattering" or making fast, continual switches if the cycling above and below the set point occurs rapidly.

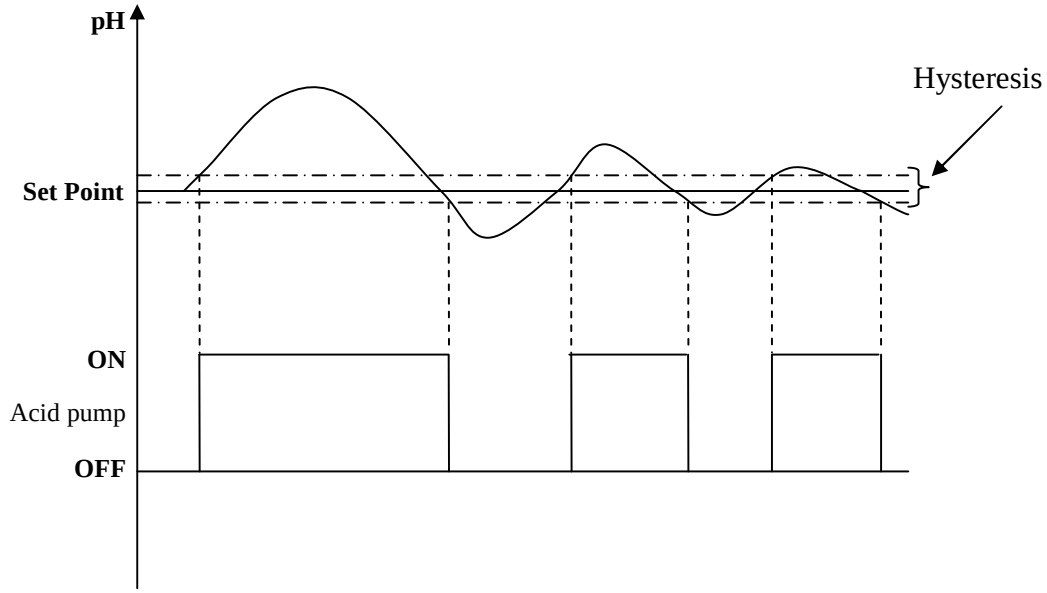

Figure 2. Operation of an On/Off system in controlling the pH using hysteresis

Advantages:

- On/Off control is very easy to design, understand and implement.
- On/Off controllers are very cheap.
- On/Off control systems are usually used when precise control is not necessary.
- They are useful in slow changing systems

Disadvantages:

- They are either 100% ON or OFF regardless of where the reading is with respect to the set point. This can cause considerable over shoots and undershoots.
- They perform poorly when controlling rapid system fluctuations. Hence they provide poor control and are not recommended for chemical processes.
- If no Hysteresis is implemented, they can damage actuators and pumps due to rapidly switching them ON and OFF around the set point.
- When Hysteresis is used, there is a constant error around the set point.
- Performance varies significantly based on the system size and is dependent on the dosing pump size, i.e. oversized dosing pumps will cause overshooting.