Basic Principles of Process Control Systems and Automation – Measurement of Variables Critical to Controlling Processes – pH*

Your Objectives:

At the end of the lesson, you should be able to be prepared to appraise the variables critical to controlling processes.

***pH** is defined as a measure of how acidic or how basic water is.

Electrode options

Off-line measurements are a direct, manual, approach to measuring bioprocessing parameters. An off-line measurement is taken from a sample removed from the process. This is generally a most reliable and accurate method for monitoring, except that it can be slower and more labour-intensive. By contrast, in-situ, or in-line, monitoring is carried out using sensors within the vessel or flow lines. These sensors offer a rapid, real-time measurement, but they may fall short in measurement sensitivity vis-à-vis pH range and durability.

On-line monitoring falls somewhere between off-line and in-situ monitoring. Basically, on-line monitoring refers to a process in which a sample is automatically withdrawn and analysed. This method offers a good compromise between the rapidity of an in-situ measurement and the reliability of an off-line measurement.

The control of pH is based on the comparison of the adjusted "set point" and pH real values. For pH measurement, practically only sterilisable electrodes are used. The control of pH values is ensured with the help of **peristaltic pumps**—typically with silicone tubes—which correspondingly **meter out*** the acid and the alkali. Normally, the "set point" adjustment consists of the lower pH_{min} and higher pH_{max} values. It is when the pH is between those two values that no influence occurs. Such an adjustment of the pH "set point" is applied to prevent an overdose of the **titration solution** (titrant). Having said that, the "narrow" regulation limits of pH are not necessary for the successful course of the cultivation process. It should be noted that pH measurements should be accurate within ± 0.02 pH units, since the dynamics of pH values' changes provide valuable data on the **process kinetics**.

*meter out/in: https://youtu.be/4eCuPVxezzY