

# METTLER TOLEDO APPLICATION NOTE

## On-Line Control Of pH In Dyeing Processes

### BACKGROUND

Textile dyeing processes require that dyes in solution penetrate the fibers and become fixed. The efficiency of these processes is strongly influenced by factors such as temperature and pH, both of which can vary depending on substrate, dye group, or individual process requirements.

Typical examples of pH-dependent processes are found in the coloring of wool and polyamides with acid-type dyestuffs or the coloring of cotton using reactive dyestuffs. In each case, the specific pH value of the various dyestuffs is instrumental to the end result. If a particular value is not correctly maintained, a number of problems can arise, such as poor fixation, unevenness, wastage of dyestuffs, etc.

Apart from the actual dyeing procedure itself, other wet processes involved such as scouring and "wash-off" also often require pH control to ensure that neither the coloring nor the substrate suffers harm.

On-line measuring systems which allow continuous pH monitoring are particularly beneficial for applications in the dyeing industry. An additional advantage of on-line systems is that the pH value can be fully integrated as a parameter into an overall process control strategy.

Contributory features of on-line pH measurements in dyeing processes:

- right-first-time results, i.e., no corrective additions necessary
- optimum dye consumption
- fewer chemicals required
- shorter dyeing times
- less wastewater treatment required

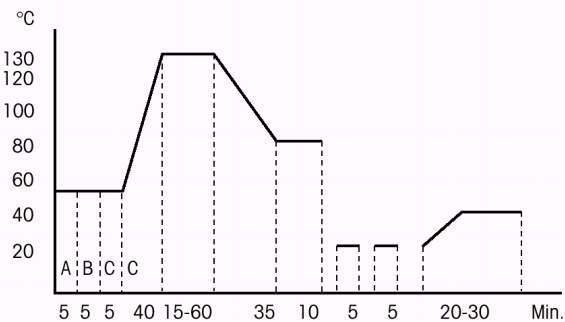
METTLER TOLEDO on-line measuring systems enable pH readings to be taken directly within the process itself, and the measured values, apart from being prominently visually displayed,

can be transmitted directly to a process control system. This helps to ensure consistency and reproducibility of the coloring, minimizing waste and providing substantial economic benefits.

### THE PROCESS

The difficult conditions encountered within modern dyeing processes make the use of most conventional industrial pH measuring systems highly unsuitable. For instance, temperatures up to 266 - 275 °F may be experienced at some stages within the process stream. Exposure to elevated temperatures has a significant negative influence on the operational life of a sensor.

Dye bath process:  
Example of a temperature profile:



A, B, C, D, etc. = process phases, pH sensitive

There are a number of problems surrounding pH measurement which are commonly experienced by process operators in extended-run applications at industrial level, namely:

- slow response or incorrect measurements due to contamination or blockage of the sensor junction
- time-consuming maintenance, cleaning and calibration procedures due to impractical design of the sensor and the installation method
- reduction in life of sensor due to the influence of elevated temperatures
- inaccurate pH control arising from the use of standard PID controllers

## INSTRUMENTATION

Mettler Toledo on-line measuring systems have been developed in close cooperation with end users in order to arrive at viable, practical solutions to such problems.

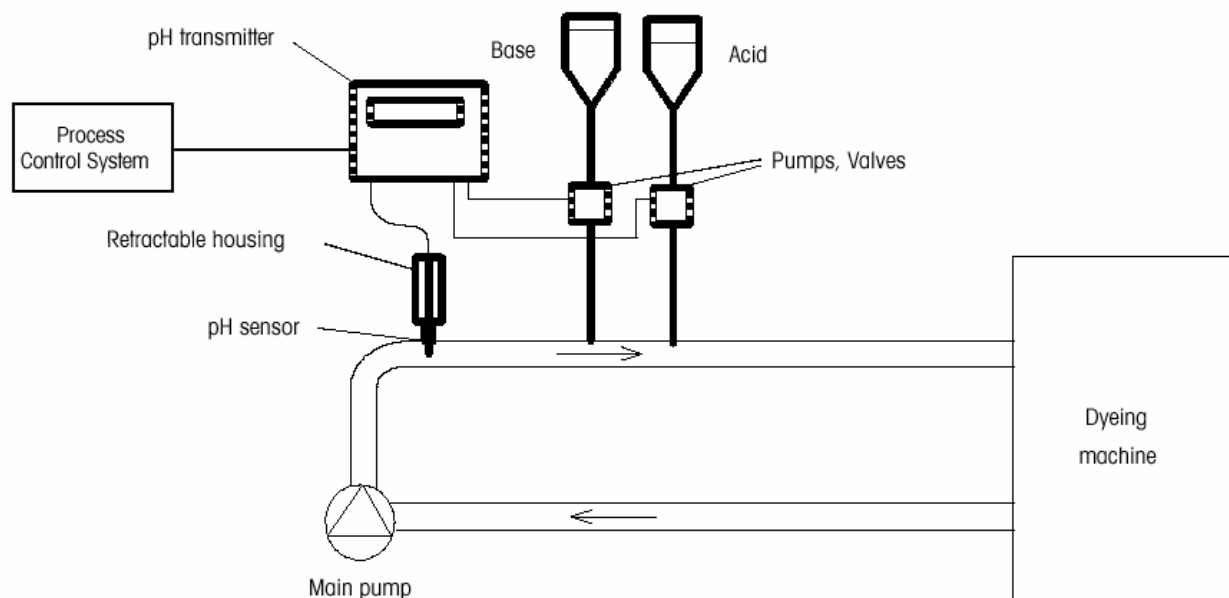
For applications in the dyeing industry, it is recommended to use our Xerolyt® pH sensor with solid reference electrolyte in conjunction with a retractable InTrac® 777-SL housing.

The XEROLYT sensor features our patented solid polymer reference electrolyte which has been formulated to maintain a stable potential for accurate and repeatable pH / ORP measurement and extend electrode lifetime up to five times. Use of the solid polymer reference permits an open aperture instead of the conventional ceramic junction, allowing the electrolyte and medium to be in direct contact. This aperture is much less likely to become clogged than the fine pores of a ceramic diaphragm, making Xerolyt particularly suitable for heavily contaminated or sulfide-containing media and solutions with a high concentration of suspended solids.

The electrode should be installed in an InTrac 777-SL retractable housing, which allows users to remove the electrode from the process without process interruption. The retractable feature permits routine electrode maintenance throughout the process to further extend the electrode life. In particularly harsh processes, users may also use the automatic (pneumatic) housing version to set timed insertion / retraction intervals to limit sensor contact with the medium, which may also extend sensor life. The patented design of the immersion tube isolates the sensor on retraction and guarantees complete separation of the process from the outside environment. Additional safety features, including position indicator and interlock which prevent misuse of the retractable housing, make this a safe, practical housing for on-line control of a dyeing process.

This system is compatible with the 2100 pH analyzer; for more sophisticated features, the 2500 pH analyzer is also recommended. The 2500 pH analyzer has a dedicated controller as well as a range of auxiliary support functions including data logging.

Example: Mettler Toledo on-line pH measurement system in a dyehouse.



## PRODUCTS

### 2100 pH Analyzer

- Detachable front panel and plug-in terminals for ease of installation
- All functions accessible through the keypad for increased ease of use
- Continuous sensor and transmitter diagnostics to monitor performance
- FM certification for Class I, Div 1 & 2 Environments and CSA General Purpose Approval
- 3 year warranty

### 2500 pH/ ORP Analyzer

- Continuous system and sensor diagnostics
- Measures pH, ORP and temperature simultaneously
- Menu-driven operation by operator prompting in plain text dialog
- Log Book records the last 200 events with date and time stamp to document performance
- Cleaning control function allows the use of a retractable housing and automated sensor cleaning
- Cal timer and alarm setting may be utilized for scheduling routine preventative maintenance
- Comprehensive diagnostics include all the functions necessary to automatically record and maintain QM documentation required for meeting GMP, ISO 9000 and EPA requirements

### Xerolyt<sup>®</sup> DXK pH Electrode

- Patented Xerolyt solid polymer reference system maintains a stable potential for accurate and repeatable pH measurement and low maintenance
- Open junction eliminates reference clogging and extends sensor life
- High pressure resistance eliminates requirement for pressurizable housing
- Xerolyt solid polymer is particularly suitable for use in emulsions, suspensions, heavily contaminated or sulfide-containing media, and solutions with high concentration of suspended solids

### InTrac<sup>®</sup> 777-SL Retractable Housing

- Rugged 316L SS or PVDF construction for maximum chemical resistance
- Flushing chamber for automatic cleaning and calibration reduces overall system downtime
- Patented immersion tube design isolates the sensor on retraction and guarantees complete separation of the process from the outside environment.
- Safety interlocks prevent sensor removal from housing while in measuring position
- Manual or pneumatic operation