



Application Note AN-PAN-1035

在线分析纺织印染浴中的靛蓝、保险粉及其他参数

The size of the indigo molecule makes it difficult to dye synthetic fibers, but the large pores of cellulose (such as in cotton) accept it readily. Indigo is insoluble in water, so it must first be reduced to the water-soluble leuco-indigo form by sodium hydrosulfite in a strong alkaline bath. Good circulation within the bath is imperative for consistent dye coverage, but care must be taken not to introduce any oxygen. Fabrics must be oxidized between dips in the dye bath to set the indigo within the pores of the fibers, but multiple dips are necessary for darker, uniform

coverage.

This Process Application Note is focused on monitoring indigo, hydrosulfite, and other parameters in textile dye baths using the 2035 Potentiometric and 2060 TI Process Analyzers from Metrohm Process Analytics. Many critical parameters need to be monitored and controlled to ensure high quality of the end product: the pH value for proper NaOH (alkali) dosage, the concentrations of both hydrosulfite and indigo, as well as the temperature of the bath and even the redox potential.

To achieve uniform color, many parameters need to be controlled for continuous dyeing processes: the pH for proper NaOH (alkali) dosage, the concentrations of both $\text{Na}_2\text{S}_2\text{O}_4$ and indigo, as well as the temperature of the vat. The redox potential of the dye bath also needs to be controlled for proper dyeing of the fabric.

Manual laboratory methods can be quite cumbersome and can introduce bias depending on the analyst. Therefore, the complexity of the process necessitates inline or online analysis of the dye

baths for the most precise results. A great choice for online monitoring the indigo, hydrosulfite, and other parameters such as pH and conductivity in dye baths is the **2035 Process Analyzer - Potentiometric (Figure 1)** from Metrohm Process Analytics. Together with the plant circulation system, these fast-responding online process analyzers can help keep the dye bath throughput high without losing money from excess chemical consumption due to inefficient processes, ensuring the quality of the dyed fabric remains constant.

INTRODUCTION



Figure 1. 2035 Potentiometric Analyzer from Metrohm Process Analytics.

APPLICATION

The simultaneous monotonic titrations of hydrosulfite and indigo in indigo dye baths are performed in a closed vessel under nitrogen gas with potassium ferricyanide ($\text{K}_4\text{Fe}[\text{CN}]_6$) as a titrant and a reagent mix (NaOH + dispersing agent). The Metrohm

Process Analytics 2035 Potentiometric and 2060 TI Process Analyzers (**Figures 1 and 2**) are ideally suited for the fully automatic execution of these analyses, as well as additional parameters like pH or conductivity.

Table 1. Textile dye bath measurement parameters

Parameters	Range
Hydrosulfite	0.25–4 g/L
Indigo	0.25–7 g/L (can be expanded to measure higher ranges)

REMARKS

The analysis of sodium hydrosulfite and indigo must be carried under N₂ gas in order to prevent the evaporation and oxidation of dye with ambient air. If the sample line contains fabric particles, it needs to

be filtered before the sample inlet of the analyzer to prevent blockages. This method can also be used for loop dyeing applications for threads and yarns.

CONCLUSION

The Metrohm Process Analytics 2060 TI Process Analyzer and 2035 Potentiometric Process Analyzer can not only measure the concentration of indigo

and hydrosulfite, but also pH and conductivity measurements to give an overall health status of the dye baths without delay.



Figure 2. 2060 TI Process Analyzer from Metrohm Process Analytics.

BENEFITS FOR TITRATION IN PROCESS

- **Detect process upsets** via automated analysis.
- **Increased product throughput**, reproducibility, production rates, and profitability.
- **Better color uniformity** is achieved by constantly monitoring the chemical composition of the baths.
- **Fully automated diagnostics** – automatic alarms for when bath samples are out of the specified parameters.



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