Metrohm NIRSystems

Application Bulletin 411

Analysis of ink and paint using near-infrared spectroscopy

Branch

Chemicals, ink and paint

Keywords

Near-infrared spectroscopy, ink, paint, pigment, dye, solvent.

Summary

Near-infrared spectroscopy (NIR) has been used for several analyses. Due to its rapid and nondestructive determination of samples, NIRS is an indispensable tool for controlling the quality of products and raw materials, in process and in finished ink and paint products. This Application Bulletin shows examples of NIR applications and corresponding feasibility studies using NIRSystems in the ink and paint industry.

Introduction

Providing increased quality control in different process steps becomes important. It helps to reduce a failure of production and to increase product consistency.

NIR and visible (VIS) spectral characteristics demonstrate its ability for analysis of different kinds of material. Quality and quantity of pigment is one of important parameters that need to be controlled.

NIR spectroscopy is typically used for qualification control of raw materials such as pigment and solvent. There are many possible applications which can be performed during process and finished products control. For example: quantitative analysis of solvents, additives, polymer and pigments contents in intermediate and finished products.

Metrohm NIRSystems provides the solutions especially with a feature of covering visible and NIR range, Metrohm NIRSystems additionally offers the customer the possibility to analyze related color parameters.

Contents

No. 1: Monitoring dye strength in aqueous dye solutions

Summary

This feasibility study was aimed to monitor dye strength in aqueous dye solutions. Thirteen samples were provided with dye strength in the 90 to 121.8% range.

System

Model 5000, liquid sampling system was used for this application.

The equivalent and recommended instrument

NIRS XDS RapidLiquid Analyzer	2.921.1410

Sampling

The samples were measured in transmittance mode in the 1100–2500 nm region. A 0.5 mm quartz cuvette was used for sampling. Possible bands for monitoring dye appear at 1675 and 1730 nm. A calibration for dye was developed at 1678 nm (SEC of 1%).

Results

The results indicate that NIR can be used to monitor the level of dye in water based dye solutions.

No. 2: Qualitative analysis of moisture in flush pigments

Summary

NIR system was used to qualitatively distinguish moisture levels in flush pigments in this application. Five products (a total of 19 samples) were provided for analysis.

System

Model 5000, transmission detector module, fiber optic bundle setup module, interactance fiber and reflectance probe was used for this application.

The equivalent and recommended instrument

NIRS XDS SmartProbe Analyzer 2m Fiber	2.921.1610

Sampling

All samples were analyzed in the 1100–2500 nm range using an interactance reflectance fiber optic probe. Each sample was analyzed five times, repositioning the probe between scans. A spectral library was created using the moisture regions: 1360–1500 nm and 1845–1990 nm.

Results

The results indicate that NIR can be used to qualitatively distinguish between varying levels of moisture in flush pigments.

No. 3: Monitoring the moisture level in yellow pigment

Summary

This feasibility study was performed to determine whether the moisture in a yellow pigment could be monitored. The provided pigment samples were in the form of large oblong pellets (approximately 0.5 by 1 mm) interspersed among coarse powder. The five samples provided had moisture ranging from 0.3 to 2.6%.

System

Model 5000, reflectance detector module, sample transport module was used for this application.

The equivalent and recommended instrument

NIRS XDS RapidContent Analyzer Solids	2.921.1120

Sampling

Samples were scanned from 1100–2500 nm in reflectance mode. The samples were presented to the spectrometer in two manners. First the samples were presented as a powder in a standard sample cup after gently grinding the sample with a mortar and pestle. This was done to see whether moisture could be determined for samples in an 'ideal' condition. Secondly, the samples were loaded as is into a coarse sample cell, which holds a much greater amount of sample than does the standard sample cup. Water was monitored in the 1940 nm region for both cells (1938 nm, SEC of 0.1%, for the standard sample cup, 1940 nm, SEC of 0.1%, for the coarse cell).

Results

The results indicate that NIR can be used to monitor water in yellow pigment using both of the sampling methods described above.

No. 4: Monitoring color strength and viscosity in inks

Summary

The aim of this study was to prove the ability of NIRS for monitoring color strength and viscosity in inks. Viscosity values ranged from 6.1 to 6.7, while color strength ranged from 86.06 to 92.18.

System

Process Analytics Model 6500 with remote reflectance probe was used for this application.

The equivalent and recommended instrument

NIRS XDS Process Analyzer MicroBundle SinglePoint	2.928.0110

Sampling

The samples were analyzed using a Process Analytics instrument with a remote reflectance probe attachment. The samples were analyzed by placing the ink in a round quartz cup, which was then placed on the remote reflectance head. The samples were analyzed in the 400 to 2500 nm region. For color strength, a PLS calibration was developed using four factors (SEC of 1.6). This calibration was performed in the 430 to 800 nm region. For viscosity, a PLS calibration model was developed using six factors (SEC of 0.2%). Each of the calibration equations were validated when tested on an independent sample set.

Results

The results indicate that NIR can be used to monitor color strength and viscosity in ink.

No. 5: Monitoring a catalyst in black paint primer

Summary

NIRS was applied to monitor a catalyst in black paint primer samples. Three concentrations of catalyst were analyzed: 4%, 8% and 14%.

System

Model 5000, rapid content analyzer was used for this application.

The equivalent and recommended instrument

NIRS XDS RapidContent Analyzer	2.921.1110

Sampling

The samples were analyzed in the 1100 – 2500 nm region using the Rapid Content Sampler. Differences were seen between the 4%, 8% and 14% samples in the 2020 nm spectral region. However, excess titanium dioxide in the samples caused additional spectral information to be obscured.

Results

The results indicate that NIR can be used to detect the presence of catalyst in black primer samples. Due to the excess titanium dioxide, it is difficult to determine the accuracy and precision for this method.