



# Analysis of Dyes in Plastics using HPLC

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**Polymer  
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## Abstract

Dyes which are used for coloring plastics have to fulfill special requirements. They have to be heat resistant, resistant against UV-irradiation and weatherproof. In addition, they should show strong coloring power and high brilliance. The analyzed colors in this application brief are soluble in organic solvents but are practically insoluble in water. This is important if the colored plastics are to be used in food packaging materials or in toys. Some of these colors are also used as coloring agents for polyamide fibers and other engineering plastics. The following colors were analyzed:

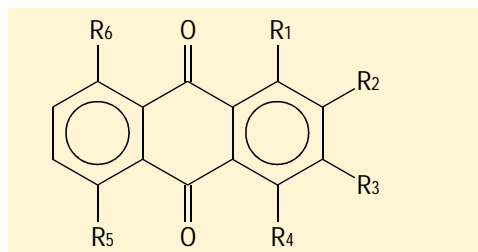


Figure 2  
Chemical structure of dyes

Name	Color Index	Structure
Solvent yellow 21		Monoazo 1:2 chromo complex
Filamid violet RB		Monoazo 1:2 chromo complex
Disperse yellow 54	47020	Chinophthalon
Solvent red 52	68210	Anthraquinone
Macrolex blue 3R		Anthraquinone
Solvent blue 97		Anthraquinone

Table 1  
Chemical structure of dyes

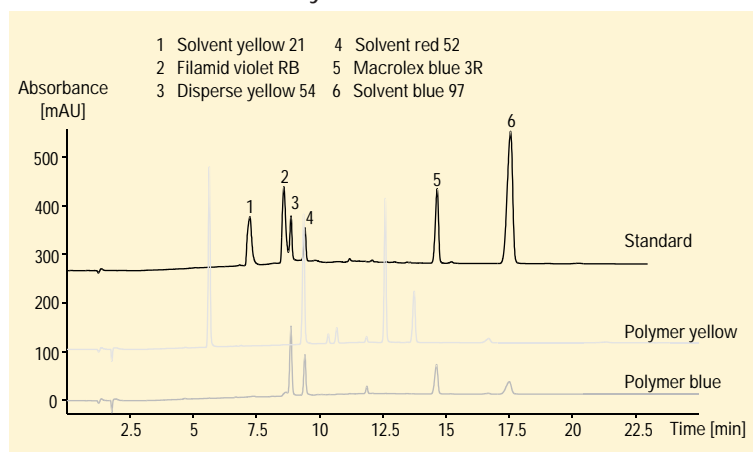


Figure 1  
Standard chromatogram

## Conditions

**Column** 125 x 3 mm BDS, 3  $\mu$ m  
**Mobile Phase** A = Water + 0.001 m Tetrabutylammoniumhydrogensulfate, pH = 3.0 with H<sub>2</sub>SO<sub>4</sub>, B = Acetonitrile  
**Gradient** Start with 30 % B, to 98 % B in 10 min  
**Flow Rate** 0.5 ml/min  
**Injection Vol** 5  $\mu$ l  
**Oven Temp** 40 °C  
**UV-Detector** DAD,  
 280/20 nm Reference 900/50 nm  
 350/40 nm Reference 900/50 nm  
 465/40 nm Reference 900/50 nm  
 540/40 nm Reference 900/50 nm  
 600/40 nm Reference 900/50 nm  
**Sample preparation** Polymer samples were dissolved in Tetrahydrofuran and filtered after extraction with ultra-sonic bath for 30 min



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- Solvent yellow 21 • Filamid violet RB • Disperse yellow 54
- Solvent red • Macrolex blue 3R • Solvent blue 97

These dyes have different chemical compound classes, for example Anthraquinone type, Chinophthalon type and Monoazo-1:2-chromo complex type.

### Method performance

The dyes in this analysis were analyzed using reversed phase HPLC with ion pairing compound in the mobile phase. A diode array detector was used as the detection system. Spectra which are very characteristic of this compound group were used as identification tools, in addition to the retention times.

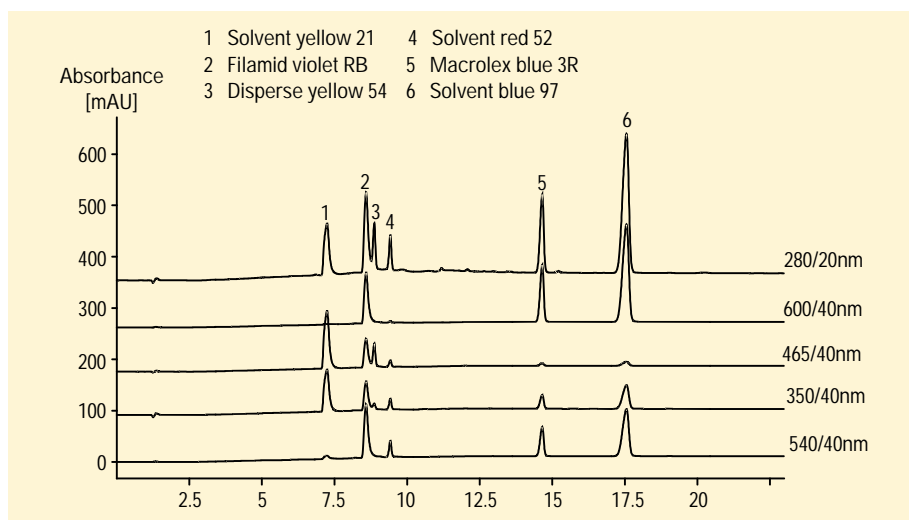


Figure 3  
Analysis of dyes at different wavelengths

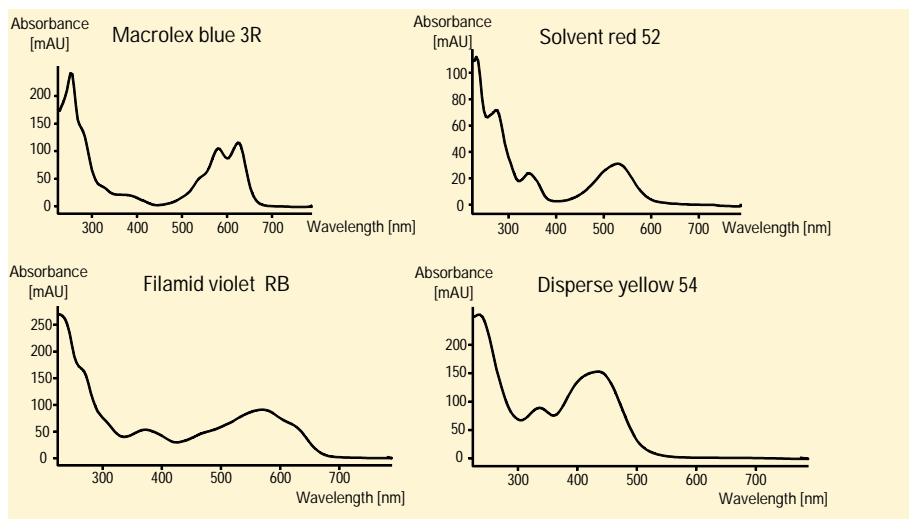


Figure 4  
Spectra of polymer dyes

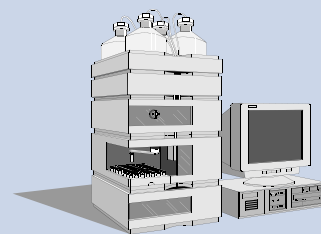
### Method performance

Limit of Detection (LOD) = < 1 ng  
Precision of retention times (rsd) = 0.2 %  
Precision of areas (rsd) = < 3 %

### Equipment

#### Agilent 1100 Series

- degasser
  - binary pump
  - autosampler
  - thermostatted column compartment
  - diode array detector
- Agilent ChemStation + software



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Released 06/97  
Publication Number 5965-9042E



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