

Analysis of Formaldehyde in Water-Based Toys According to GB/T 46510 – 2025 by HPLC with Post-Column Derivatization

Amount of Formaldehyde in consumer products is strictly regulated due to its toxicity and cancerogenic properties. The limits are especially stringent for toys and most countries have mandated testing protocols to minimize the risk to children. The main sources of exposure to formaldehyde from toys are urea-formaldehyde resin adhesives used in plywood and particle boards, synthetic materials and plastic, fabrics treated to prevent shrinkage and improve color stability as well as formaldehyde-releasing preservatives added to water-based products used by children.

In October 2025 China has released an updated method GB/T 46510 - 2025 for determination of free formaldehyde in water-based toys by High Performance Liquid Chromatography. This method utilized post-column derivatization with Nash Reagent and UV/Vis detection at 420 nm. This method is intended for analysis of such products as bubble solutions, finger paints, inks, and gels.

Method

Analytical Conditions

Column: Reversed-phase C₁₈ column,
5 µm, 4.6 x 250 mm

Column Temperature: 30 °C

Flow Rate: 1.0 mL/min

Mobile Phase: 2 mL/L of Phosphoric acid in DI water

Separation of Formaldehyde is isocratic but column washing step with 50 / 50 mobile phase /acetonitrile is recommended.

Injection Volume: 10 µL

Post-Column Conditions

Post-Column System: Onyx PCX or Vector PCX

Reactor Volume: 0.5 mL

Reactor Temperature: 100 °C

Reagent: DI Water

62.5 g/L Ammonium Acetate

7.5 mL/L Glacial Acetic Acid

5 mL/L Acetylacetone

Flow Rate: 0.5 mL/min

Detection: UV/Vis 420 nm

Sample Preparation

Weigh 0.2 g sample, add phosphoric acid solution to mark, vortex 1 min, purify if necessary, filter through 0.45 µm membrane and analyze within 12 h

Table 1. Recoveries of free formaldehyde			
Sample type	Finger Paint	Bubbles solution	Water-based nail polish
Formaldehyde in the blank	2.95 mg/kg	0.027 mg/kg	29.1 mg/kg
RSD%, N=3	1.9	5.1	2.6
Spike level 1	5 mg/kg	5 mg/kg	5 mg/kg
Recoveries	89.7%	90.5%	87.7%
RSD%, N=3	5.8	6.1	3.4
Spike level 2	10 mg/kg	10 mg/kg	10 mg/kg
Recoveries	84.6%	87.2%	83.7%
RSD%, N=3	3.7	1.1	3.2

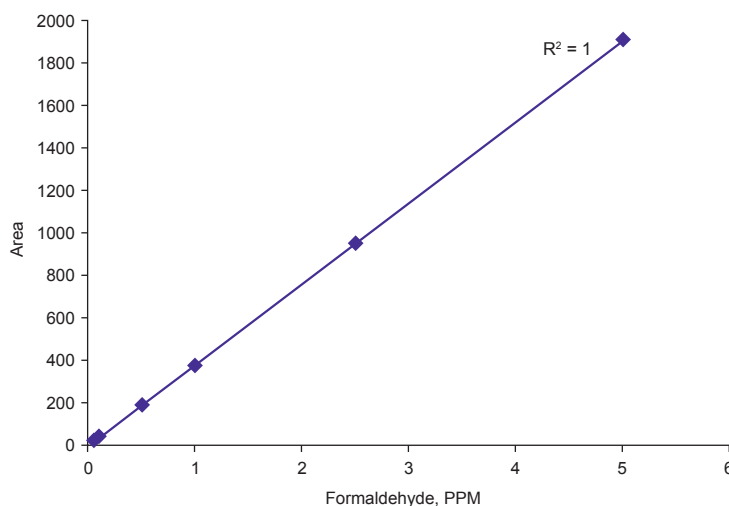


Fig 1. Calibration curve for Formaldehyde (0.05 – 5 ppm)

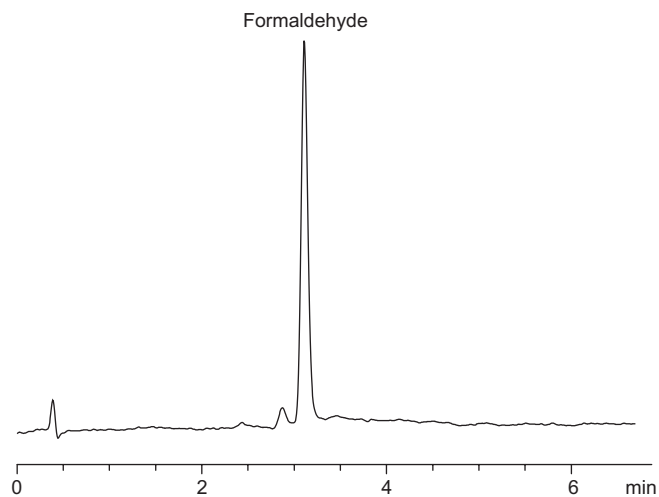


Fig 2. Chromatogram of Formaldehyde 0.1 ppm standard

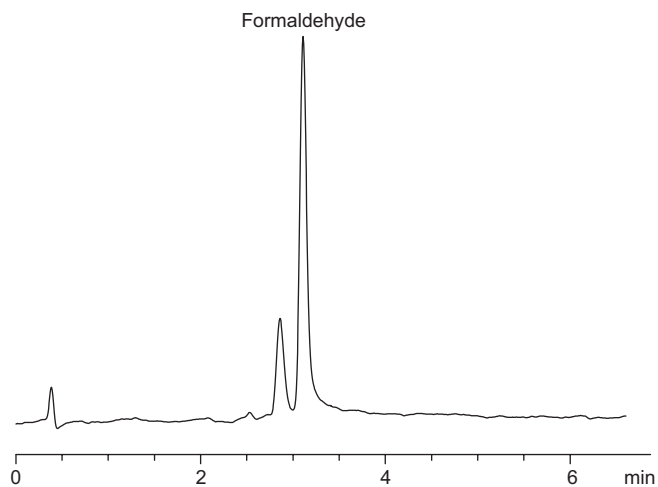


Fig 3. Chromatogram of finger paint containing 2.95 mg/kg of Formaldehyde

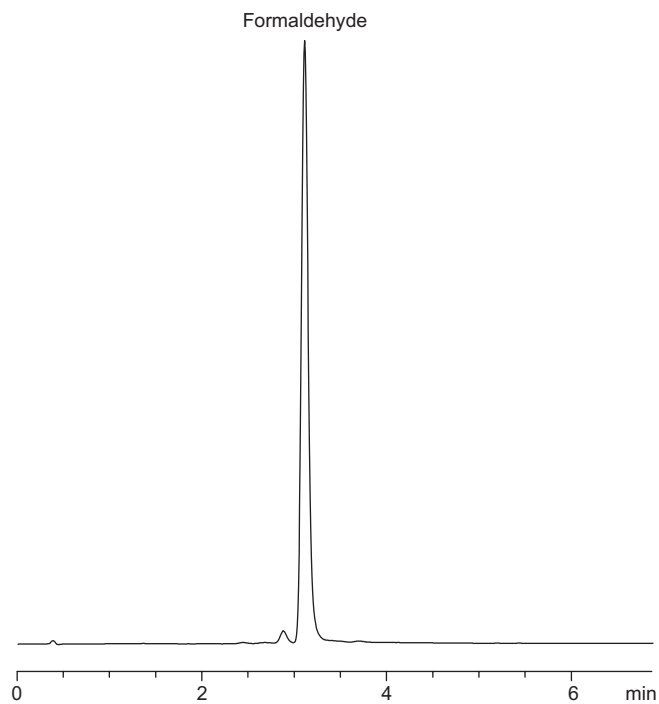


Fig 4. Chromatogram of water-based nail polish containing 29.1 mg/kg of Formaldehyde