

# Determination of Polycyclic Aromatic Hydrocarbons in Plastic Toys by GC - MS

## Background

Polycyclic aromatic hydrocarbons (PAHs) are volatile hydrocarbons produced by incomplete combustion of organic polymer compounds, petroleum, coal, wood, tobacco, etc., which are serious pollutants of environmental and food. Plastic toys are made of polymer synthetic resin as the main raw material, added with other auxiliary materials or additives, molded at a specific temperature and pressure, and may produce PAHs during processing, use, disposal or combustion. Studies have shown that PAHs are carcinogenic and have great potential hazards to human health and the ecological environment. As early as 2013, REACH regulations have clear restrictions on PAHs[1]. At present, the literature reports mainly focus on the detection methods of PAHs in soil, coal and atmosphere. Including thin layer chromatography fluorescence spectrophotometry, paper chromatography fluorescence spectrophotometry, fluorescence spectrophotometry, liquid chromatography, gas chromatography and gas chromatography-mass spectrometry (GC-MS), However, there is no detection technology for the content of residual PAHs in plastic toys, so it is urgent to carry out the detection of PAHs in plastic toys. The current methods for the determination of PAHs have some disadvantages, such as tedious pretreatment process, low recovery rate, high uncertainty and so on. The author studied the extraction effects of different solvents, optimized the chromatographic conditions, and finally established a gas chromatography-mass spectrometry (GC - MS) method for the determination of 16 PAHs in plastic toys. The method is simple, accurate, rapid and sensitive, and can be used for rapid quantitative detection of PAHs in plastic toys.





Compounds	Rubber bands	toy pens	plastic balls	balloons	plastic blocks	toy gloves	toy seals	keyboards
pyrene	<0.12	0.31	1.43	<0.12	<0.12	<0.12	0.20	0.15
Benzo [a] anthracene	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	<0.12	0.43	2.03	<0.12	<0.12	0.32	<0.12	<0.12
Benzo [b] fluoranthene	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Benzo [k] fluoranthene	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	0.33	0.26
Benzo (a) pyrene	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Indeno [1,2,3-cd] pyrene	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Dibenzo [a, h] anthracene	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12
Benzo [g, h, i] Perylene	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12

Table 1. Detection results of PAHs in plastic toys

The content of PAHs in common plastic toys was determined by GC-MS. The results are shown in Table 1. It can be seen from Table 1 that among the 8 different types of plastic toys, 7 kinds of toys were detected to contain PAH compounds, and the measured value of the plastic balls exceeded the REACH regulations for children's 0.5 mg/kg limit.

### Summary

The mass concentration of 16 PAHs was linear in the range of 0.002~0.18 mg/L, the correlation coefficient was greater than 0.991, and the limit of quantification was 0.12~0.20 mg/kg. The relative standard deviation of the measurement results was 4.2% to 7.4% (n=6), and the recoveries were between 84.9% and 116.7%. The method is simple, rapid, accurate and reproducible, and can meet the current requirements for detecting PAHs in plastic toys.



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### **Reference**

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(EU) No 1272/2013 Commission regulation (EU)No 1272/2013of 6 december 2013 amending annex XVII to regulation (EC)No 1907/2006 of the european parliament and of the council on the registration, evaluation, authorisation and restriction of chemicals (REACH) as regards polycyclic aromatic hydrocarbons [Z] .