Detecting heavy metals in toys using X-ray fluorescence

Children's toys contaminated with traces of heavy metals and other hazardous substances – sometimes in dangerously high concentrations – repeatedly make for alarming headlines. Thus, toy manufacturers are under considerable pressure to prove that their products are free of harmful substances so that they qualify for the appropriate safety labels.

Within Europe, children's playthings are subject to both the toy safety directive and the standard DIN EN 71, which defines, for example, the criteria for testing mechanical and physical properties and organic compounds, electric toy safety, and the upper limits for certain heavy metals and other hazardous substances. This standard dictates that the object be exposed for one or two hours to 0.07 mol/l hydrochloric acid, which simulates gastric juices. The dissolved product is then analysed, usually with AAS or ICP. The disadvantages of this approach are that the sample is destroyed in the process and the tests are very time-consuming.

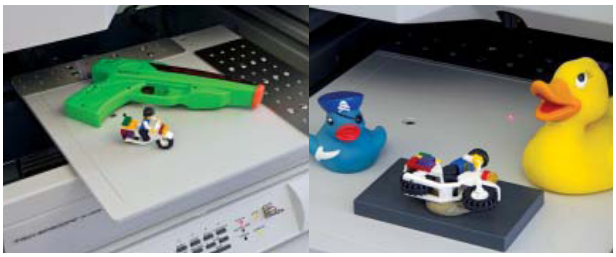

Fig.1: Analysis of hazardous substances in various toys uisng a FISCHERSCOPE® X-RAY XDV®-SDD

In contrast, X-ray fluorescence (XRF) analysis is a straightforward method for the quick and non-destructive determination of the concentrations of Pb, Hg, Cd and other heavy metals. Table 1 shows the detection limits for various plastics measured with a FISCHERSCOPE® XDV®-SDD. In this way, the precise measurement results can be easily checked against the prescribed limiting values.

element	limiting values DIN EN 71	Detection limits POM	PVC	ABS blue	Measuring example ABS brown [standard deviation]
Sb	60	42.6	43.2	24.9	45159 [180]
As	25	3.9	8.7	2.7	42 [3.8]
Ba	1000	138.0	87.0	60.0	2740 [79]
Cd	75	17.4	19.2	22.2	10 [8.4]
Pb	90	8.7	12.6	6.5	4 [4.3]
Hg	60	2.4	8.1	1.5	-3 [2.6]
Se	500	1.5	4.2	1.2	5 [1.7]
Cr	60	11.7	54.0	7.5	12134 [281]

Tab.1: Limiting values specified in DIN EN 71 and detection limits in ppm for three different plastic materials, as measured with a FISCHERSCOPE® XDV®-SDD. Average values are shown for a brown ABS sample (as well as standard deviations in brackets).The limiting values for Sb, As, Ba and Cr have been clearly exceeded.

Used as a screening method, the XRF warns the user if a given value has been exceeded. Further wet chemical analyses can then be carried out to crosscheck the result.

The pollutant concentration can also be measured very selectively, for example on the painted eye of a plastic figure. With the help of the XRF, an entire batch can be tested quickly, allowing the selective removal of individual contaminated parts – which might never have been detected in random tests. A further advantage is that the concentration of all heavy metals can be determined simultaneously in one measurement step.

With the FISCHERSCOPE® X-RAY XDV®-SDD, even the smallest concentrations of heavy metals and other hazardous substances in toys can be detected quickly and, above all, non-destructively. This makes it possible to verify compliance with specified regulations and standards. For further information please contact your local FISCHER representative.