

# X-MET8000



## X-MET8000 series for the rapid determination of HBCD content in polystyrene heat insulation panels

### INTRODUCTION

Polystyrene foam such as expanded polystyrene (EPS) or extruded polystyrene (XPS) panels are commonly used for heat insulation in buildings. To delay the panels' ignition and limit fire growth, additive flame retardants such as hexabromocyclododecane (HBCD or HBCDD) are added to the material.

Recent studies showed that HBCD may have an adverse impact on human health and the environment, so its use is now regulated in many countries, and a number of alternative fire retardants such as PolyFRs have been introduced.

In 2016, European regulations, also adopted by other countries worldwide, were amended, banning the use of HBCD and requiring that polystyrene material is declared "hazardous waste" if it contains more than 1000mg/kg HBCD. If it does, the material must go to a hazardous waste incineration plant instead of following the normal recycling process, and this typically increases disposal costs by a factor of 3.

To provide demolition companies with accurate waste disposal costs fast, waste management companies need to test the waste polystyrene on site. They can also sort material at the recycling/incineration plant to minimise processing costs.



## USING THE X-MET8000 HANDHELD X-RAY FLUORESCENCE (HHXRF) ANALYSER FOR THE ON-SITE SORTING OF POLYSTYRENE

XRF is a rapid, easy-to-use elemental analysis technique. You can use it to determine bromine content in polystyrene waste, but XRF cannot separate HBCD from other brominated compounds without sample preparation. Until now, laboratory techniques like gas chromatography (GC) or high-pressure liquid chromatography (HPLC) were used for this task, requiring lengthy sample preparation and skilled laboratory staff.

Now a fast and cost effective methodology is available to waste disposal professionals for the identification and quantification of HBCD in polystyrene on site\*. There is no need to send samples to an off-site laboratory, saving time and money. Following simple sample preparation steps, operators can get results within minutes using our portable XRF analyser.

Hitachi High Tech's X-MET8000 is a rugged, versatile, handheld XRF analyser. Whether in the laboratory or in the field, the X-MET8000's optimised combination of a high performance X-ray tube and large area silicon drift detector (SDD) delivers the speed and performance needed for the routine testing of waste polystyrene.

With its icon-driven intuitive user-interface, it is easy to use. Results can be customised to show what is important to you, for example user-defined messages such as "Hazardous", so you can decide on the waste's disposal cost and route on the spot.

### METHODOLOGY FOR ROUTINE ANALYSIS

Unlike other brominated compounds, HBCD can be extracted from polystyrene with acetone, and there is a direct relationship between the HBCD content in polystyrene and the Br content extracted in the acetone solution:

$$[\text{HBCD}_{\text{Polystyrene}}] = ([\text{Br}_{\text{Acetone}}] * 3.5) / 0.75$$

This formula takes into account the amount of Br in HBCD, and also the efficiency of extraction process. This calculation can be defined as a PseudoElement in the X-MET's user interface, and alert limits setup to provide a clear message to the operator.

By analysing the solution with an X-MET calibrated for this purpose, users can quickly identify polystyrene that contains HBCD and if it's above or below the critical level.

The sample preparation is simple:

1. Remove some polystyrene from the panel to be tested
2. Weigh 2g in a glass container (e.g. small beaker) and add 5g of acetone. This will initially form a slurry, and gel-like matter will settle at the bottom of the container
3. Pour all the solution into a sample cup fitted with polypropylene film, leaving the gel in the glass container
4. Measure the cup with the X-MET.

When analysing solutions, the X-MET8000 is used with the small portable benchtop stand for convenience and maximum user safety. The light stand fits in the X-MET's case for total portability.

A safety window is used underneath the sample cup to contain potential leaks and prevent costly analyser repair.

TIME	METHOD	DATE	
3:10:57pm	Polystyrene	25/10/2017	
ELEMENT	PPM	+/-	ALARM
HBCD	4827		HAZARDOUS
Br	1034	6	

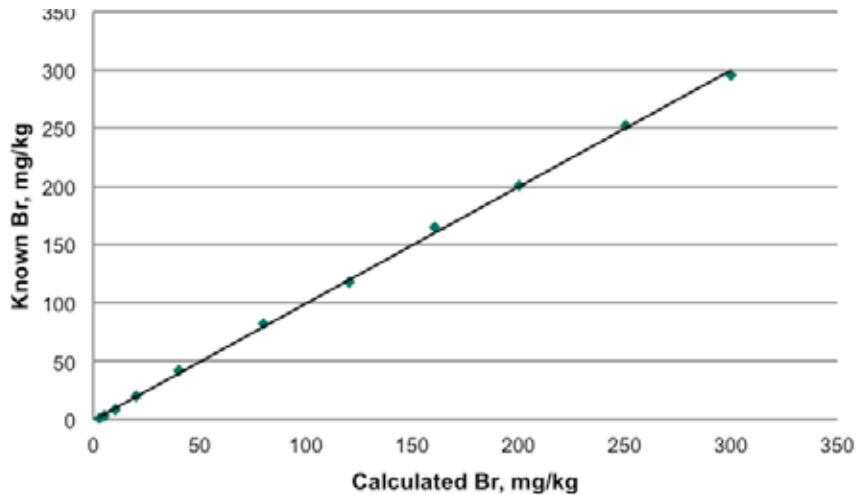



## X-MET8000 CALIBRATION AND RESULTS

For this application, a series of calibration standards was prepared by dissolving known amounts of HBCD powder in acetone, and calculating their Br content. Each standard was measured for 60 seconds to create an empirical calibration that establishes the relationship between Br content and X-ray signal.

The calibration graph shows an excellent correlation between the known Br content (thus the HBCD content) and the X-MET's calculated content.

### Calibration graph:



To demonstrate the X-MET's excellent repeatability, a polystyrene sample was prepared as described in this document, and measured 10 times for 10 seconds only. 

**Table 1: X-MET's repeatability data**

Repeat	Measured Br in solution, mg/kg	Calculated HBCD in polystyrene, mg/kg
1	137	639
2	139	649
3	139	649
4	138	644
5	139	649
6	140	653
7	136	635
8	138	644
9	138	644
10	140	653
Average	138	646
Standard deviation	1	6
Precision (95% confidence)	3	12

## SUMMARY

Using simple sample preparation steps, waste management professionals can use the X-MET8000 on-site to screen polystyrene material for the presence of the regulated HBCD. With results available within minutes, the decision on whether the material goes to normal refuse or hazardous waste incineration plants can be made quickly. This provides considerable time and cost savings compared to the traditional laboratory tests used until now.

\* This methodology was developed by the Fraunhofer Institute in Germany. Reference: "Test report KR/8010/17: Screening analysis of HBCDD in EPS and XPS foams by XRF"



## ORDERING INFORMATION MINIMUM REQUIRED:

- X-MET8000 Smart, Optimum or Expert (model depends on other applications requirements). Includes the compact and rugged carrying case, a wrist strap and lanyard, 2 Li-ion batteries, a battery charger, a USB cable to connect to a PC/laptop, 5 replacements windows, user manuals.
- Empirical calibration software (P/No. 54-4106250); included as standard with the Expert model)
- Sample cups (P/No. 51-4106018 for a box of 100)
- Safety window (P/No. 54-LX6879-2)
- Polyester film (P/No. 51-3882096 for a roll of 100m)
- Benchtop stand (P/No. 54-4106313) or light stand (P/No. 54-4106255)
- Customised calibration (P/No. 54-4106218). The calibration will be created by our local Applications team.

## OPTIONAL EXTRAS:

- Rack for sample cells (P/No. 54-LX1032 ; holds 10 cups)

Visit [www.hitachi-hightech.com/hha](http://www.hitachi-hightech.com/hha) for more information.

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