

Executive summary of the results of occupational exposure limits for EPS insulation boards

Introduction

The PolyStyreneLoop demonstration plant recycles polystyrene foam demolition waste containing the flame-retardant Hexabromocyclododecane (HBCD). Since the 1960s HBCD was widely applied as a flame-retardant in polystyrene foam. In expanded polystyrene (EPS) insulation boards the typical HBCD concentration ranged between 5,000-10,000 mg/kg. In 2013, HBCD was classified as a Persistent Organic Pollutant (POP) under the Stockholm Convention. This led to a worldwide ban on the sale and use of HBCD, gradually implemented by all signatory countries. In 2016, the EU POP regulation on the production, placing on the market, and use of POPs set out the waste treatment to follow. Polystyrene foam waste with HBCD concentrations above 1,000 ppm must either be incinerated or undergo a physical-chemical treatment. The physical-chemical treatment is the CreaSolv® Process on which the PolyStyreneLoop demonstration plant is built. This technology has been accepted as Best Available Technology (BAT) to treat polystyrene foam waste with HBCD concentrations in the UN Basel General Technical Guidelines on the Environmentally Sound Management of Wastes.

Background information on the emission test

In order to validate the safe handling of polystyrene foam containing HBCD during demolition, pre-treatment and recycling, DEKRA analysed the emissions of respirable and inhalable dust, HBCD, styrene and n-pentane. The tests took place on 21 May 2019 in the Netherlands. The measurements of EPS waste containing HBCD were conducted during the demolition of a coolhouse in Zundert and during the pre-treatment of the material at the site of a recycler in Dongen.

The coolhouse, insulated on the walls and ceiling with around 1,000 m³ EPS, was built in 1968. Around 2008, the roof was renovated with new EPS material. Via GC-MS analysis, the HBCD concentration of the EPS from the walls and the ceiling was measured.

Results of the measurements can be found in Table 1

Table 1 - Results of the HBCD concentrations

Material	HBCD concentration [mg/kg]
EPS from walls	220
EPS from ceiling	4,740

The HBCD concentration of the walls is a lot lower than commonly applied. The reason for this is unknown.

Demolition

During the demolition, EPS was removed from walls and the ceiling. EPS from the walls was removed by breaking the transition wedge between wall and ceiling with a crowbar and then taking off the board mechanically with an excavator. EPS from the ceiling was reached via a hydraulic ramp where the screws holding the boards in place were removed with a battery screwdriver. The boards were then set on the hydraulic ramp, descended and grabbed by an excavator that placed the entire board on a pile with the rest of the material. Loose EPS beads were swept together, collected and disposed as well as vacuumed.

Results of the measurements during demolition can be seen in table 2

Table 2 - Results from demolition

Emission	Occupational exposure limit [mg/m ³]	Measured concentration [mg/m ³]	
		Person 1	Person 2
Respirable dust	1.25	0.18	0.14
Inhalable dust	10	0.63	0.65
HBCD*	0.7	< 0.016	< 0.015
Styrene	86	< 0.39	< 0.36
n-pentane	3,000	< 0.2	< 0.18

Pre-treatment

On the site of the recycler the material coming from the coolhouse underwent pre-treatment. The container which transported the EPS insulation boards tilted and deposited the material in a hall. With the help of a spade the boards were broken into pieces of about 1 m before being pushed onto the transportation belt of the shredder. The shredder reduced the EPS to pieces of size 3-5 cm. Through vacuum the material was then transported to silos where the EPS was stored until it was finally compacted.

Results of the measurements during pre-treatment can be seen in table 3

Table 3 - Results from pre-treatment

Emission	Occupational exposure limit [mg/m ³]	Measured concentration [mg/m ³]
Respirable dust	1.25	< 0.14
Inhalable dust	10	0.69
HBCD*	0.7	< 0.018
Styrene	86	< 0.44
n-pentane	3,000	0.34

* Important to note, there is no occupational exposure limit for HBCD. To be able to evaluate the emissions, the limit concentrations for bromine are used as guiding parameter.

Conclusion

DEKRA concluded that the protective measurements taken were sufficient and that the occupational exposure limits for the measured emissions during demolition and pre-treatment were well-below the limit concentrations.

The full report from DEKRA can be found under report no. 12686/421592/32983/555221255/3