

EPS – THE INSULATION FOR SUSTAINABLE BUILDING

Ing. Pavel Zemene, PhD.

Czech EPS Association, Czech Republic, info@epsr.cz

Ing. František Vörös

Czech EPS Association, Czech Republic, info@epsr.cz

Summary

After a historical introduction, a description of the development of production and converting of EPS with an emphasis on the insulation of buildings follows. Role of producers and processors of EPS consists not only in quality and innovation of products, but especially in meeting of the three pillars for renewable product - economy, ecology and social benefits. In the field of ecology, an important role plays the implementation of EU directives and regulations - REACH, GPP, EPBD, CPD (CPR) and in particular the EPD.

Keywords: expandable and expanded PS (EPS), Czech EPS Association, Sustainable Building, EPBD, ISO 14025 – Environmental Product Declaration (EPD).

1 Introduction – History

Expanded polystyrene (EPS) insulations, produced from expandable polystyrene beads or pellets containing pentane as physical blowing agent, have encountered significant growth and increasing market share in recent years. History of the styrene polymers begins in 1839, when the Berlin chemist Simon distilled a liquid from resin of the tree *Liquidamber orientalis*, which he called styrene. After several days of standing in warm area, this liquid gelled and the world's first polystyrene - called styroxide - came into existence. Path to the industrial production of styrene took almost 100 years, when its production was started at BASF in Ludwigshafen in 1931.

2 Production of EPS Beads

The first products - light cellular plates and shaped pieces were exhibited at the Kunststoffe - Messe at Düsseldorf in 1952. In 1960, the global production of EPS reached 35 thousand tons/year. Development of consumption, especially in the construction industry, caused an increase in the world production of EPS to more than 5 million tons in 2009, of which over 1.7 million tons in Europe. Similarly, production of EPS in Kaucuk Kralupy (now Synthos Kralupy) has seen dynamic growth in the 45 years after the start-up, and currently it is close to 100 thousand metric tons /year [1]. see Figure No. 1.

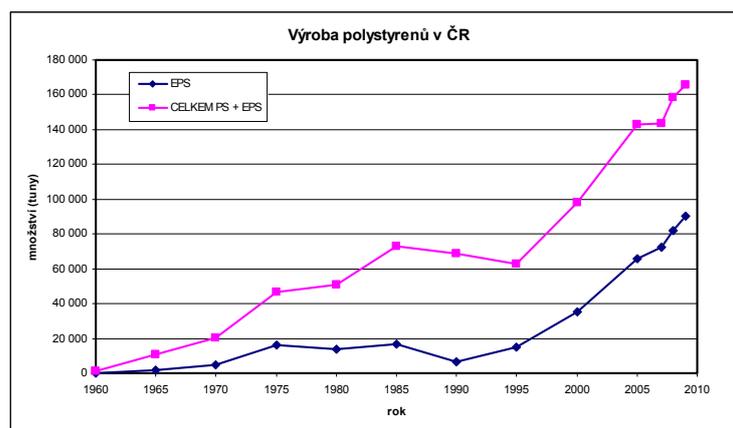


Fig. 1 Polystyrenes Production in the CR [quantity in tones/year]

Manufacturers of EPS in Europe are organized through The Plastics Europe (PE) in Brussels in the EPS Working Group [2]. The 14 most important manufacturers of the total number of 20 are involved. Together, they address issues such the EPS quality - voluntary initiative to reach max. content of free styrene 1000 ppm and that of benzene up to 10 ppm. In addition, they solve serious problems of production plants comparisons regarding the environmental issues:

- IPPC – Integrated Pollution Prevention and Control;
- BAT – Best Available Techniques.

Further information on the environmental issues are specified in the following documents:

- White Paper on PS and EPS - extensive study with environmental data - last reissue in Brussels in 2004.
- Environmental Product Declaration for PS and EPS also including a section on life cycle analysis (LCA).

Members of the Plastics Europe cooperate in finding of substitutes for the up to now used fire retardant, the HBCD - hexabromocyclododecane, which retardant was suggested to be enrolled in the Annex XIV (SVHC - substances of very high concern because of the for PBT properties - persistence, bioaccumulation and toxicity) of the Law on Chemicals - REACH by the European Chemicals Agency (ECHA) in Helsinki. Also the other substances used for the production of EPS, such as styrene, pentane, benzene are under common checking and administrative assessing.

Very important activities of the Plastics Europe members are product range innovations, of which the most important is the EPS having addition of very fine graphite powder, which powder serves as an absorber of infrared radiation [3]. This increases by up 20 % the thermal insulation properties, when compared with the conventional white EPS board, see the Graph No.2. Usually, this material is silver-grey, and it was patented by BASF in 1995. Subsequently, the firms Sunpor, Nova Ineos, Jackon, Polymeri Europa, and Synthos also involved in the process of innovation.

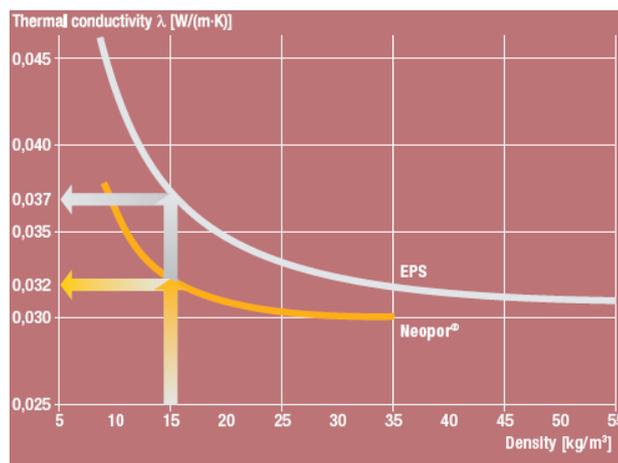


Fig. 2 Thermal conductivity vs. density

3 Processors (Convertors) of EPS beads to EPS boards

The processing (converting) proper of EPS beads or pellets to insulating boards is carried in five stages:

- Prefoaming;
- Conditioning;
- Moulding of blocks;
- Cutting to boards;
- Packing and labelling.

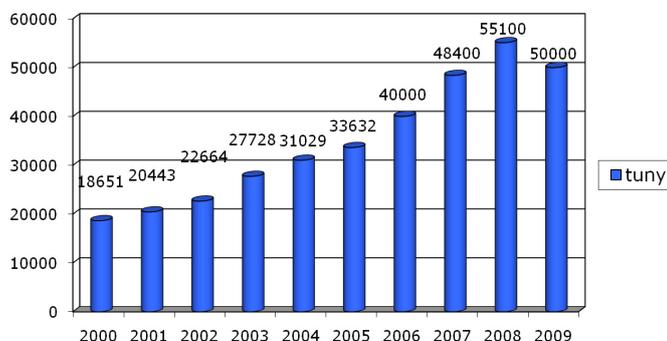
EPS products quality is tested according to the EN 13 172 standard and the package label, attached to products, specifies characteristics and application possibilities in accordance with the local specific requirements.

EPS Association represents interests of the 12 ordinary and 3 associate members. The Association was founded in 1998, and one of its main activities relates to the independent monitoring of quality with the ability to impose sanctions on manufacturers of low-quality boards, and on the other hand with the possibility of granting a mark of quality – see labels in Figure 3.



Trend of the EPS consumption in the CR shows next Figure. There have been significant annual growths of consumption in the CR, since 1997. However, a 9.3% drop, if compared to 2008, was registered in 2009 for the first time [3]. In addition to the crisis, which caused about one third of this decrease in the consumption of EPS in the packaging sector, the decline was caused also by the not quite well mastered activities "Zelená úsporám (Green Light to Savings)" and "Nový panel (New Panel)" of the Ministry of Environment (MŽP)

and the Ministry of Local Development (MMR), when from the allocated subsidy, received from the sale of the obtained allowances for the CO₂ emissions amounting up to 1 billion Euros, with the possibility of drawing the subsidy up to the end of 2012, fewer projects regarding thermal insulation of buildings were realized in 2009 than in 2008.



Twenty in total of national associations of EPS producers and converters in Europe are associated in the EUMEPS residing in Brussels [4]. Totally, 900 companies with 60 thousand employees involved in this association covers 90% of activities in the field of EPS insulation products. The EPS share of the insulation market in Europe is 35%. Already 200 million homes in the last 50 years have been isolated using EPS. Mission of the PE and the EUMEPS are activities at the European Union level, namely:

Contribution to the reduction of CO₂ emissions - the Kyoto Protocol, the Copenhagen summit. It is known that without the insulation of buildings the EU's commitments would be difficult to meet. In the manufacture of EPS and the subsequent conversion to the EPS boards and their application to the insulation of buildings there are CO₂ emissions that are 150 times lower than the effects of the subsequent energy savings and, therefore, also of the carbon dioxide emissions from heating or cooling of buildings. In other words, 1 kg of oil consumed for the EPS production and application saves 150 kilograms of oil in the insulated buildings during their lifetime of approx. 50 years. Situation in the CR has been mapped by prof. Hajek and prof. Tywoniak at the CEBS 07 Conference in Prague in 2007[5].

– Sustainable Construction (Sustainable Building) is based on three principles of sustainability, and this economy, ecology and social impacts. By means of insulated buildings, it is possible to save 260 billion Euro in the EU annually [6] and 15 million buildings are planned to be renovated by 2020[1]. Renovating of old buildings with poor insulation characteristics can assure work for further 500 thousand workers. Users of these buildings can save up to 80% of the costs of heating and air conditioning.

Another impetus for the sustainable buildings should be amendment to the existing EU Directive 2002/91/EC - Energy Performance in Building Directive (EPBD), which amendment could be approved in the 1st half of 2010.

Similar amendment to the current EU standard for construction products (CPD), in which to the six existing requirements the seventh on the sustainability is going to be added, should help further in further development of EPS insulation applications. Scheduled approval is in 2011.

Voluntary EU initiative known as the Green Public Procurement (GPP) places emphasis on environment and labelling of products. Within the scope of this activity,

requirements for EPS boards were processed. Specifically, it is about the "Thermal Insulation - GPP Product Sheet" and the "Technical Specifications for GPP - Thermal Insulation Background Report". The EPS insulations were included in the most favourable category of A+.

Insulation Model	Evaluation
EPS 15-30kg/m ³	A+
Glass wool 10 – 48kg/m ³	A+
Mineral wool 33 - 60kg/m ³	A+
Mineral wool 80 - 160kg/m ³	A – C
PU (pentane) 32kg/m ³	A
Sheep Wool - 25kg/m ³	A
Cork insulation 120kg/m ³	A
Foam glass 105 - 120kg/m ³	C - D

To all these activities, it is necessary to join the standardization processes within the technical committees:

CEN/TC 350 – Sustainable Construction

CEN/TC 351 – Regulated Substances

ISO 14025 – Environmental Product Declaration (EPD)

Little wonder then, that an excess of activities in different sectors leads to duplicities. The following institutions reacted to them with constructive comments:

The European Insulation Platform (EIP) by a letter of Mr. Barroso of 28.1.2009 with suggestions how to solve it [7];

Five supranational institutions on the issue of hazardous substances in the upcoming CPR and in relation to the valid REACH standard [8].

Similarly, there is an inconsistency within the EU in the field of EPD for building products. The EPS CZ Association as a member of EUMEPS supports the initiative of the similar German IVH Association at Heidelberg [9] with the objective to take their results over for all member countries of the EUMEPS.

The IVH Association managed to secure the approval of the Environmental Declaration (EPD) for three groups of EPS insulation boards in the beginning of 2010. The result was conditioned by an approval of the Committee on Health Evaluation of Construction Products, when the results of volatile substances emissions were evaluated, which evaluation was prepared by the Research Institute for Insulations in Munich and the Fraunhofer's Institute for Building Physics in Stuttgart. An environmental balance of the EPS boards within a LCA analysis was performed according to ISO 14025 by the PE International company.

Recommendations for granting of EPD for the insulation boards of EPS was submitted by the German Institute for Construction and Environment. The mark "Deutsches Gütesiegel Nachhaltiges Bauen" itself was certified by the Federal Ministry for Transport, Building and Urban Development on the base of recommendation of a nine-member expertise committee. This mark confirms meeting of the stipulated PCR (Product Category Rules) conditions for insulating materials of plastics.



4 Conclusion

Increasing of the EPS consumption including the innovation activities in the grades exhibiting improved insulation capabilities, forecasts and chances for significant growth of insulations, constant properties of EPS insulations throughout the whole lifetime, addressing of economic, social and environmental impacts throughout the whole lifetime of the EPS, this all speaks unequivocally for further development in the industry of manufacturing and processing of EPS.

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