NANOPCM

New Advanced Insulation Phase Change Materials

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D6.5 Recommendations for standardization

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Summary

NanoPCM project is developing innovative advanced insulation panels by incorporation of novel materials (PCMs) to a traditional insulation materials matrix (polyurethane).

As purpose of the developed work, NanoPCM aims to get a product available in the market. For this, few stages must be studied:

- Feasibility of production of advanced materials at pilot scale plant.
- Incorporation of novel microencapsulated materials to an insulation matrix
- Feasibility of production at full scale plant.
- Thermal improvement in comparison to traditional insulation materials
- Presence in the current market.

Within the last point, different considerations are necessary, as level of dissemination or exploitation and possibilities to be involved in the present market.

In this document, it is shown a researching about current standards which could be related to the NanoPCM products. Within this report, it is explained the three standards that NanoPCM has already been working in. They are focused in phase change materials and environmental aspects.

On the other hand, deliverables 8.4 "Final version of the dissemination plan" (reported at month 30) and 8.6 "Final version of the exploitation plan", which will be reported at month 36, give an added value to the NanoPCM product and consequently contribute to the presence of it in the market, by presenting a deep market analysis and study of commercialization in future deliverable D8.6 "Final version of the exploitation plan".

Contents

Abbreviations

NANOPCM	New Advanced Insulation Phase Change Materials
PCM	Phase Change Materials
NGO	Non-Government organizations.
ROI	Return on Investments

1.-Introduction

As definition, a standard is a document which provides requirements, rules and guidelines, for a process, product or service. These requirements are sometimes complemented by a description of the process, product or services.

Standards are the result of a consensus and are approved by a recognized body. On the other hand, the process of formulating, issuing and implementing standards is called standardization.

Any product, process or service is intended to meet the needs of the user. Sometimes the expectations of the users may be at variance with the actual purpose. Standards help by identifying the optimum parameters for the performance of a process, product or service and the method for evaluating product conformity.

Standards act as a good vehicle for technology transfer. Since standards incorporate the results of advances in science, technology and experience, they reflect the state of the art in technical development. As standardization is a dynamic process, standards are updated as new technologies are developed.

Whenever the transfer of goods and services is involved, standards spell out what means of communication are to be used between different parties. Since standards contain information that is recorded in a precise and documented form, they contribute towards better communication and understanding in a large variety of settings.

As NanoPCM is involved in an environmental point of view, all the developments performed within the materials and products productions have been considering this factor as the main one. In this sense, environmental protection is an important aim of the standardization. In the studied cases, eco-label is deeply linked to the preservation of environment.

The standardization provides benefits to different sectors of society. They are exposed as follows:

- For manufacturers, the standards:

Rationalize the manufacturing process

Eliminate or reduce wasteful material or labor

Reduce inventories of both raw material and finished products

Reduce the cost of manufacture

- For customers, standards:

Assure the quality of goods purchased an services received

Provide better value for money

Are convenient for settling disputes, if any, with suppliers

- For traders,

Provide a worktable basis for acceptance or rejection of goods or consequential disputes, if any

Minimize delays, correspondence, etc., rsulting from inaccuarate or incomplete specification of materials or products

- For technologist,

Provide starting points for research and development for further improvement of goods and services.

On the other hand, the next graph shows the process from the development of new manufacturing process or product to arrive to the current market. In this way, the standardization would be present on the entire process, as it gives competitive capacity to the manufacturing process, ensure the market requirements at the same time connects to the market.

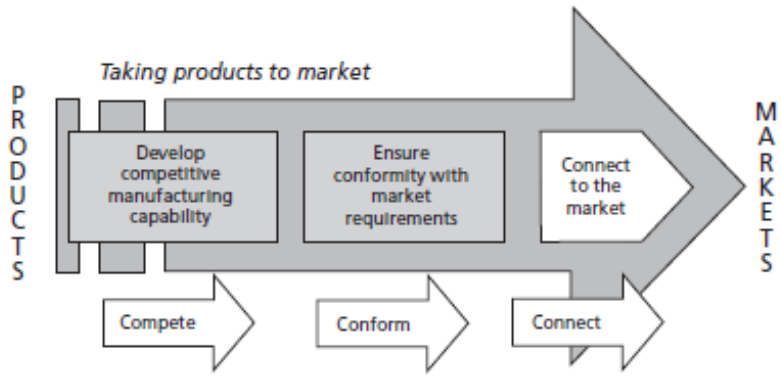

Figure 1 Process from the product manufacturing to the market

2. STANDARDS FOLLOWED BY NANOPCM

1.1 RAL- GZ 896 Quality assurance- Phase Change materials

These quality and testing specifications set out the general principles for PCM including PCM composites, PCM objects and PCM systems, in particular for authoritative parameters, requirements, as well as content and scope of monitoring measures.

In the case of materials developed within the NanoPCm project, there are innovative PCMs, as encapsulated or non-encapsulated as chemically linked, as well as final products such as the rigid polyurethane panels with 10% of different types of PCMs microcapsules.

This standard is related to the specification of the stored quantity of heat (enthalpy change) at predefined temperature intervals for the case of melting and that of crystallization.

This regulation is referred to the cycling thermal stability of the product is applying to. This way, PCM must survive a defined number of cycles without damage. In this case, one cycle is defined as complete melting and re-crystallization of the PCM.

During the cycles, samples are taken at regular intervals, and are examined for several quality criteria. The product is defective if the result of one of the quality criteria tested was negative.

In this standard, the product can apply to different categories, depending on the number of total cycles. The next table shows the category names and number of cycles associated to:

Category name	Number of cycles
A	≥ 10,000 cycles
B	≥ 5,000 cycles
C	≥ 1,000 cycles
D	≥ 500 cycles
E	≥ 100 cycles
F	≥ 50 cycles

Table 1 Categories and number of cycles related to

Then, as it can be extracted from the table, if the product aims to reach the category A, it would be necessary performing at least 10000 thermal cycles. If the results are positive, it means there is not degradation at the end, the product belongs to the category A of RAL standard.

On the other hand, other requirements from this regulation are related to the information shown by the manufacturer. This way, manufacturers must prepare a product data sheet for every product, which at least includes data on the following properties:

- Product name with specification of:
    - Encapsulated PCM or not encapsulated PCM
    - Operating range
    - Maximum and minimum permissible temperature
    - Specific weight
    - Special Storage advice
    - Specified permissible applications and cycle category reached

- Specification of at least the following definitive properties:
    - Phase transition temperature and storage heat
    - Reproducibility of the phase transition

Additionally, a safety data sheet should be included with the legal requirements of the intended country of sale and include relevant warnings. For the NanoPCM product, a specific assessment about safety and risk of the developed product is shown in the deliverable 5.3 "Safety and Risk Assessment of processing & product", where special attention was taken to nanomaterials used in the manufacturing process because of its critical behavior.

However, non-specific countries have been considered at this stage of the project although Europe is the main focus of the researching. In Deliverable 8.6 "Final version of the exploitation plan", it will be included an study about potential locations to sell the NanoPCM product, as well as possible partnerships and applications.

1.1.1 Tests

Deep studies about the needed equipment were carried out. The result was that it was necessary a heating chamber able to perform the thermal cycling using a velocity of 2ºC/min. For this, numerous thermocouples connected to a data logger were needed. The objective was to monitor the thermal behavior of the different samples while the thermal cycling.

Different samples developed at WP2, WP3 and WP6 were tested as well as commercial polyurethane foams to do a proper comparison of the thermal results.

The next table shows the samples included in this experience:

Samples
PU foam (Blank)
Pu foam + Microencapsulated RT27
PU Foam + Microencapsulated fatty acids
PU Foam + Microencapsulated octadecane
PU foam + impregnated SiO_2 porous
Microencapsulated RT27 (powder sample)
Microencapsulated fatty acids (powder sample)
Microencapsulated octadecane (powder sample)
SiO_2 porous (powder sample)
Masterbach panel (resin + PCM chemically linked)

Table 2 Samples to be included in the thermal cycling test

The total number of different samples is 10, including 4 powder samples, 5 foam samples and one solid sample. (masterbatch)

Depending on the intended category, apart from the start measurement at the beginning of cycling, control measurements at various frequencies need to be carried out. Next table shows the specifications:

Category name	Number of cycles	Check the quality criteria every
A	≥ 10,000 cycles	1,000 cycles
B	≥ 5,000 cycles	500 cycles
C	≥ 1,000 cycles	250 cycles
D	≥ 500 cycles	100 cycles
E	≥ 100 cycles	25 cycles
F	≥ 50 cycles	10 cycles

Table 3 Number of group of cycles to check the properties within the thermal cycling test

As it can be extracted from the table, if applying to category A, apart on performing at least 10000 cycles, it would be necessary checking the properties each 1000 cycles. Other additional consideration is that samples taken out from the equipment cannot be introduced again in. Because of this, a proper number of samples must be included to fill the necessary tests.

In the case of NanoPCM, the hypothesis considered was: every year, the PCM suffer around 100 cycles of melting and re-crystallization. It was though because of the temperature range melting considered. This way, around three months would be critical and, supposing 1 complete thermal cycle (melting and cooling) per day, and overestimating it, the result is 100 cycles suffered by the material per year.

Regarding this estimation, 1000 cycles would be suffered by the advanced PU insulation panel along 10 years of use.

In order of carrying out a first performance of tests and acquire some experience before the application to the RAL standard, the tests were develop to belong to category C. Because of this, the materials were tested under 1000 heating and cooling cycles at 65%RH, checking the properties each 250 cycles. The velocity used was 2ºC/min, what means 30 min spent in every cycle. The total time invested was 21 days.

To perform the thought tests, few companies were contacted.

The first idea was performing the experiences in Fraunhofer USA, as they have an high expertise in this area. However, high budget was required and despite of wanting to be working with them, it was not possible.

Then, the University of Cantabria was contacted. After few meetings, they cannot carry out the tests because their control system is not able to.

Finally, CENTROCOT, an Italian researching center, was contacted. They have the equipment and experience enough to perform the experiences. The heating chamber used for this experiences was:

Figure 2 Equipment used for the thermal cycling tests

On the other hand, initially, the equipment was not prepared to monitor more than 4 samples. As NanoPCM has developed 9 different materials in addition to the blank sample, people from Acciona were there to install additional thermocouples and a data logger able to support a bigger amount of channels. As result, the thermal behavior from all the samples can be plotted.

This way, 40 samples were introduced in the specific oven, 4 samples of each type showed in table 2 to extract samples at 250, 500, 750 and 1000 cycles.

An example of the thermal cycle carried out during thermal tests is as follow:

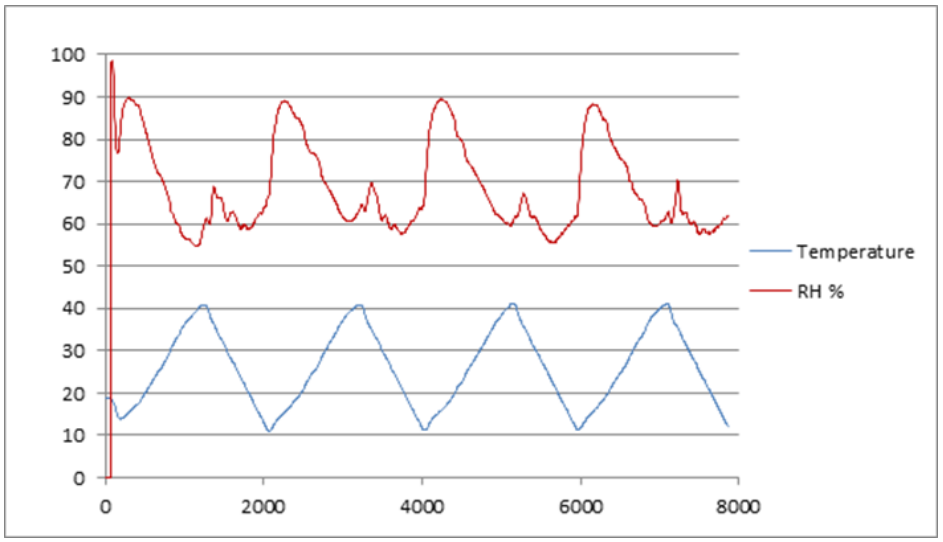

Figure: Thermal cycling tests

Samples were received in the facilities of Acciona and analyzed using DSC and SEM pictures to check the properties. The results are shown in the Deliverable 4.2 "Assessment of the cycling stability and durability at month 30".

1.1.2 Official documents to present

For the report to present for the future standardization, following points must be included:

- Number of samples and measurements
- Special aspects of sample preparation or preparation of the measurement method use.
- Specification of the thermal conductivity at predetermined temperatures above and below the melting point or the melting range
- Specification of the sample density at the beginning and end of the measurement
- Documentation of the humidity, room temperature and normal pressure during the measurement
- Documentation of specific observations during the measurement

Following the RAL standard, it would be necessary to present the additional documents:

1- Documentation of the initial measurements
2- Parameters of temperature ramp

3- Documentation of the control measurements and results
4- Proof of cycles completed
5- Cases of damage (if applicable)
6- Information on the cycle categories successfully tested
7- Safety sheet

In Annex I, a draft of a report to apply to RAL standard is shown. As it is not an official document written by the Quality Committee of the Quality Association, it is not enough to be included in the group of products which belongs to category A, although can give an idea about how the official document would be.

Figure 3 Quality label for PCM

1.2 Eco-label

The EU Ecolabel helps you identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw material through to production, use and disposal. Recognised throughout Europe, EU Ecolabel is a voluntary label promoting environmental excellence which can be trusted.

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The EU Ecolabel scheme is a commitment to environmental sustainability. The criteria have been developed and agreed upon by scientists, NGOs and stakeholders to create a credible and reliable way to make environmentally responsible choices.

From the raw materials to manufacturing, packaging, distribution and disposal, EU Ecolabel products are evaluated by independent experts to ensure they meet criteria that reduce their environmental impact. The EU Ecolabel is an easy way to make an informed choice about the products you're buying.

The scheme is voluntary, but hundreds of companies across Europe have joined up because of EU Ecolabel's competitive edge and commitment to the environment. Customers can rely on the logo because every product is checked by independent experts.

At first, it was looked for a proper group of products to include the NanoPCM product. However, a group of polyurethane foam does not exist, and for sure, not any group related to foams with PCM inserted because NanoPCM is an innovative product. Then it was necessary to apply to create a new group to be included in "hard coverings" group.

In Annex I, it is described the information sent to the official organism in Spain. From their comments, the inclusion in a group or the creation of a new one could take a maximum of 6 months.

As it can be extracted from the delivered information, not specific data or compositions were shown as it should be discussed deeply by the consortium. In addition, the objective of that first step is opening the possibility of getting the standardization in a near future within a group of products.

1.3 M-Value

For years the insulation industry has been synonymous with R-Value. This rating system relates to "Thermal Resistance".
Depending on your climate zone and local weather patterns, your local building codes are designed to make sure that any structure being built in the region is up-to-date with modern building advancements to make it as energy efficient as possible.

This process considers the cost of such improvements as well as the ROI of these improvements. In a typical southern home for example, one might find a building code rating of R-19 in the outside walls and R-23 overhead. This R Rating system is now the industry standard for insulation.

That being said, the leaders of the International Phase Change Consortium have taken it upon themselves to set an international standard for phase change materials. When phase change materials are added to a structure, the resulting improvement is in the form of "Thermal Mass". This characteristic of a structure relates to the ability of the structure to maintain its desired temperature. This can also be referred to as "smart thermal mass" in that it seeks to maintain a set temperature as opposed to the average temperature of the day, as most thermal mass tends to provide.

In determining the M-Value, products are tested to determine their ability to store latent heat and are given a corresponding M-Value rating which states the products Btu Rating per square foot of space in which it is installed. As an example, a product with an M-Value of 51 will have the ability to store 51 Btu's of latent heat per square foot.

Following this description, M-values can be extracted from the same experiences already done within the RAL standard, although translated to American units. These values are shown In the deliverable 4.2 “Assessment of the cycling stability and durability at month”.

3. OTHER STANDARDS

Aside from specific standards related to the particular behavior of phase change materials, other regulations were studied considering the final application of NanoPCM project developed insulation materials.

3.1 Fire resistance

EN ISO 1182	Non combustion test
EN ISO 1716:2002	Reaction to fire test for building products –Determination of the heat of combustion
EN ISO 9239-1:2002	Reaction to fire test for building products –Part 1: Determination of burning behaviour using a radiant heat source
EN ISO 11925-2:2002	Reaction to fire test – Ignitability of building products subjected to direct impingement of flame. Part 2: Single flame source test
EN 13823	Reaction to fire test for building products –. Building products excluding flooring exposed to the thermal attack by a single burning item
Pr EN 14390	Fire test – Large scale room reference test for surface products
EN 13238.	Reaction to fire test for building products – Conditioning procedures and general rules for selection of substrates
EN ISO 9705 (Pr EN 14390)	Fire Test – Full scale room test for surface. Products

3.2 Structural elements without any fire confining function

Applied to walls, floors, roofs, beam, columns, balconies, stairs, footbridge

Regulation(s): EN13501-2; EN1365-1,2,3,4,5,6; EN1992-1.2; EN1993-1.2; EN1994-1.2; EN1995-1.2; EN1996-1.2; EN1999-1.2

Classification: R 15 20 30 45 60 90 120 180 240 360

3.3 Structural elements with fire confining function applied to walls

The reference regulation(s) are: EN13501-2; EN1365-1; EN1992-1.2; EN1993-1.2; EN1994-1.2; EN1995-1.2; EN1996-1.2; EN1999-1.2

Classification: RE 20 30 60 90 120 180 240; REI 15 20 30 45 60 90 120 180 240; REI-M 30 60 90 120 180 240; REW 20 30 60 90 120 180 240

3.4 Non structural parts or elements of building work and products

Applied to separation elements (comprising those that have not insulated parts)

Regulation(s): EN13501-2; EN1364-1; EN1992-1.2; EN1993-1.2; EN1994-1.2; EN1995-1.2; EN1996-1.2; EN1999-1.2

Classification: E 20 30 60 90 120; EI 15 20 30 45 60 90 120 180 240; EI-M 30 60 90 120; EW 20 30 60 90 120

3.5 Applied to facades (separating walls) and external walls (including glass elements)

Regulation(s): EN13501-2; EN1364-3, 4, 5,6; EN1992-1.2; EN1993-1.2; EN1994-1.2; EN1995-1.2; EN1996-1.2; EN1999-1.2

Classification: E 15 30 60 90 120; EI 15 30 60 90 120; EW 20 30 60

Notes: The classification is completed by «(i → o)», «(o → i)», o «(i_ o)» to indicate if the element has been submitted to testing and if respects the requirements of fire coming from outside or inside or both.

"Mechanical stability" indicates that the possible fall of elements is not subject to cause damages to people in the indicating period for E or EI Classification.

4. CONCLUSIONS

Three different types of standardization have been already studied. All of them can be applied to the NanoPCM products.

On the one hand, M-value and R-value are focused in the storage heat within the products and materials developed within the NanoPCM project. The aim of them is to extract the efficiency to compare to other products or materials using the same measure system, parameters and conditions.

On the other hand, the Eco-Label is referred to environmental components of the product and possible damages it could produce. In this sense, the Life Cycle Assessment is the most important parameter to take into account. It is being developed within the Work Package 5 "LCA, recycling, cost analysis and safety", which will be concluded on month 36.

After the meeting during March 2013, the European Union Ecolabelling Board (EUEB) regretted to inform that the products proposed have not been selected by the EUEB as one of the priority product groups for future criteria development.

The EUEB found that the products are not very suitable for the EU Ecolabel as such for the following reasons:

- They are mainly Business to Business products not yet available on the market and therefore only partially falling under the scope of the EU Ecolabel Regulation.
- They are building components and it would be very difficult to define the scope of the related EU Ecolabel product group in a technology-neutral manner. Moreover , they believe that a functional approach as the one we are proposing for the product group Office Building under development (http://susproc.jrc.ec.europa.eu/buildings/index.html) would be more suitable.
- NanoPCM is stating that the objective of acquiring the Ecolabel would be to promote the standardization process for the products, thing that is not in line with the EU Ecolabel objectives.

Acknowledgements

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References

- http://ec.europa.eu/environment/ecolabel/
- Phase Change Material, Quality Assurance, RAL-GZ 896
- *"Role of standards. A guide for small and medium-sized entreprises."* United Nations Industrial development organization
- http://www.phasechange.com/m-value-page.php
- *"Latent heat storage in buildings. Storing heat and cold in a compact and demand-oriented manner"*. BINE. Informationsdienst, 2009
- *"Calorimetric evaluation of phase change materials for use as thermal interface materials."* Zongrong Liu, DDL Chung,
- *"Development of standards for materials testing and quality control of PCM," H Mehling, H*-P Ebert, P Schossig
- *"An empirical study on the impact of standardization of materials and purchasing procedures on purchasing and business performance."* Cristóbal Sanchez Rodríguez, David Hemsworth, Ángel R Martínez Lorente, Jose G Clavel
- *Deliverable 2*.1 "Report on selection of the organic components (matrix) acting as PCM support according to the requirements of final application and of the reactive groups presented in the PCM"

ANNEX I

- Report for RAL Standardization

Number of samples and measurements

4 samples of 10 different types of materials were introduced in the heating chamber to carry out the thermal cycling test.

Samples	Amount
PU foam (Blank)	4
Pu foam + Microencapsulated RT27	4
PU Foam + Microencapsulated fatty acids	4
PU Foam + Microencapsulated octadecane	4
PU foam + SiO2 porous	4
Microencapsulated RT27	4
Microencapsulated fatty acids	4
Microencapsulated octadecane	4
SiO2 porous	4
Masterbach panel	4
TOTAL SAMPLES	40

Table 4Samples used for the thermal cycling test

Special aspects of sample preparation or preparation of the measurement method use.

For the samples preparation, the information is included in few deliverables within the NanoPCM project. The next table shows where the information is:

Samples	Information about the production
PU foam (Blank)	Deliverable 6.1
Pu foam + Microencapsulated RT27	Deliverable 6.1
PU Foam + Microencapsulated fatty acids	Deliverable 6.1
PU Foam + Microencapsulated octadecane	Deliverable 6.1
PU foam + SiO2 porous	Deliverable 6.1
Microencapsulated RT27	Deliverable 2.5
Microencapsulated fatty acids	Deliverable 3.3
Microencapsulated octadecane	Deliverable 3.3
SiO2 porous	Deliverable 3.3
Masterbach panel	Deliverable 2.3

Table 5 Deliverables in which the synthesis of the different products used in the samples construction are told

In relation to the methodology, DSC and SEM pictures were used to compare the status of materials after thermal cycling tests.

For the DSC measurements, a ramp of 1ºC /min from 10ºC to 40ºC was used and the same velocity for the opposite way

Specification of the thermal conductivity at predetermined temperatures above and below the melting point or the melting range

The melting range is shown in the next table, depending on the sample tested

Samples	Melting temperature [°C]
Hexadecane	17,66
Octadecane	27,67
Fatty acids	19,01
Rubytherm RT27	27
Masterbach	13-33

Table 6 Materials used in the thermal cycling tests and melting temperatures related to

Specification of the sample density at the beginning and end of the measurement

In the case of powder samples, they have a density around 800 Kg/m^3, while foam samples are around 45-59 kg/m^3

Documentation of the humidity, room temperature and normal pressure during the measurement

The thermal cycling test was carried out at 65%RH, while the room temperature was around 20ºC (outside of the oven

Documentation of specific observations during the measurement

N/A

Documentation of the initial measurements

Initial DSC and SEM are shown in the Deliverable 4.2 "Assessment of the cycling stability and durability at month"

Parameters of temperature ramp

The ramp was defined as 2ºC/min, from 10ºC to 40ºC, getting thermal cycles of 30 min.

Documentation of the control measurements and results

Graphs of the measurements done after 250, 500, 750 and 1000 cycles are shown in the Deliverable 4.2 "Assessment of the cycling stability and durability at month"

Proof of cycles completed

Graphs shown in Deliverable 4.2 "Assessment of the cycling stability and durability at month" are the proof

Cases of damage (if applicable)

N/A

Information on the cycle categories successfully tested

Category C, 1000 cycles checking the properties each 250 cycles

Safety sheet

The information related to safety and risk using the developed materials within the NanoPCM project is shown in the Deliverable 5.3 " Safety and risk assessment of processing & product" Additional information will be available in the Deliverable 5.4 "Safety and Risk Assessment of the new PCM materials as constructive elements"

PROPOSAL FOR INCLUSION OF A NEW PRODUCT GROUP IN THE EU ECOLABEL SCHEME

Please complete this form and send it to the EU Ecolabel Helpdesk: ecolabel@biois.com
Date: 19/11/2012

Contact information
Company or organisation (if applicable): ACCIONA Infrastructure
Activity sector: Construction
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Telephone number: +34 917 912 733
Fax (optional):

1. Product group designation:

1.1. How would you define this new product group (in terms of name, products covered, sub-product groups, etc.)?

This product is called NanoPCM and consists in rigid polyurethane foam panels with different phase change materials (PCM) and nanoparticles.

The NanoPCM material possesses higher insulation properties than the traditional ones and contributes to the indoor comfort maintenance by means of the thermal storage.

1.2. Is the product (group) targeting consumers or businesses?

With the production of NanoPCM materials, it is expected to reduce the cost of nanotechnology-based insulation systems and make their wide-scale commercial application feasible.

The introduction of the novel materials in current insulation systems like polyurethane foam or sandwich insulation panels will favour the implementation in buildings due to the needs of special structures or specialized technicians, without increasing the installation cost.

2. Reasoning for choice and scope of the product group:

2.1. What are the advantages and limitations of the product(s) compared to competing products and/or other products produced by the same company (if applicable)?

ACCIONA Infrastructure does not produce any competing product.

The use of NanoPCM materials with storage capacity in building walls and roofs will not only contribute to reduce required energy consumption but also in reducing the annual energy cost for end users. Additionally, it helps in extending the periods of thermal comfort without using HVAC systems during inter-seasons periods

The 42% of the current spent energy could be saved using traditional insulation systems. Through substitution of them by NanoPCM materials, the total savings could be increased around 60%. Economically, it can mean 120 000 millions of euros /year or even more, regarding the increasing of the oil price.

3. Significant potential for effecting environmental improvements:

3.1. Please provide information on environmental impacts of the product group (preferably using life cycle assessment data/studies). Please indicate critical and controversial issues related to these claims on environmental impact if any.

In the development of NanoPCM materials, several residual by-products are used.

Additionally, as NanoPCM materials have better insulation properties, it will increase the energy savings. It will be translated as a reduction of the CO_2 production.

Currently, proper LCA studies are being carried out and the results will be available soon.

3.2. Please provide information on potential environmental benefits that the establishment of the EU Ecolabel product group may bring.

Nowadays, the climate warming is a problem that concerns everybody and with the Kyoto Protocol the countries have established some goals to get in the decrease of greenhouse gas emissions. The most of the efforts have been channelled into the reduction of CO_2 emission, what is equivalent to the energy savings.

This way, the NanoPCM product will avoid CO2 emissions by decreasing the energy consumption in terms of heating or cooling. Buildings will be more efficient and improvements in people comfort will be reached.

NanoPCM product could manage some waste from other industries, what means the reduction of CO2 emissions by the reduction of the transportation of residual waste.

Additionally, the use of polyurethane foam with PCM will reduce the thickness of typical used panels. It will decrease the emissions from the panels transportation.

4. Market description:

4.1. How is this product's market segmented? Please provide information on the corresponding market shares.

This product is not commercially available yet. The Eco-Label will facilitate its incorporation into the market.

4.2. Please provide intra-community market data for the sector, including volumes, turnover and main actors.

The rigid polyurethane market is a segmented big one related to the polyurethane components. Only few companies sell rigid polyurethane. Most of them sell the raw materials.

As per Global Industry Analysts, the global market for foamed plastics (polyurethane) is projected to reach 9.6 mln tons by the year 2015, driven by resurgent demand from construction, furniture and bedding, and automotive markets.

Major players profiled in the report include BASF AG, Bayer AG, British Vita Unlimited, The Dow Chemical Company, FXI - Foamex Innovations, Huntsman Polyurethanes, Mitsui Chemicals Inc., Recticel S.A, and Woodbridge Foam Corporation.

4.3. Could you describe any possible trade issues (for instance, in terms of access to the market, intellectual property, etc.)?

The only issue that has been found so far is the lack of normative regarding the acquisition of quality labels or certifications for prototype construction elements.

In terms of intellectual property, the NanoPCM consortium possesses the rights for exploitation following the rules within FP7 projects.

4.4. What is the current and future potential for market penetration of the product(s) bearing the EU Ecolabel? Please provide relevant market estimates.

The objective of acquiring the Eco-Label is to promote the standardisation process for the NanoPCM product. Nowadays there are no standards developed for polyurethane foam panels containing PCM.

In terms of revenue, the market was estimated to be worth US$33,033 mln in 2010 and is expected to reach US$55479.68 mln by 2016.

North America, Asia-Pacific, and Europe dominate the polyurethane market and together accounted for 95% of the global polyurethane demand in 2010. North America and Western Europe are mature markets and are expected to grow at a sluggish rate.

However, Asia-Pacific, Eastern Europe and South America are expected to drive the demand for polyurethanes in the coming decade. The furniture and interior industry dominated the polyurethane market, accounting for 28.01% of the total demand in 2010. The second largest end-use of polyurethanes is in construction industry, which accounted for 24.98% of the overall market in 2010.

Electronic appliances, however, are the fastest growing market for polyurethanes. Polyurethane demand for electronic appliances is expected to grow at a CAGR of 7.3% to 2011.

The need for low-cost and long-lasting materials and rising significance of energy efficiency in appliances and buildings is expected to foster growth in the foamed plastics market. The global economic meltdown led to significant decline in demand for polyurethane (PU) foams across the globe, largely due to the contraction in majority of the end-use markets including automotive and construction. Both flexible and rigid PU foams registered decline during 2008 and 2009, with the demand for flexible PU foams registering steeper decline in the US and Western Europe.

Demand for PU foams is highly dependent on diverse end-use applications particularly in furniture and automotive sectors. Subdued consumer spending, slowdown in new housing starts, decline in automotive production, and increase in the volume of imported furniture contributed to a significant decline in PU production.

5. The environmental awareness:

5.1. Has this product(s) already been awarded a certification or ecolabel under another scheme?

This is the first certification that is been applied for NanoPCM.

6. Complementary information

6.1. Are you/your organisation interested in initiating and participating in the development of EU Ecolabel criteria for the proposed product group? If yes, please describe how you propose to do so.

Yes, we are, we believe that there is an important number of projects that aim to develop insulation materials containing different concentrations and types of PCM that find very high barriers to reach the market, and this is a very important step to tackle those barriers.

6.2. Please suggest stakeholders who should be involved in criteria development.

-Local Authorities & National/Regional Public Bodies are key players as policy makers, favourable legislative framework creation, public procurements, owners and promoters of their own buildings.
-Public and private promoters.They can offer to their clients the advantage of the developed components so that they should be informed about it that could help to foster the adoption of the technologies
-Architects' Associations. Architects need to be provided with appropriated tools to consider thermal storage systems and smart insulation materials for new and retroffited buildings. Due the relevance presence of SMEs in the consortium will ensure a proper dissemination to Architects that are namely SMEs
-Construction companies associations should be aware of the new technologies that will be installed in new and existing buildings. They will be also provided with design guidelines like the ones made for architects.
-Clients and users: key actors providing their perspectives in the formulation and assessment of the project results in aspects such us, design for all, cultural heritage, adaptability for the future and value procurement through and new business models

7. Other information you would like to add to complete this form:

NanoPCM is a project funded by the European Commission within activity EeB.NMO.2010-1 (New nanotechnology-based high performance insulation systems for energy efficiency).

NanoPCM project started in June 2010 and it will be funded until June 2013. It is being developed in collaboration with other European partners: Tekniker(Spain), Active Space Technologies (Germany) , DIAD Group (Italy), PCM Products Ltd (Lithuania), Purinova (Poland) and University of Castilla-La Mancha (Spain).

As this project is in an advanced stage, it has been already successful because of first thermal results tested at lab scale.

Currently, panels of NanoPCM materials have been installed in two demo-buildinsgs placed in Spain and Poland. Real results will be extracted in the coming months.

8. References of data and information collected and used to fill out this form:

NanoPCM project

Thank you for your interest in the development of the EU Ecolabel.
This information will be kept and considered within the EU Ecolabel product group prioritisation process.

For more information on product group development, please see Annex I of the new Regulation on the EU Ecolabel available here.

More information about the EU Ecolabel is available here: www.ecolabel.eu.