Periodic Reporting for period 1 - HOMESKIN (HOMES Key INsulating material)

Reporting period: 2015-02-01 to 2016-07-31

Summary of the context and overall objectives of the project

By boosting resource efficiency and reducing reliance on fuels and materials, the European Union will improve its supply's security on raw materials. This will allow the EU's economy to be more resilient to future wavering of the global energy market. Insulation Renewable Materials (IRM) is therefore expected to be a high growth market particularly in the field of energy efficient building envelopes.

Indeed, buildings are currently responsible for 40% of the global energy consumption and 36% of the CO2 emissions in the European Union. By improving buildings’ energy efficiency, we could reduce the total EU energy consumption by 5% to 6% and lower CO2 emissions by about 5%.

In this context, the HOMESKIN project aims at developing a new silica Advanced Aerogel-Based Composite (AABC) material possessing one of the lowest thermal conductivity of all insulation materials found in the market.

The proposed solution will bring to the market new insulation technologies that do not only possess very high thermal insulation performance but also are thinner, lighter, non-flammable, and with lower CO2 and Volatile Organic Compound (VOC) emissions. The new material developed can be applied to new buildings as well as old buildings’ retrofit applications.
The particularity of this new material is its adaptability to the three most important insulation systems, bringing super-isolation performance to indoor insulation systems, External Thermal Insulation Composite System (ETICS) and to roof insulation systems.

Thanks to an important focus of the consortium on the development of the silica Advanced Aerogel-Based Composite and on the conception of a new reactor, PCAS / ENERSENS will have the opportunity to increase the productivity and manufacturing capability of this new super-insulation technology. This innovative reactor will help bridge the gap between laboratory scales towards markets deployments and will create a significant economic and social added value. Thus, HOMESKIN wants to prepare the industrial roll-out of a leading key enabling technology for Europe which will bring an estimated value creation over 2,000 M€ annually. According to the latest estimates, the large industrial pilot for the manufacturing of the AABC materials (40 M€ CAPEX approximately) is expected to generate a 75 M€/year turnover and more than 100 M€/year of value over the value chain. Each million invested shall generate around 5 direct jobs in Europe.

To reach these outcomes, the consortium encompasses 10 specialized partners covering 5 countries. Large companies bring in the project the commercial & state-of-the-art materials and process. On the other hand, academic partners have been selected to drive jointly the research work in order to achieve performance tests and take part to the European certification. Finally, to bridge up the gap between materials, knowledge and industrial prototypes, an RTO has been selected to structure the consortium and to provide a multi-sites platform with complementary and flexible capacities.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The first step of the project was to develop the new Advanced Aerogel Based Composite material reaching all the technical requirements. Indeed, one of the first HOMESKIN objective was focused on improving the process energy balance and on decreasing the chemical formulation cost of the silica aerogel (AABC). PCAS achieved this goal by developing a new chemical formulation replacing expensive and polluting chemical compounds by an important amount of water. PCAS also developed an enhanced recycling system for process effluents. Both improvements allowed reducing the energy balance by 67% and the formulation cost by 24%.

The second important step reached at the end of this period (M18), is the design, conception and manufacturing of the Fast Advanced Integrated Reactor (FAIR). After a first designed reactor, which was finally not adapted to reach the goals of the project, mainly for safety reasons, a second one was designed.

PCAS helped by ARMINES and USTUTT for the performance characterisations and helped by PAREX, TROCELLEN and FLAG for the industrial applications, worked intensively on the selection of the AABC reinforcement. After a first selection of melamine reinforcement, results of aging indicated a very poor durability of the insulation material. Others selections and tests orientated the choice of reinforcement on Glass fiber and PET fiber. Thermal conductivity results showed good values but mechanical
characterizations indicated a no compatibility of those reinforcements for indoor, outdoor or roof insulation systems requirements. This is why the research for AABC reinforcement, adapted to the chemical process and application constraints, finally selected the Needle Glass Fiber as reinforcement. Currently, all the advanced analyses of this super-insulation material are being performed (acoustic, thermal, moisture, VOC, LCA) and industrial partners are working on the integration of this high performance product in their insulation systems.

In parallel of this advancement, consortium partners were actively implicated in the dissemination of the HOMESKIN project and on the final products and systems developed. The main achievements in terms of dissemination activities were to set-up a Project Identity, displayed on the HOMESKIN Website (http://homeskin.net/) edit a promotion video of HOMESKIN and present the project at scientific exhibition, policy exhibition like COP21 but also at fair trade like ECO-BUILD, BATIMAT and soon at BAU.

Concerning the certification and the standardisation, ITeC focused on the main European regulations and requirements affecting the insulation product itself (AABC insulation product) and the insulation systems under development. Now that the final AABC is identified, validation and assessment of the product will start soon.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Technologic progresses
Thanks to the important work of the consortium within the HOMESKIN project, progresses beyond the state of the art were achieved. To summarize all innovations, we highlight the technological advances in four facts:
• Development and scale up of AABC with a thermal conductivity of 0.015 W/(m.K) Improvement by at least 20% of insulation properties creating one of the most performant insulation.
• AABC answering all the first requirements (chemical stability, AABC adapted to the manufacturing, adhesion, mechanical and thermal performances reached) for ETICS systems and indoor insulation systems at laboratory scale. Tests performed based on European standard were a success.
• Reduction of the process energy balance and the consummation of raw material for the production of AABC.
  • Reduction by at least 30% of the embodied energy and CO2 at component level (will be also confirmed by the LCA analysis).
  • Reduction by at least 15% of the total costs compared to previous materials.
• Design, conception and manufacturing of a new kind of process, able to accelerate all the steps needed for the production of an Advanced Aerogel Based Composite, i.e.: reactants mixing, heating, aging, cooling, hydrophobisation, filtration, washing and drying. A significant effort was done to create a unique reactor able to integrate all the available technology bricks into one module. Results coming from this new reactor shall prove that this acceleration technology is the best candidate for massive industrial deployments ahead.
Standards and certifications

Identification of relevant regulatory requirements at European scale and application of verification methods from the Assessment Plan in order to plan the European Assessment Document and the European Technical Assessment to reach the CE-marking and the Declaration Of Performance.

Socio-Economy

HOMESKIN is strengthening the competitiveness and growth of project partners by developing innovations related to the AABC materials.

If HOMESKIN solutions are adopted massively, one can expect that 15% of the total building renovations fleet would be equipped by this technology and 10% of new buildings insulation. If 1% of the whole European park (160 million of buildings) is renovated each year, it will represent 20 million m²/year. The multiple advantages of the solution could enable a renovation’s rate rise of 2%/year equivalent to 40 million m².

Energy and environment

Due to the high insulation performance of our AABC products or AABC systems, environmental impacts are directly expected. Considering that we will begin to renovate of the oldest buildings which represent 35% of the park but 57% of the average energy consumption per annum, we can estimate:

- A reduction of 0.25% per year of the European energy consumption related building’s sector.
- A reduction of 2.5% after 10 years, increasing to more than 5% after 20 years with regard to the current consumption.
- A reduction of 30% of CO2 emissions.

A European Commission progress report from 2013 found that EU countries had to significantly step up their efforts to take advantage of the opportunities presented by Nearly Zero-Energy Buildings (NZEB). The directive linked to the NZEB promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness. One important methodology shall be laid down taking into consideration the following aspects: the actual thermal characteristics of the building including its internal partitions and so the thermal capacity of used materials. In conclusion, to reach all the requirements of the directive, our new AABC material is a very good candidate.

Living space

Built-up areas — defined as cities, towns and suburbs — provide a home to almost three quarters (72.4%) of the EU-28’s population. The quality of urban life in
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