

Insulation Materials and Blowing Agents: Properties and Impacts



Introduction

In February 2017, the EmiratesGBC Technical Workshop covered the advantages and disadvantages of the major different insulation materials available in the market. Participants were invited to discuss on their direct experience with the different materials and on the properties of the materials in order to identify their best applications.

Materials and their properties

With up to 80% of the energy consumption associated with buildings in the GCC region, with up to 70% associated to air-conditioning needs (especially during summer months), the choice of adequate insulation materials and techniques of the building envelope is critical.

The slides available on the side describe the various insulation materials available in the market, their key properties in terms of density and thermal insulation ability, advantages and disadvantages in terms of (amongst others) applications, fire resistance or environmental impact on production/application.

Environmental Impact and Fire Safety

Following the comparison of existing types of insulation materials, the facilitators reviewed the direct negative impacts of their chemical components on climate change. The international conventions banning the use of CFCs and HCFCs have been addressed, with growing commitments in the MENA regions to phase out specific compounds from the industry and align with these conventions through drastic national plans.

The following points were raised:

- **Pressures on the market:** International conventions and national plans are expected to stimulate research/innovation, development and deployment of new solutions to progress at the mandated speed, in order for manufacturers of

Mineralwool(MW) Rockwool



Raw Material: Various rocks Dolomit, Diabas
Binder: Synthetic resin
Density: 80 - 200 kg/m³
Thermal Conductivity: 0,035 - 0,040 W/mK
Application: Roof, Wall, Floor



Advantages	Fire resistant, flexible, DIY, Sound absorption, Re-useable, long life span, made from natural resources
Disadvantages	High thermal conductivity, water absorption, Fiber dust, High energy consumption during production, Skin irritating

Mineralwool(MW)



Raw Material: Glass, Sand, Soda
Binder: Synthetic resin
Density: 25 - 80 kg/m³
Thermal Conductivity: 0,035 - 0,040 W/mK
Application: Roof inter rafter, Wall cavity, Ceiling

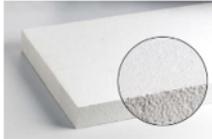


Advantages	Fire resistance, Non combustible (depending on synthetic resin used), Flexible, Sound absorption, Used for high rise buildings and factory pipe insulation
Disadvantages	Skin irritating, Fiber dust, High energy consumption during production (High Carbon dioxide emission!), High water, not a cheap material, heavy material to handle absorption between fibers, Poor compressive strength (e.g. low density MW), High thermal conductivity

Expanded Polystyrene (EPS)



Raw Material: Petrol
Blowing Agent: Pentane
Density: 15 - 45 kg/m³
Thermal Conductivity: 0,032 - 0,045 W/mK
Applications: Roof, Wall, Ceiling, Floor, Perimeter, Sound (Footstep)



Advantages	Cheap, Well known, Low production waste, Numerous producers
Disadvantages	Limited combustibility medium chemical resistance, medium compressive strength, High thermal conductivity

equipment and products to undertake the necessary changes and adopt lower GWP and zero ODP alternatives.

• **Costs of implementing changes:** Such market pressures however do not come without costs to be borne by the companies that need to invest time and money in research and development, supply of new raw materials, product testing and certifications by the authorities.

• **The meaning of sustainability:** While chemical components and properties of each material need to be addressed, a life-cycle approach should be kept in mind: an environmentally-friendly product cannot be defined based on its embedded CO2 emissions and chemical attributes only; their production and post-application impacts (e.g. VOC emissions, waste, energy efficiency, HSE risks associated to their application...) remain critical.

• **Fire codes and regulations in the UAE:** The long-expected updated fire codes haven't been shared yet with the industry, creating confusions among suppliers, consultants and contractors regarding the best way to implement projects.

Because the existing alternatives (e.g. insulation blocks) suggested by the authorities can actually negatively impact the project's quality (thermal bridges, cracks in the building structure...), the need for industry stakeholders to work together with the authorities and positively influence the market has been emphasized.

• **Sustainability vs. Safety:** With the above-mentioned pressures in mind, the focus on safety (and by extension the use of fire retardants that could negatively impact the environment) should not conflict with the corporate objectives towards sustainability. Instead of assessing, testing and certifying the materials on an individual basis it was suggested that the existing codes and regulations themselves are re-designed to better reflect the market's reality and actual needs from the industry.

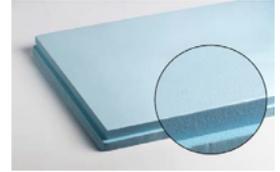
Education of the market and the authorities with regard to the various materials, especially when discussing their applicability and fire resistance, remains necessary.

Workshop facilitated by Florian Hupka and Wissam Khaddaj, Bayer Pearl.

Extruded Polystyrene (XPS)



Raw Material: Petrol
Blowing Agent: HFC, HFO, CO₂
Density: 25 - 50 kg/m³
Thermal Conductivity: 0,030 - 0,040 W/mK
Applications: Roof, Floor, Perimeter

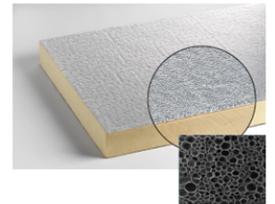


Advantages	High compressive strength, Low water absorption, Cheap, Recyclable, Low production waste, Numerous producers, Easy to process & handle, Anti-UV
Disadvantages	High thermal conductivity, Poor chemical resistance, limited combustibility

Rigid Polyurethan foam (PU)



Raw Material: Petrol
Blowing Agent: HFC, HFO, Pentane, CO₂
Density: 30 - 100 kg/m³
Thermal Conductivity: 0,022 - 0,030 W/mK
Applications: Roof, Wall, Ceiling, Floor, Perimeter, Pipelines



Advantages	Ample supply, Reusable, Recyclable, Durable, very low thermal conductivity, Good flame resistance, No water absorption, Spray application on-site
Disadvantages	Powder surface, higher in price compared to EPS/XPS, not flexible

Cork



Raw Material: Bark of cork oak
Blowing Agent: CO₂
Density: 80 - 200 kg/m³
Thermal Conductivity: 0,045 - 0,055 W/mK
Applications: Roof, Wall, Floor

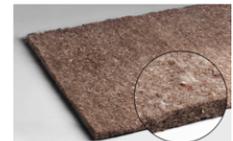


Advantages	High compressive strength, recyclable, natural sources
Disadvantages	Expensive, Moisture absorption, Poor ageing properties, Not fire resistant, Consuming natural resources (cutting trees), High thermal conductivity, Not available in ample quantities

Sheep's Wool



Raw Material: Sheep's Wool
Additive: Polyesterfiber
Density: 25 - 35 kg/m³
Thermal Conductivity: 0,035 - 0,045 W/mK
Applications: Roof, Wall, Ceiling



Advantages	"Environmentally friendly"
Disadvantages	Expensive, High water absorption, Low physical strength, Limited capacity (resource), High content of flame retardants, Contains insecticide e.g. against moths, Long distances for raw material transportation (e.g. New Zealand)