

Properties of polyurethane foams prove key to sustainable material choice

Material efficiency

In a world where demand for the products of modern life is putting pressure on both supply and the environment, there has never been more need for materials that make the most of existing resources and contribute to reduced CO₂ emissions. Durability, light weight and thermal efficiency make polyurethanes an increasingly attractive option for manufacturing and construction solutions.

Global population growth and increased life expectancy are putting the supply of materials and resources under pressure, and adding to environmental challenges such as climate change. Demand for more shelter, food and fuel is stretching finite resources and increasing potential for CO₂ emissions.

Industry needs to focus on using resources more efficiently, finding solutions that minimise resource needs over time, and developing products that contribute to quality of life while helping to reduce or mitigate environmental impact.

Because of their performance and versatility, polyurethanes are increasingly one of the materials of choice in meeting these objectives. "Resource conservation has become a priority in material selection, particularly where energy or fuel efficiency and durability are primary requirements," says Kalyan Ram Madabhushi, Propylene Oxide-Derivatives Business Manager – Europe/Africa.

"Industry, particularly in Europe, is looking for products that provide a high level of performance using the least material, at the lightest weight, and that deliver benefits for longer. Polyurethanes

can make a significant contribution to tackling these challenges due to their inherent properties and the flexible options they can provide."

The largest market for Shell's CARADOL* range of polyols – principal raw materials for polyurethanes – continues to be flexible slabstock foam for soft furnishing and bedding, but demand for rigid foam for insulation, refrigeration and automotive applications has been growing strongly.

REGULATORY TRENDS

Madabhushi, who is Shell's representative in ISOPA, the European Diisocyanate and Polyol Producers Association, says that material selection in Europe is also being influenced by regulatory trends.

"The EU is committed to reducing greenhouse gas emissions by 20% to 30% by 2020. A major element of this will be more efficient homes, vehicles and domestic appliances – areas where polyurethanes have a key role to play.

"This trend is a good fit with the sustainability of the PO-Derivatives business and the Shell Group's overall commitment to CO₂ reduction. Production of polyurethanes accounts for a tiny proportion of overall energy use but the products have the

potential to deliver significant benefits."

Polyurethane (PU) foams are strong but light, may be flexible or rigid, and can be formulated to consume the minimum raw material for a specific application or performance requirement.

The extremely low thermal conductivity of rigid foams provides high levels of insulation for homes and buildings, reducing the energy required to keep them warm or cool. It also helps in the preservation of food that would otherwise spoil before it could be consumed.

In vehicles, the increasing use of polyurethane is contributing to lighter, more fuel-efficient cars. "By substituting steel and other materials, car makers can continue to deliver increasing levels of luxury and performance required by consumers, but with fewer materials and at lower weight," he says.

"The durability of polyurethane-based products means they last longer, avoiding unnecessary replacement that would use up additional resources, and extends the time in which benefits are delivered."

THERMAL INSULATION

With nearly half of all fossil fuels used for heating and cooling buildings – and generating a significant proportion of CO₂ emissions – considerable savings in costs, energy and CO₂ can be achieved through more effective insulation.

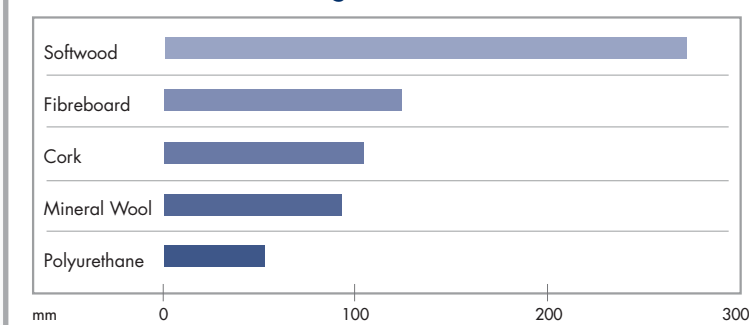
Rigid PU foam is one of the best insulation materials available for construction of new buildings as well as renovation of existing buildings. The energy savings achieved during its use far exceed that consumed in its production.

The closed cell structure and encapsulated insulating gas provides unrivalled performance where the highest level of insulation is required, or where the thickness of insulation is a consideration in design or cost of construction.

Alternative materials need to be up to 60% thicker to achieve the same level of insulation (see Figure 1).

Demand for rigid PU foam for building insulation is already growing at around 7% per annum in the EU. Tougher →

FIGURE 1
Thickness of materials to give same level of insulation



Source: ISOPA

Kalyan Ram Madabhushi, Propylene Oxide-Derivatives Business Manager, Europe/Africa - lighter cars and warmer homes are just two of the benefits delivered by polyurethane foams.



energy efficiency targets are expected to drive further substantial demand growth.

By using new technologies such as insulated sandwich panels with structural strength, polyurethanes contribute to more efficient use of other natural resources such as steel and wood.

Insulation is also vital for the low temperature preservation of food during processing, storage and distribution to the consumer. Rigid polyurethane sandwich panels not only help to keep food at the right temperature for the least amount of energy, they also prevent condensation that could lead to formation of bacteria.

Insulation is used at every stage of the consumer food chain from agricultural buildings and processing factories to refrigerated transport, cold stores and display units. Most fridges and freezers produced in the world are insulated with PU foam and its performance is key to appliances that meet ever more stringent energy efficiency standards and also cost less to run.

LIGHT WEIGHT

Energy efficiency is just as important in the automotive sector, which is looking for ways to produce lighter vehicles, with better fuel economy.

Plastics generally have helped to significantly reduce energy consumption in cars over the past 20 years. The use of polyurethane has grown compared to other materials because of its ability to provide high levels of performance and design flexibility whilst reducing weight.

Car seats and headrests are often made from low-density flexible PU foam because it represents the best material choice to meet the needs of both manufacturers and consumers. It combines a high level of cushioning and soundproofing, vibration damping, as well as comfort and durability.

Its light weight contributes to improved fuel efficiency over the lifetime of the car, reducing CO₂ and other emissions.

DURABILITY

The most successful materials in the future are expected to be those that not only minimise resource and energy consumption but which are also very durable. Products will increasingly need



Polyurethane foams are used in refrigeration at every stage of the food supply chain.

to be designed and optimised for a specific purpose and use pattern, with a service life that is closely matched to human needs.

The life span of products containing polyurethane can reach 50 years or more, depending on nature of application (see Figure 2). When they do reach the end of their useful life polyurethanes can be recycled or a large portion of the 'borrowed' energy used in their initial production recovered through incineration.

New applications are also emerging for scrap or 'trim' foam left over when finished blocks of foam are cut to size.

Polyurethanes have become an essential part of modern life, delivering benefits across a range of products. Those same properties have an equally important role today in helping to address key global challenges of climate change and the need for resource efficiency.

"The properties of polyurethanes are becoming an increasingly important factor in sustainable material choices," says Madabhushi. "The benefits they can deliver are also aligned with the Shell Group's commitment to energy efficiency and CO₂ reduction."

*CARADOL is a Shell trademark

