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Interview: S. Hulme, N. Keane, Ingevity

CPI Polyurethanes Technical Conference preview

Cyclopentane as a blowing agent

PU coatings for metal cans

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High energy efficiency of buildings with cyclopentane

Insulation is a major topic in the construction industry – providing higher energy efficiency, generating cost savings and supporting an improved climate balance. To achieve this, insulation with particularly good insulating properties is needed. Cyclopentane as a blowing agent in insulating foams contributes to the energy efficiency goals of the European Green Deal.

Our society and our planet are undergoing a transformation the likes of which we have not seen since the Industrial Revolution over one hundred and fifty years ago. Energy efficiency is the clearly defined goal for everyone. Recently, the European Commission has released its “Fit for 55” program, outlining a roadmap to the achievement of climate neutrality in the EU by 2050, with an intermediate climate target of at least a 55 % net reduction in greenhouse gas emissions by 2030. This is a substantial increase compared to the previous target of a minimum 40 % reduction and will have significant influence on the way we live and carry out business within the EU.

One cornerstone of the EU's policy to combat climate change and to cost-effectively reduce greenhouse gas emissions is the EU Emission Trading System (ETS), which was initially introduced in 2005. Since then, energy-intensive industrial companies, the power sector and commercial aviation within the European Economic area have had to submit allowances in order to cover their CO₂-emissions. Companies receive allowances on an annual basis which are reduced over time and any shortfall has to be purchased thereby creating a penalty for carbon emission and driving a reduction in total emissions. To

▼ One way to enhance the energy efficiency of buildings is to ensure a proper insulation.



Source: Haltermann Carlless - istockphoto, Gipi/23

reach EU climate targets under the European Green Deal, however, the European Commission intends to increase the ambition of the existing EU ETS reducing free allowance and increasing the rate of reduction thereby making allowances significantly more expensive in the years to come. This will drive sustainable innovation and solutions for more energy savings not only in construction and building, but across all society.

Enhancing energy efficiency in buildings

The building sector is vital in the transition to climate-neutrality. At the moment, buildings account for 40 % of the EU's energy consumption and about 36 % of European green-

house gas emissions. No other sector in the EU uses more energy or emits more carbon dioxide. Since most of the buildings that we will occupy in 2050 have already been built, the main challenge is to renovate these existing buildings to make them more energy- and carbon-efficient.

Different options are available to help evolve the built environment in Europe towards a climate-neutral, circular and sustainable future. One way to enhance the energy efficiency of buildings is to ensure a proper insulation. There are different materials available for insulation, where blowing agents play an important role.

Expanded polystyrene (EPS): The rigid foam insulation material is made from styrene, an

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aromatic hydrocarbon. This is industrially processed into the polymer polystyrene. Expanded into EPS foam, it is used in various applications. Alternatively, polystyrene can be processed into insulation boards as continuous goods, then called "XPS". Foamed polystyrene is a classic among thermal insulations; it is easy to process, inexpensive, pressure-resistant and light.

Rigid polyurethane (PU) foam: Polyurethane consists of two starting materials, a diisocyanate and a polyol. Depending on the diisocyanate and polyol used, rigid foams or flexible foams can be produced. Rigid PU-foam has very good thermal insulation properties, which allows a thinner insulation layer. Rigid PU-foam is as durable and pressure-resistant as expanded polystyrene.

▼ Rigid PU-foam has very good thermal insulation properties, which allows for thinner insulation layer and more flexibility in construction.



Source: Haltermann Carless - Istockphoto: Anatoly Szov

Pentane – a key component for efficient insulation

The foaming process usually includes low boiling inert molecules, the blowing agents, that give the material the desired properties. Three pentanes are commercially used for blowing foams: n-pentane, iso-pentane and cyclopentane. Their properties as blowing agents and as thermal insulators make them a valuable base material for PU- and EPS foams. Due to their good ecological profile with zero ozone depletion (ODP) and low global warming potential (GWP), as well as their property as low heat conductors (in the case of cyclopentane), they make an important contribution to higher energy efficiency in buildings, thus helping to reduce greenhouse gas emissions. Pentanes comply with the worldwide regulations for the protection of the stratospheric ozone layer, which have been internationally anchored in the Montreal Protocol since 1987. They are a sustainable alternative to the banned chlorofluorocarbons (CFCs) and to hydrofluorocarbons (HFCs).

The commercially used pentane isomers n-pentane, iso-pentane and cyclopentane have different advantages. Usually pentanes are used as individual blends of two or even all three isomers allowing the properties to be optimally adjusted for the intended use. In

▼ Haltermann Carless production site in Speyer, Germany.



Source: Haltermann Carless

polyurethane (PU) foam, pentanes remain as cell gas. This cell gas has a lower heat-conductivity than ambient air, adding to the insulation properties of the foam. This is contrary to styrene foam, which is an open-cell foam. It only requires pentane for blowing the foam, as the insulation qualities come from the polystyrene (PS) and the foam itself, and not from the blowing agent.

Cyclopentane is the most valuable pentane as it contributes to an even greater extent

than iso-pentane and n-pentane to the insulation properties of a polyurethane (PU) or polyisocyanurate (PIR) foam. Though the base materials for polyurethane are more costly than those for polystyrene (PS), the PU-foam has advantages: The insulation layer is thinner than PS-foam and allows more flexibility in construction.

The iso-pentane is the lowest boiling isomer, closely followed by n-pentane. These pentanes are mostly used for blowing polysty-

rene (PS). Due to the physical properties of polymer and blowing agent, all blowing agent evaporates from polystyrene foam quickly after production.

As the only company in Europe that produces all three types of pentane, Haltermann Carless is in the position to supply tailor-made pentane blends in any mixing ratio allowing manufacturers of insulation materials to receive the optimum pentane product for their application. Haltermann Carless has decades of experience in the production of pentanes.

The products are manufactured in Speyer, Germany, with a purity of at least 95 % serving the strong requirements of the industry. To meet the growing market demand for cyclopentane and to respond to the shortfall of this much sought-after feedstock, Haltermann Carless is currently investing in a new hydrogenation plant at the production site in Speyer. With its commissioning in Q1 2022, the chemical company will significantly offer new capacity volumes to the global market and become the largest Cyclopentane producer worldwide.

Outlook

Significant energy efficiency potential in the construction industry can be unlocked through better insulation. The renovation of the EU's building stock is therefore important for a climate-neutral Europe. Cyclopentanes are fundamental to the insulating performance of modern insulation materials. They make an important contribution to greater energy efficiency in buildings and thus to support the the European built environment to evolve towards a sustainable and climate-neutral future.

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