Honeywell launches fourth generation high performance, LGWP blowing agent

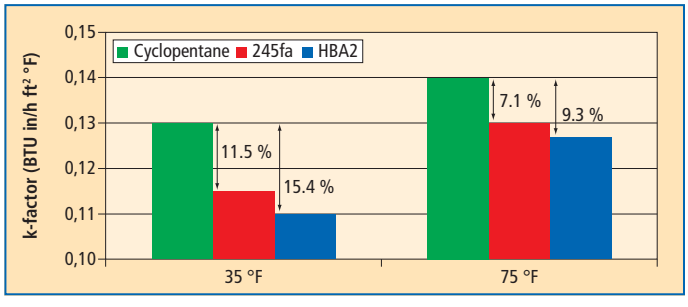
Honeywell will officially launch its latest addition to its "fourth generation platform" of blowing agents for the polyurethane industry during the CPI (Center for the Polyurethanes Industry) Polyurethanes Technical Conference, 26–28 September 2011, in Nashville, TN, USA. The first in the series, 1234ze, was commercialised in Europe in the second quarter of 2008.

Honeywell will highlight the improved performance and low environmental impact of its new blowing agent HBA2 or 1233zd(E), in three different applications in papers scheduled to be delivered at the conference. The first paper, delivered by **Jim Bowman,** Senior Principal Engineer, will present new data on the use of HBA2 in the appliance sector. He will compare the performance of HBA2 to other blowing agents used for domestic appliances **(figs. 1** and **2).** The second paper, delivered by **Mary Bogdan,** Senior Principal Chemist, will provide data from trials of HBA2 in spray foam applied under a range of demanding environmental conditions compared to blowing agents currently in use **(fig. 3).** The third paper, delivered by **Jim Ling,** Senior Research Chemist, will highlight the performance of both HBA2 and 1234ze(E) in panel applications.

On a global basis, the industry, individual government regulators, and NGOs continue to seek a low environmental impact and energy efficient solution across all energy consuming applications, including household refrigerators and construction materials. Honeywell's latest fourth generation blowing agent demonstrates the company's intent to achieve these goals through the use of high performance halochemical solutions.

Responding to environmental concerns

The use of fluorocarbon blowing agents started in the mid-1950s with trichlorofluoromethane (CFC-11). Concerns over ozone depletion during the 1970s, led to the development of a second generation of high performance blowing agents, the HCFCs, such as HCFC-141b. Although conversion to HCFC-141b reduced the Ozone Depletion Potential (ODP) of the blowing agent by 90 %, subsequent regulation required the phaseout of these blowing agents. A third generation of blowing agents was developed – the HFCs – including HFC-245fa. These HFC materials satisfied the requirements of ODP regulations while retaining the high performance and non-flammability requirements of many insulating foam applications. Honeywell has been the leader in the development of fluorocarbon blowing agents and is now leading the development of a fourth generation fluorocarbon technology, which is driven by the continued need for energy efficient and low environmental impact solutions.



◀ ***Fig. 1:*** *k-factor comparison appliance*

In its quest to develop these fourth generation materials, Honeywell's goal was to retain all the positive attributes of the HFCs: high energy efficiency performance, non-flammability, non Volatile Organic Compound (VOC), and ease of conversion. These properties continue to differentiate fluorocarbon blowing agents as the best choice for high performance rigid foam insulation applications and for those applications where a flammable blowing agent is unsafe, too costly to use, or fails to provide the desired foam performance.

As an added benefit, the fourth generation materials were formulated to have a significantly lower global warming potential, reducing the climate change impact of the materials. "We have succeeded in creating a highly energy efficient blowing agent that also has a very low GWP of 7," said **Sanjeev Rastogi,** Business Director. "By keeping the good attributes of HFCs, improving efficiency, and dramatically reducing the global warming potential, we are making it even easier for our customers to adopt the new products in both developed and developing countries."

HBA2: Wonder molecule?

This new high performance material, while containing fluorine, also contains an olefin structure. The presence of a double bond in the molecule backbone makes the haloalkenes a separate and distinct class of materials from their predecessors. The chemical structure results in a much shorter atmospheric lifetime than HFC materials, thereby resulting in a much lower global warming potential (GWP). HBA2 (1233zd) is a liquid blowing agent, making it suitable for use in appliance foams, pour-in-place applications, and spray foam insulation.

"HBA2 is a great molecule that offers improved performance and superior environmental properties compared to today's blowing agents," said **Dave Williams,** Senior Technical Manager. "Results obtained so far have far exceeded expectations. The molecule yields higher energy efficiency than 245fa in all applications we've evaluated,

including appliances, spray foam, and panels, while also offering the possibility of lower cost solutions and optimisation of performance through its inclusion in blends."

"Regulation and the growing number of 'green' builders are the two main issues within the construction industry driving demand for the next generation blowing agents" stated Mary Bogdan. "We are aware of a growing number of architects and specifiers interested in using high performance materials within the passive house concept. Rigid foams using HBA2 help to meet these requirements."

Blending is a new technology that is developing quickly as end users consider optimisation of cost and performance through the use of various blowing agents. Commercial options for fourth generation blowing agents can also incorporate a combination of the liquid HBA2 and the gaseous 1234ze blowing agents. "This combination has proven very successful for spray foam applied in cold regions, where the properties imparted by the two molecules help to improve the reactivity of the formulation," explained Bogdan. Blends with other blowing agents, including water, hydrocarbons, and others are under development by Honeywell, and are expected to broaden the choices in blowing agents for customers. For example, in countries where energy standards are high, OEMs can use pure HBA2 as a blowing agent; however, in countries where energy standards are not as high, OEMs can dilute with water to meet the energy performance and also lower costs. Further, as energy standards increase (which they will eventually), they can decrease the amount of the diluent.

"Blends of hydrocarbon with HBA2 could provide a viable option to balance cost with physical properties and thermal insulation requirements for insulated metal panel applications", said Jim Y. K. Ling, global technology sector leader. "For panel applications that require superior thermal insulation at low temperatures, pure HBA2 or blends of hydrocarbons and HBA2 may provide a better solution than just hydrocarbons."

At high temperatures polyol premixes made using HBA2 have a 14 % lower vapour pressure than polyol premixes using currently available blowing agents like HFC-245fa, making spray foam formulations easier to handle and to store. "We fully anticipate that, due to the superior properties of HBA2, many end users will start using it ahead of regulatory requirements," suggests Williams.

Superior appliance performance

Energy efficiency standards for refrigerators and freezers continue to increase in most countries. Meeting these energy standards determines whether a refrigerator can be sold in that country. In a recent trial of 22 cubic foot refrigerators and freezers manufactured using HBA2 (to be presented at 2011 CPI conference), the refrigerators exceeded the Energy Star label requirements by an average of 9.5 % (see **fig. 2).** According to Bowman, "This highly energy efficient household refrigerator/freezer was demonstrated to meet the requirements of 'proposed' DOE 2014 energy standard without employment of further energy solutions to this refrigerator/freezer platform, such as vacuum insulation panels or compressor modification."

Benefits of fourth generation molecule

HBA2 is a non-flammable liquid by ASTM E-681 test methods, and exhibits no flashpoint or vapour flame limits. In transportation, storage, and in factory use as a blowing agent, HBA2 has no limitations on hazards classification.

- HBA2 is a near drop-in replacement for liquid HFC blowing agents and does not require costly hydrocarbon storage and handling or risk mitigation equipment.
- HBA2 is liquid at room temperature and can be used in most existing foam equipment with little or no modification, minimising or eliminating the need for large capital conversion costs. HBA2 is an extremely promising replacement for foam insulation blowing agents currently in use that can make significant contributions to reducing global warming.

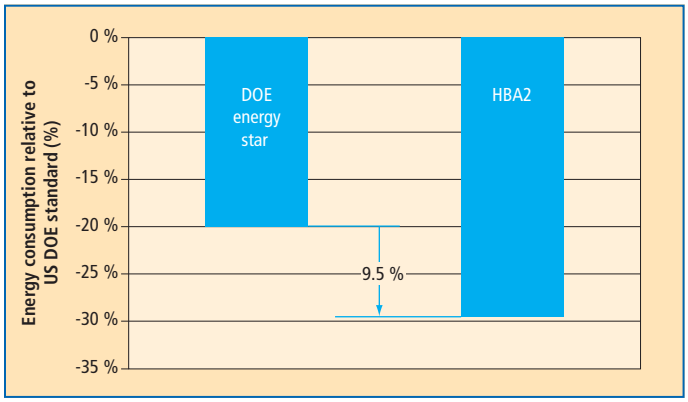


Fig. 2: *Refrigerator energy consumption*

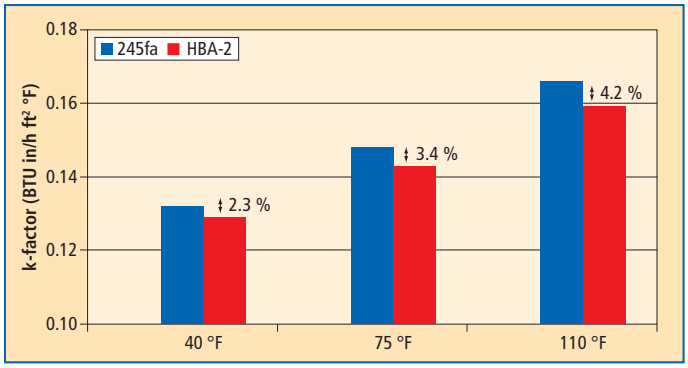


Fig. 3: *k-factor comparison spray foam*

The energy efficiency benefits of HBA2, combined with its low environmental impact and safety in use, make it the right choice as a replacement for HFC-245fa, HCFC-141b, and HFC-365mfc for use in foam insulation blowing agents.

Provides both low GWP and low VOC impact

Low GWP materials, because of their very short atmospheric lifetime, often prove to be VOC that contribute to ground level ozone formation. The measure that characterises whether a chemical is a VOC is the Maximum Incremental Reactivity (MIR). This measure (MIR) at which chemicals are generally considered to be a VOC, by US regulation, is that of ethane.

The MIR of both 1234ze(E) and HBA2 has been measured at less than the value for ethane, hence both are expected to be classified as VOC-exempt in the US.

The European Union uses a somewhat different measure to characterise propensity for ground level ozone formation – Photochemical Ozone Creation Potential (POCP) – which is reported, and compared to ethane, which has a POCP of 12.3 (Nielsen, University of Copenhagen). 1234ze(E) has a measured POCP of 6.4, well below that of ethane. The POCP of HBA2 is also estimated to be in this range and well below that of ethane.

Global legislative and commercial status

Honeywell's 1234ze(E) has recently been listed as an acceptable substitute for HCFC foams under the US EPA's Significant New Alternatives Policy (SNAP) programme. In addition, the US EPA Toxic Substances Control Act (TSCA) office has issued a Pre-Manufacturing Notice (PMN) for 1234ze(E), allowing for commercial sale of this product in the US. SNAP listing and TSCA approval for HBA2 has been applied for and is pending.

In Europe, 1234ze(E) has been registered under REACH and HBA-2 is registered up to 10 t and a higher level of registration is in progress. In addition, 1234ze(E) and HBA2 provide a substantial reduction in greenhouse gas emissions when used in place of high GWP F-gases regulated under the EU F-gas Regulation.

In Japan, both 1234ze(E) and HBA2 have been approved for commercial sale. Product registrations for both 1234ze and HBA2 are ongoing in the rest of the world.

1234ze(E) has been available commercially since 2008, and Honeywell recently announced that it will build a commercial scale plant in Baton Rouge, expected to start up in 2013. HBA2 is expected to be commercially available in late 2012/2013.