Polyurethanes for Rotomolded Products Can Be Environmentally Friendly and Still Provide the Performance You Need

From the smallest coolers to the largest shipping containers, rotationally molded products often require effective insulation. And when it comes to insulating properties, it’s hard to beat polyurethanes. The versatile chemistry and ability to be “poured-in-place” solves many challenges for a wide range of products – not only for insulation, but also for flotation and/or structural support.

Polyurethanes are formed by reacting a polyol with either a diisocyanate or a polymeric isocyanate in the presence of suitable catalysts and additives, then adding a blowing agent, which produces a cellular structure and provides the insulation value. During manufacturing, the blowing agent expands the liquid polyurethane chemicals, enabling them to fill cavities of any shape or size before solidifying into a rigid foam.
The History of Blowing Agents

The polyurethane foam industry is now in its fourth distinct generation of blowing agents. Starting in the 1960s, chlorofluorocarbons (CFCs) were the original blowing agents, offering thermal efficiencies twice those of earlier insulation. But CFCs destroy ozone molecules when they break down. This is referred to as a blowing agent’s Ozone Depletion Potential (ODP). Because of their high ODPs, CFCs have long been banned in the U.S. and nearly worldwide through the Montreal Protocol.

In the 1990s, manufacturers introduced the second generation of blowing agents, HCFCs (hydrochlorofluorocarbons). HCFCs offered lower ODP, but also provided reduced thermal values. Continuing concern over ozone depletion led to the phase out of HCFCs in most developed countries.

In the early 2000s, the third generation of blowing agents, hydrofluorocarbons (HFCs), were introduced. HFCs, which are still in use today, have no ODP. However, HFCs again reduced thermal efficiency compared to earlier blowing agents. Plus, it was later found that HFCs contribute to global warming. Due to their high Global Warming Potential (GWP), HFCs have been targeted for phase out by a long list of organizations and governments.

Eliminating HFCs

Current global agreements such as the Kigali Amendment to the Montreal Protocol and the Paris Climate Agreement contain provisions to phase out HFC blowing agents. In the U.S., a 2015 rule under the EPA’s Significant New Alternatives Policy (SNAP) program called for the phase out of HFCs to reduce GWP. But in 2017 a court ruled that the EPA lacked authority to extend the SNAP program (originally formed to reduce ODP) to GWP. So, the EPA rule will most likely not be enforced as currently written.

However, current US federal policy issues should not distract attention from what has become a global shift away from HFC blowing agents that have high GWP values. For example, the state of California recently passed a law which adopts the EPA rules for phasing out HFCs. That law applies to all products made in – and shipped into – the state.

Three other states – New York, Maryland and Connecticut – have already announced similar plans. These and another 15 states are part of the US Climate Alliance, which has committed to adopting the policies of the Paris Agreement to completely phase out HFCs.

Considering the US state and international actions on HFCs, manufacturers who want to sell their products nationwide (or worldwide) will soon be forced to use non-HFC blowing agents in their polyurethane foam. Fortunately, there are viable “fourth generation” options available now.
Fourth-Generation Blowing Agents

Fourth-generation blowing agents – with no ODP and greatly reduced or no GWP – now include three main options:

Hydrofluoroolefins (HFOs)
HFO blowing agents are the newest of the fourth generation blowing agents. They offer increased thermal performance compared to third generation HFCs and are non-flammable. However, they have high molecular weights, meaning more blowing agent is required, which increases costs. A widely reported issue with HFOs is in-situ acid formation, which has detrimental effects on catalysts and hence, shortens shelf-life stability. Further, some HFOs have been found to produce trifluoroacetic acid (TFA), which bioaccumulates and could have a potential long-term environmental impact.

Hydrocarbons (HCs)
HCs such as cyclopentane, n-pentane and isopentane have a low molecular weight and can offer lower costs than other blowing agents. But they also offer lower thermal efficiency than the other fourth generation options. In addition, they are highly flammable, requiring upfront investment in safety equipment. They are also volatile organic compounds (VOCs), meaning they produce smog.

Ecomate®
Ecomate, based on naturally occurring methyl methanoate and produced by Foam Supplies, Inc., has been in commercial use since 2002, making it a proven option. It offers excellent thermal properties (similar to HFOs) and has a low molecular weight, so less quantity is required to reach needed densities – an economic advantage. Ecomate is a liquid at room temperature and is flammable in its “neat” form, but not when blended into a polyurethane system – so no special equipment is needed. Ecomate is used in Ecofoam® insulating foam and Ecomarine™ flotation foam.

Conclusion
Polyurethanes will continue to be used in a broad variety of rotomolded products due to their flexibility and insulating properties, as well as flotation and structural support. The good news is that two of the fourth generation blowing agents – Ecomate and HFOs – end the historical tradeoff between insulating performance and environmental safety. As a result, foams made with these blowing agents can help manufacturers meet both thermal efficiency needs and environmental regulations (national and international). And with ecomate, it can all be done with no increase in manufacturing costs.