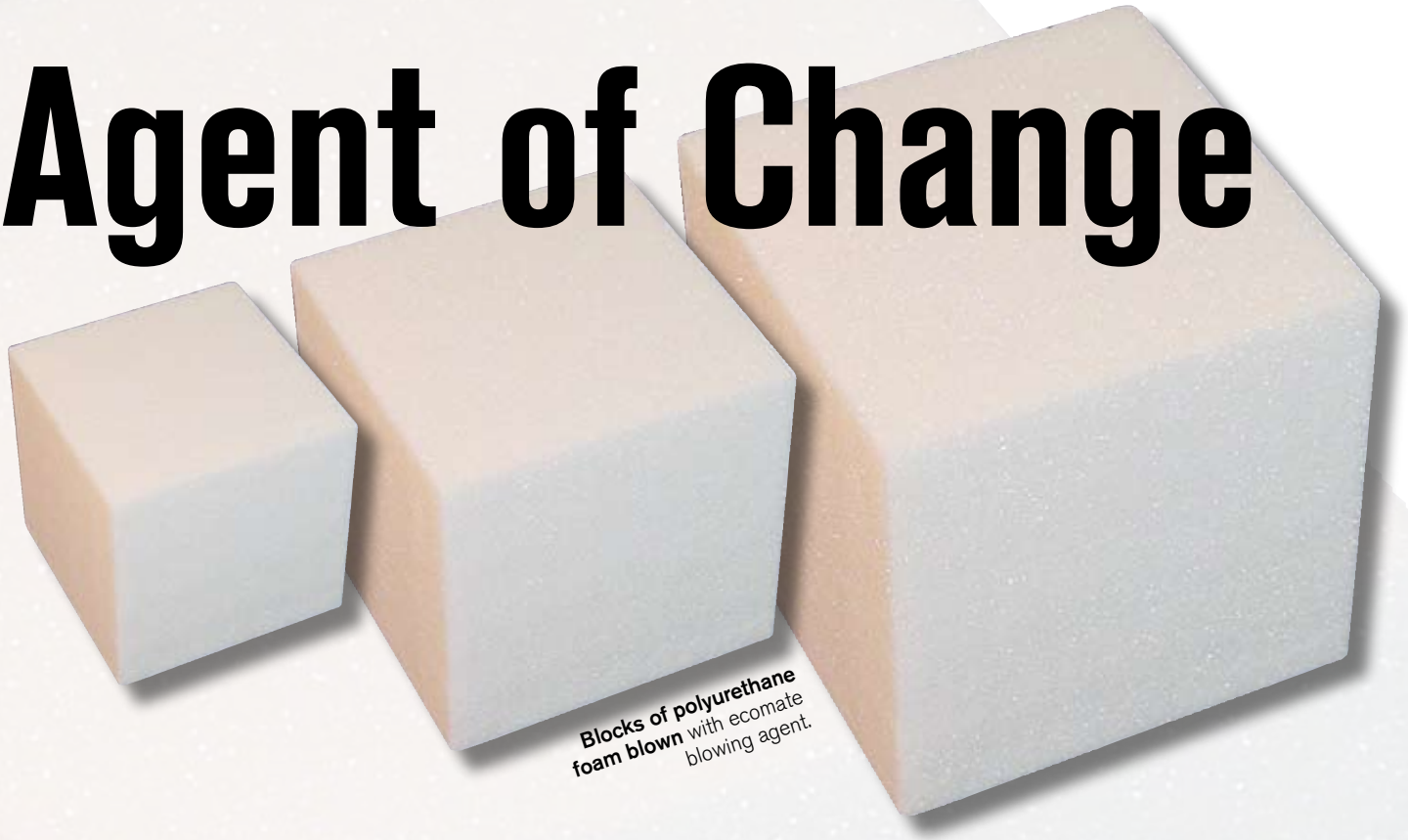
Agent of Change



Blocks of polyurethane foam blown with ecomate blowing agent.

Alternative blowing agent provides "green" blown foam.

by richard babyak

As everyone knows, the Montreal Protocol created a sea change in a number of industries, including air-conditioning, refrigeration, and foam insulation, as manufacturers in those segments had to scramble for alternatives to the chlorofluorocarbons (CFCs) being used for refrigerants and blowing agents.

Montreal also engendered two other effects. One, it permanently wedded those segments to new externalities. Companies must now weigh technology decisions in the context of how climatology and politics may interact to produce new regulations.

The second effect was to fracture consensus. In the old days, most companies used the same methods for the same applications. Today, companies head off into different directions with their alternative technologies, sometimes as a result of internal preferences, sometimes as a result of regional market imperatives.

Exhibit A for the splintering effect is blown polyurethane foam insulation, where most companies used CFC-11 in the pre-Montreal era. When that proved challenging to quickly replace, many shifted to HCFC-141b, which was approved as a temporarily acceptable, interim blowing agent.

Finding suitable alternatives for HCFC-141b was also challenging, and that research was further complicated by growing concerns over global warming, as evidenced by the Kyoto Protocol. In addition to the industry evaluating the ozone-depletion potential (ODP) of blowing agents, the industry began thinking about their global warming potential (GWP), particularly in certain regions, such as Europe, where hydrofluorocarbons (HFCs) are under increasing scrutiny.

As a result, companies pursued divergent paths as the HCFC-141b phase-out deadline (January 2005) drew near. Some commercial appliance manufacturers switched to another interim blowing agent, HCFC-22, which only buys some added time. HCFC-22 has a phase-out date of January 2010, but there is a strong possibility of that being moved up to January 2008.

For pour-in-place residential appliance applications, such as refrigerators, freezers, and water heaters, several possible alternatives were initially explored, including HFC-134a, HFC-245fa, hydrocarbons (isopentane, n-pentane, cyclopentane), and water (where the expansion gas is actually carbon dioxide generated by the reaction between water and isocyanate). A few years ago, a new candidate emerged based on methyl formate chemistry. The product is called ecomate® and is marketed by Foam Supplies, St. Louis. It is available by itself or blended into systems.

Among those options, Todd Keske, marketing manager at Foam Supplies, suggests that HFC-134a and water are not strong enough contenders to be considered in the debate. HFC-134 has a high GWP of 1,300 and exhibits a significantly rising concentration in the atmosphere due to its use as an alternative refrigerant. Those two factors are causing the chemical to come under increasing scrutiny by regulatory agencies. (As an example, the European Union has voted to phase out HFC-134a in automotive air-conditioning beginning with new model vehicles in 2011.)

Keske says water-blown systems, though improved of late, fall at the bottom of the list in terms of thermal efficiency and still finish last in adhesion-to-metal tests, which renders them impractical for most appliance applications.

Judging the options

When companies select a new blowing agent, key factors considered are cost, thermal efficiency, processability, safety, and environmental impact, which includes potential for regulation. (The cost factor includes basic material cost as well as associated costs involving equipment, labor, and the meeting of safety regulations.)

Companies may rank the importance of those factors differently based upon their production volumes, product price points, targeted operating efficiency, and the regulatory environment in which they operate. And those factors don't remain static, either. For example, the U.S. Energy Policy Act of 2005 authorized the Department of Energy to set energy efficiency standards for many previously uncovered products, including commercial refrigeration, commercial ice makers, and refrigerated vending machines. As those new standards come into play, they may alter the decisions made by manufacturers of those products.

For different reasons, North American appliance manufacturers showed an early preference for HFC-245fa, while many European appliance makers leaned toward hydrocarbons. Keske says that ecomate can serve as better alternative than either for many applications and makes his case by weighing some of the factors that go into specifying foam.

Costs

As previously noted, when comparing blowing agent costs, it is important to distinguish between mere material costs and the overall cost of using that particular material. That becomes a critical point when considering hydrocarbons.

"Hydrocarbons have the lowest cost from a materials only standpoint, ranging from $0.50/lb. to $0.90/lb., depending on volume, but are not the most economical when other user costs are factored in," Keske says. "Hydrocarbon systems are classified as flammable under U.S. regulations. This increases shipping and handling costs and requires the creation of explosion-proof environments in dispensing areas. While ecomate is also classified as flammable in its pure (neat) form, when system-blended with polyol, the systems are rated as only combustible. Hydrocarbons also raise equipment costs because of the need for emulsification and agitation tanks. All of this can cost a production facility millions of dollars in additional capital expenditure."

Another cost issue relates to the fact that hydrocarbons are considered volatile organic compounds (VOCs) that can contribute to air pollution. As a result, VOC emissions are monitored and regulated in the U.S. If a company is located in a non-attainment area, the company must buy permits in order to emit the VOCs, or they must install expensive VOC capture equipment.

Another aspect to hydrocarbons costs relates to competitive markets. The same hydrocarbons used for blowing agents have other applications, such as fuel additives, that add to demand and can affect pricing. Keske says that, over the past year, banning of certain fuel additives drove up demand for pentanes and also drove up their price.

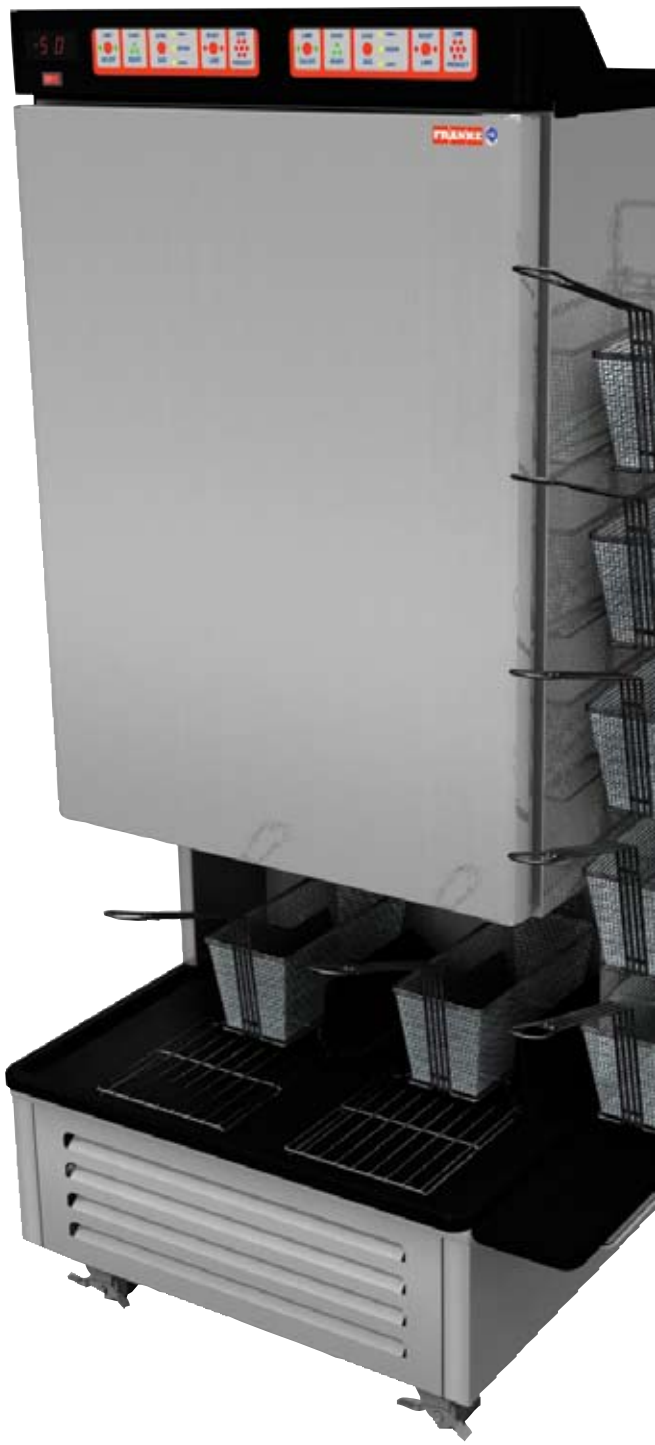
HFC-245fa carries the highest in-the-door price at typically between $3/lb. to $4/lb. Adding to that are processing costs due to equipment required for agitation, emulsification equipment and pressurized storage.

Foam Supplies sells ecomate for under $1/lb., placing it in a range comparable to hydrocarbons, but ecomate has a potential cost benefit over hydrocarbons due to the fact that ecomate can be used with the same equipment previously used to process the HCFC-141b systems that largely dominated the appliance industry up until 2005.

Processability

A primary reason HCFC-141b was chosen as in interim replacement for CFC-11 was that they were both liquid blowing agents with nearly identical processing characteristics. Liquid blowing agents and systems process differently from froth systems such as those using HCFC-22, HFC-134a, and HFC-245fa.

"That doesn't mean that liquid is better than



froth," Keske says. "But the appliance industry happens to have a longer history with liquid systems, so it has a legacy of application knowledge and already possesses large, fixed capital assets for use with such systems. Although some consider HFC-245fa to be a liquid, it produces froth foams unless the foaming process is kept at or below 60 DegF, which is generally difficult."

"Hydrocarbons and ecomate are both liquid blowing agents at ambient temperature, but hydrocarbons have a lower flash point that requires greater attention for safe handling. Hydrocarbon systems are three-component systems requiring agitation and emulsification that add to equipment, processing, and maintenance costs. While ecomate can also be a three-stream process, it only requires a static mixer to achieve it. This lets the OEM use existing equipment and makes the process easier to control and maintain. Static mixers cost less than emulsification equipment, and ecomate does not require agitation tanks, and it stays in solution well past industry standards. So ecomate will process very similar to HCFC-141b without additional equipment costs, making it an easy solution."

Thermal efficiency

Foam Supplies places the average k-factor rating for ecomate systems between 0.14 and 0.16 and reports a gas lambda value of 10.7 at 25 DegC.

"Hydrocarbons, ecomate, and HFC-245fa can all produce thermally efficient foams," Keske notes. "It's important to recognize that actual thermal efficiencies and k-factors of the end product is heavily dependent on the insulation system's properties in its entirety, rather than the k-factor of the blowing agent itself. In tests conducted by independent laboratories, ecomate systems have demonstrated thermal efficiencies within +/-2 percent of those achieved by other blowing agents. Side-by-side testing of different systems is the optimal way for a manufacturer to determine the thermal efficiency achievable for its specific product."

Environmental impact

As environmental impact becomes a increasingly important factor in both business and politics, Foam Supplies sees ecomate as an attractive choice.

"Among the blowing agents in use, ecomate is the only one that simultaneously achieves 0 ODP and 0 GWP, and is a VOC exempt compound," Keske says. "Hydrocarbons are VOCs and HFC-245fa has a GWP rating estimated between 790 and 1,040. And even though HFC-245fa is relatively new, we predict that, as a result of a recently published research report, Kyoto signatories may place some tax or regulatory burdens on HFC-245fa in the future."

(The report Keske refers to is titled "First Appearance and Rapid Growth of Anthropogenic HFC-245fa in the Atmosphere," by Martin Vollmer, et al, published in Geophysical Research Letters, Vol. 33, October 2006.)

Another aspect to environmental considerations is the marketing angle. As consumers become more aware and concerned with environmental issues, it often affects their purchase decisions, which can reverberate back through a company's supply chain.

A case in point can be found in the desire of the McDonald's restaurant chain to demonstrate its concern for the environment, and how that influences the specification of the foodservice appliances the company uses. As a result, Foam Supplies now has its ecomate systems being used by Franke Foodservice Equipment Corp., La Vergne, Tenn., which is a main supplier of commercial kitchen equipment to McDonald's.

"The primary reason for our switch to ecomate is its environmental friendliness together with excellent insulation properties, which are equal to or better than HCFC-141b or HFC-134a polyurethane foams," says Christian Zweifel, vice president, technology, Franke Foodservice Equipment. "We were using different foam-in-place HFC-polyurethane products for our commercial freezers and refrigerators, all of which had some GWP inherently built-in. As a good corporate citizen, we are concerned about the environment, and so are our customers."

McDonald's echoed that sentiment. "McDonald's supports ecomate, a 0 ODP and 0 GWP polyurethane foam, which helps protect the environment while providing excellent insulation properties," says Bernard Morauw, worldwide equipment staff director for McDonald's. "These environmentally friendly initiatives are very important to McDonald's." ■

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Franke Foodservice Equipment has switched to ecomate systems for insulating many of its foodservice appliances. Franke is a key supplier to McDonald's restaurant chain.

ecomate®

BY FOAM SUPPLIES, INC.

Foam Supplies, Inc.
4387 North Rider Trail
Earth City, MO 63045
800.325.4875
www.ecomatesystems.com
info@foamsupplies.com