Under the direction of Robert Gotschy (shown with 3D glasses), BSH's virtual reality lab develops and optimizes appliances such as fully automated coffee machines.

Energy-Saving Champions

Washing machines, dryers, refrigerators, dishwashers, and ranges made by BSH Bosch und Siemens Hausgeräte GmbH — Europe's leading household appliance manufacturer — are true energy-saving champions. Material efficiency plays a key role in the development of such devices.

The list of energy-saving innovations from BSH Bosch und Siemens Hausgeräte GmbH is long. One such innovation is a dishwasher equipped with Zeolith drying technology that was introduced in 2009. The appliance uses zeolite, a natural silicate, to absorb moisture, while at the same time emitting heat to support the dishwasher's drying system (see *Pictures of the Future,* Spring 2010, p. 80). The new material thus helps to reduce energy and water use. "With devices designed to save significant amounts of energy, it's very important to combine technologies, components, and materials in such a way that highly efficient appliances remain affordable," says Rudolf Walfort, Director of Central Technology at BSH.

The company offers appliances in every product category that bear European Union energy labels for the new efficiency classes of A+, A++, and A+++. An A+++ refrigerator-freezer, for instance, is 60 percent more efficient than an A unit. BSH has established a "super efficiency portfolio" for its energy-saving champions, and this portfolio now accounts for one out of every four household appliances sold by BSH in Europe.

"The super efficiency portfolio appliances we sold in Europe in 2010 have cut electricity consumption by some 1.9 billion kilowatt-hours as calculated in terms of the average lifespan of the devices and in comparison with the market standard from the same year," says Walfort. That figure corresponds to the average annual electricity consumption of 500,000 German households.

Environmental Protection Guidelines. This success derives from the environmental impact monitoring system developed by BSH, which has served as a stringent guideline for every one of its newly developed products since 1996. In line with this system, designers examine the entire lifecycle of a product series in terms of its effect on the environment — starting with production and extending all the way through to use and disposal. The questions they ask include: What will a product's lifetime energy and water consumption be? Are a product's materials environmentally sound and recyclable? Can material savings be achieved? "Regardless of what we look at, our goal is to always make our new products better than their predecessors," says Dr. Arno Ruminy from BSH's Environmental Protection unit.

Today, up to 95 percent of an appliance's total environmental impact is caused by the consumer's use of the product — for example, through the use of energy, water, and detergents (see *Pictures of the Future,* Spring 2009, p. 32). This figure has been reduced to 81 percent with products from the super-efficiency portfolio. "We don't believe we will be able to duplicate such major energy-saving advances for the active-use phase in the future, however," says Ruminy. "That's why our development focus will shift more and more to resource efficiency."

One measure here involves using special concrete rather than iron for balance control in washing machines. "It costs less and is more environmentally friendly," says Ruminy. In addition, the containers that hold dishwashing soap are now made of polypropylene, which unlike steel can be formed into an optimal shape that ensures less detergent residue remains in the machines.

Lightweight design has also made its way into ovens, whose interiors now weigh half as much as they did ten years ago, thanks to thinner sheet metals and special stiffening technologies. Along with materials selection, intelligent electronics also plays a key role in energy efficiency. Electronic controls in washing machines and dishwashers, for example, determine how water should be distributed in order to minimize the amount of detergent used and the number of washing cycles.

Development in 3D. BSH designers utilize simulations to optimize their appliances. Since the beginning of 2011, they've also been able to conduct experiments at a fully equipped virtual reality (VR) lab in the German state of Bavaria. The facility's demonstration room houses two powerful projectors that display stereo images on a surface with an area of nearly 11 square meters. The images are generated with the help of design data for appliances such as stoves. The interiors of the appliances are also projected onto the floor with mirrors. Special 3D glasses allow development engineers like VR Laboratory Director Franz Perschl to move virtually through the oversized depiction of a range, for example.

Developers are currently simulating the mounting of a baking sheet. "We want to see if we can reduce fastener thickness from 0.8 to 0.6 millimeters or perhaps optimize the fastener by changing its geometrical shape," Perschl explains. Engineers use this procedure to estimate whether thin sheet metal meets all relevant stability criteria.

"Until we opened this facility, we were unable to see such things in advance. Instead, we had to order testing tools and build prototypes," Perschl reports. The virtual reality lab makes it possible to determine whether concepts for energy and materials savings can be implemented in real-life even before stamping tools are manufactured.

"Right now, we use these virtual methods for only about ten percent of our technical product development work," says Robert Gotschy, Head of BSH's Virtual Reality Program. They are used mostly to help engineers make better decisions concerning product design, operation, and the choice of materials during early project phases. A second lab that focuses on product design is located at BSH headquarters in Munich, Germany.

The overriding objective for Gotschy is to save time and get new products to market more quickly. The virtual approach also offers another benefit: As it normally takes up to four weeks to go from a design idea to a finished model that will no longer be altered, model development requires much less material. "Here, we use silicones, plastic foams, artificial wood, resins, paint, metal, and electronic components," says Gotschy. By contrast, the creation of a virtual product depiction — including all the reflections, mirroring, and material properties — takes no more than two days. "Of course, we'll continue to need real-life models, but we can now reduce the amount of time required during the product creation process by one-third, and in some project phases by as much as two-thirds," Gotschy says.

BSH developers face yet another challenge, however. "We will need to use more alternative materials, recyclates, and new materials made from renewable resources in the future," says Walfort. This makes sense, as such an approach also forms a key part of BSH's strategy for continually enhancing the environmental compatibility of household appliances, and minimizing demand for limited natural resources. ■ *Nikola Wohllaib*