materials, and others. A technology transfer program is being established with the industrial sector.

Advanced Inverter Technology

Vehicles that run on electricity are attractive transportation options because they minimize pollution and conserve liquid fuels. As part of DOE's efforts to improve these vehicles, research carried out under DOE's Electric Vehicle Propulsion System Technology Program has led to the introduction of an advanced inverter technology. The new inverter, developed in support of DOE's ETX-II R&D Program for vehicle propulsion applications, is greatly reduced in size and weight. Two technological advances central to the development of the advanced inverter are the metal-oxide semiconductor-controlled thyristor power switch and high-voltage multilayer capacitors. These technologies give the inverter greater power efficiency and better thermal management, while reducing capacitor volume and heat loss.

The inverter technology and design concepts used in DOE's ETX-II Program led to the development of an inverter and control system for a diesel/electric drive motor for the radiator cooling fan. This system is being used to regulate the cooling fan speed to maintain optimum engine operating temperature on commercial diesel/electric locomotives.

Battery Combustion-Attenuation Material

All batteries based on aqueous systems emit hydrogen and oxygen, combustible gases that could cause the battery case to rupture if the gases were to ignite. Under DOE's Electric and Hybrid Vehicle Testing and Evaluation Program, research has led to the development of an inexpensive device to manage the combustible gases emitted from electric vehicle batteries. Specifically, researchers designed a combustion-attenuation material for both basic and acidic electrolyte batteries; it acts by filling the open volume or headspace of the battery, preventing the battery case from rupturing if the gases within the battery cells should ignite during charging or operation of an electric vehicle. This device was tested with nickel-iron battery modules, which produce more gases than most batteries, and demonstrated a clear reduction in the level of risk of or damage from the ignition of combustible gases.

This technology was patented and incorporated into the nickel-iron battery packs being designed for the dual-shaft electric propulsion system. The first commercial orders for batteries equipped with the combustion-attenuation materials have been placed for sealed lead-acid batteries to be used in emergency stand-by power generation equipment.

Hyperfiltration of Food

Concentration of liquids, particularly concentration of fruit and vegetable juices, is one of the most energy-intensive steps in the food-processing industry. Almost all concentrated juice made in the United States is produced using some type of evaporation process during which water is removed from single-strength juice to yield a product consisting of 50% to 70% solid material. Membrane technology is also used to concentrate juices, using semipermeable membranes to separate water from the solution. This technology offers good potential for saving energy.

DOE funded an investigation by the National Food Processors Association into applying high-temperature hyperfiltration to food processing. The study focused on the use of thin-film composites, a new class of membrane with several advantages over standard cellulose acetate membranes. These new membranes can withstand higher temperatures, operate within a wider pH range, and have increased resistance to biological degradation. Membranes were tested using several configurations in selected high-temperature food-processing streams to characterize membrane performance as a function of time. A prototype unit for tomato juice concentration was built and tested successfully at a commercial host site.

PET Bottle Separator

The increased use of plastics in recent decades has resulted in increased levels of plastic wastes at both the consumer level and the producer/fabricator level. Recycling efforts are complicated because different types of plastic wastes must be separated from one another before further processing can occur. The nature of plastics makes such separation a difficult procedure. For example, selective incineration is hampered by the thermal degradation of plastics at high temperatures, and flotation techniques cannot be used because of the narrow range of densities in plastics.