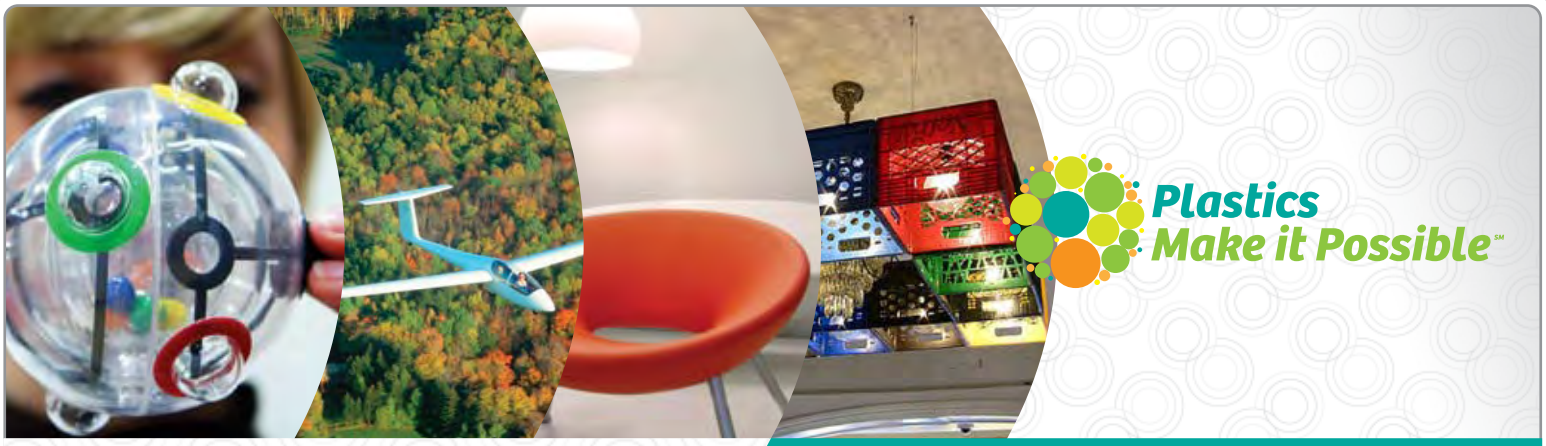

Plastics Make it Possible™

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PLASTICS MAKE IT POSSIBLE™ SHOWCASES EXCEPTIONAL INNOVATIONS IN PLASTIC. THIS MONTH WE LOOK AT HOW PLASTIC IS USED IN THE HEALTH AND MEDICAL FIELDS.

SPOTLIGHT ON

Plastics in Medicine

There are hundreds of different ways in which plastics play vital, and even life-saving, roles in modern medicine, ranging from surgical equipment and drug delivery devices, to medical implants and pharmaceuticals, to medical equipment packaging.

Perhaps the biggest contribution of plastics has been their role in reducing the risk of infection. The development of sterile, single-use products, such as blood bags, has dramatically cut down on the spread of infectious disease. Yet numerous examples of medical uses of plastics are less familiar to most of us. The "artificial skin" used to help burn victims to heal incorporates a layer of material – much like the plastic wrap we use in the kitchen – that is coated with another layer of animal protein to encourage the growth of new skin.

- "Plastic blood" may sound impossible, but researchers at the University of Sheffield in England have created artificial blood, based on plastic molecules incorporating iron, that can mimic hemoglobin and carry oxygen around the body. This could be a life saver for those injured on a battlefield or in a natural disaster, where blood shortages can be a serious problem. Plastic blood can be produced in large quantities, and

(See MEDICINE, Page 2)

The synthetic blood paste solution in a dish (left) and with water added (right). (Photo provided by University of Sheffield)

Plastic Innovations in Prosthetics Put Amputees Back in Action

Bob Radocy demonstrates the TRS EAGLE®, a recreational prosthesis with plastic-based joints that store energy from the backswing motion. With this golf model an amputee can duplicate the human biomechanics of a swing.

Aron Ralston

Bob Radocy

Aron Ralston first caught the public's attention in 2003 when a climbing accident forced him to amputate his own right arm. Today, Ralston is internationally known for having climbed all of Colorado's 14,000-foot peaks, a remarkable achievement for any climber, but all the more so for an amputee.

Ralston credits Bob Radocy, the designer of a unique plastic prosthesis and founder of TRS, a Boulder-based prosthetics design and consulting company, with giving him the ability to get back on the mountain. Radocy and his team design unique prosthetics that return amputees to sports and outdoor recreation.

Rodocy has been driven by his own experiences as an amputee to create "active prosthetics." After he lost his left hand in 1971, Rodocy used a variety of prosthetics, most of which were made from stainless steel or aircraft aluminum.

Although the all-metal devices were durable, he recalls feeling frustrated by their limitations. "I felt more handicapped by the technology," he said. In 1977, with degrees in engineering and biology, Radocy began drafting his own device criteria. He refined his designs while he was in graduate school and then founded TRS.

(See PROSTHETICS, Page 2)

Plastic Occlusive Wrap Helps Keep Premature Babies Warm

A seven-day-old premature baby girl lies in an incubator as her mother looks on. An occlusive wrap bag helps keep the baby warm. Several small studies have demonstrated that immediately wrapping a baby in plastic before the amniotic fluid starts to evaporate can help keep them warm. A long-term study is currently underway to examine the health benefits.

MEDICINE, from page 1

importantly, it does not need to be refrigerated or handled as carefully as blood donated from human volunteers.

- A "super plastic" originally developed by NASA as an insulator for spacecraft is now saving the lives of heart patients. Licensed by Medtronic, the super-insulating material was recently approved by the FDA for use in a high-tech pacemaker – an implantable cardiac resynchronizing device, which tweaks the contractions of the heart by sending tiny electrical pulses down wires that snake through the heart. The super plastic is very flexible, resistant to chemicals, and withstands extreme hot and cold temperatures. The material also is biologically inert, making it suitable for implantable devices.

- Dime-sized plastic disks are helping with drug delivery in the quest to extend the lives of brain cancer patients. The wafers, made of biodegradable polymers, are impregnated with chemotherapy drugs and implanted at the site of a tumor during surgery. Over time, the disks dissolve, releasing the cancer-treating drug into surrounding cells. Trials have shown that this treatment can improve patient outcomes.

WE NEED YOUR INNOVATIONS!

The monthly *Plastics Make it Possible*℠ Newsletter is published by the American Chemistry Council to promote innovations in the use of plastics.

Please send stories about your innovations to innovations@americanchemistry.com.

We will be pleased to consider them for publication.

Thank you.

American® Chemistry Council

PROSTHETICS, from page 1

As the company grew, Radocy experimented with new materials aiming to develop an "active prosthesis" that could mimic the strength, resilience and flexibility of the human hand. He eventually chose a combination of rigid core plastics and more supple, coated polyurethane for many of the designs. TRS's Free Flex® and Super Sport ®, multipurpose prosthetic hands for contact athletics, both make use of injection molding technologies and consist of single solid pieces of polyurethane. The soft plastic exterior allows for increased friction and flexibility of grasp and the resulting biofeedback enables amputees to determine how much pressure they exert – something all-metal devices do not offer.

Polyurethane was chosen for the active-use prostheses because the polymer can mimic the characteristics of the human hand such as energy return, flex and strength in addition to grip and friction, Radocy explains. The Super Sport hand, for example, replicates the palm and is designed to flex and extend like a hand and wrist. "We began to look at polyurethane permaset polymers and temper plastics to create gripping surfaces in the prehensors (hand replacements). Using injection molding, they are easily replaceable, low cost and they give you necessary friction," says Radocy.

TRS continues to explore new materials and designs that enable amputees to regain their active lives. Radocy has recently started using high-strength synthetic materials to replicate human joints. Introduced in 2009, the TRS EAGLE® golf model is a recreational prosthesis that duplicates human biomechanics and achieves or surpasses human performance. Plastic-based joints store energy from the backswing motion and release energy at the apex so that prosthetic users can drive further and hit harder. "A person watching from the sidelines wouldn't know you don't have a hand," Radocy says.

"With the right materials that don't fatigue – synthetic polyurethane in particular – you can create devices that store and return energy when you exert external force to augment and improve the capabilities of the prosthesis."

"TRS will continue to innovate and improve our products," says Radocy, with the goal of coming "even closer to doing what actual human limbs can do.

The prosthetic below helps amputees play baseball. Polyeurethane was chosen for the active-use prostheses because the polymer can mimic the characteristics of the human hand such as energy return, flex and strength.