properties should not be negatively affected by the change-over to lead-free solders,” says Galuschki. The problem is that practically no historical data exists on the performance of new solders, most of which are alloys made of tin, silver, and copper. Soldering with lead, on the other hand, is a procedure with a long tradition — and up until just a few years ago, all manufacturing processes for electronic equipment were designed for it.

A major problem with the conversion from lead was the high melting temperatures of the new solders, which many common electronic components were unable to withstand,” explains Galuschki. The lead-free soldering materials don’t melt until approximately 220 degrees Celsius, around 40 degrees higher than the melting point of conventional tin-lead solders. The advent of more heat-resistant components made the conversion possible.

Stable Compounds. The materials used in soldering pastes were also reviewed, as state-of-the-art soldering today no longer involves soldering irons and wire. “We build soldering paste and press it through a molding tool onto circuit boards,” says Galuschki. The pastes contain micrometer-sized globules of the selected metal alloy, fluxing agents that prevent the soldering point from oxidizing, and thixotropic agents — substances that make the mixture sticky, ensuring that the globules adhere to the boards. Once the paste has been applied, a SPLACE machine places components on the board surfaces. After that, the boards proceed through an oven, where the component contacts and soldering material melt together. “The key here is sophisticated temperature regulation to ensure that the solvents in the soldering paste are vaporized before the soldering material melts,” says Galuschki. Without such vaporization, trou-

blesome gas bubbles could develop in the contacts. Researchers carry out hardness tests and employ powerful microscopes to identify such errors, using the resulting knowledge to further optimize the production process.

Although Siemens converted to lead-free soldering pastes several months before the EU ban in 2006, Galuschki and his team still face constant challenges. “We are continually adapting the processes,” he says. “One reason why we have to do this is miniaturization. We have to keep packing more functions into smaller boards.” More functions mean more tiny components that heat up quickly in the soldering oven. As a result, you either have to make such components more heat resistant or alter the temperature regulation accordingly.

Circuit boards are set to become even greener in the future, and in some cases will even be produced using renewable raw materials such as sugar cane or waste from the paper industry or biodiesel manufacturing processes. “Truly green circuit boards are really yellow,” says Galuschki, as he points to a prototype that he says to a prototype made of a light-colored bioplastic. Although mass production of the yellow “green” circuit boards is still a long way off, the first samples promise new possible applications for them.

Plastics produced by bacteria will make many electronic products more environmentally friendly in the future. Scientists are studying the properties of these polymers and identifying possible applications for them. Life is good. Take Paracoccus denitrificans, for instance. This round, purple, single-cell organism has an unharnessed existence that consists of breaking down organic residue in wastewater or soil. But in times of stress, when key trace elements required for cell division become scarce, it can respond by stockpiling reserves made of plastic. It does so by converting sugars, amino acids into a material that is produced in the first place, which it joins together into long molecules, ultimately creating polyhydroxybutyric acid (PHB). Other types of bacteria, including E. coli, can also be processed with the same machines used for conventional polypropylene. PHB is a polymer similar to the solid plastic polypropylene that is used in many areas, ranging from food packaging to textiles. PHB, which is produced by many types of bacteria and is biodegradable, is a coveted raw material. That’s why researchers from Siemens Corporate Technology (CT) and BASF AG are also interested in it. The two organizations have been collaborating in the “BioFun” and “BioPlast” projects funded by the German Ministry of Food, Agriculture and Consumer Protection. Their goal is to develop high-quality plastics from renewable raw materials and identify the most promising possibilities for their application.

Up until now, bioplastics have been used mainly in packaging and non-durable products such as disposable dishes, as many of these plastics are biodegradable. A major boom in demand for such materials began in 2006, according to the European Bioplastics Association. This rising popularity is largely brought about by greater environmental awareness on the part of consumers, a growing interest in sustainable development and agriculture, and higher raw material and energy prices. The Association believes bioplastics have the potential to account for five to ten percent of the plastic market in the near future, at the moment, they account for only around one-tenth of a percent.

Limitless Quantities: The key benefit offered by “eco-plastics” is that their production requires no critical raw materials, in practice operates practically no fossil fuels. Moreover, their disposal releases only the same amount of CO2 that is required to produce the plastic that is consumed by the bacteria that produce the plastics in the first place. Bioplastics are also interesting from an economic perspective because the base products for their production — sugar and starch — are available in virtually limitless quantities. In addition, high oil prices have significantly narrowed the price gap between bioplastics and petrochemicals. For years, Japanese electronics companies in particular have been attempting to manufacture durable products made of bioplastics. Sony, for example, has marketed a Walkman with a housing made of polyactic acid (a biopolymer), and NEC and Motorola have used the same material for cell phone casings. Such bioplastic products remain limited by the excep-

tion to the rule, however, in part because poly-lactic acid turns soft at temperatures above 50 degrees Celsius, at which point it begins to de- figure. “PHB, on the other hand, has some deci-

G Nutrients made of plastic. It does so by con-

vaporized before the soldering material melts,”

siderable advantages when it comes to demanding applications,” says Reiner Kleinert, project manager at Siemens CT in Berlin. For one thing, PHB can withstand temperatures of up to 120 degrees Celsius, and the material can also be processed with the same machines used for conventional polypropylenes.

The BioFun project focuses on electronic products, whereby the most important aspects involve mechanical properties such as flexibility, resistance to impact, and the adhesion of the polymer on the surface. “As an electronics manufacturer, we know exactly what these materials need to be capable of,” Kleinert explains. “Our involve-

ment in BioFun enables us to focus at an early stage that the new materials being developed have the right properties.” Raw materials spec-

ific to certain regions can be used. For in-

commerce. The possibilities are endless.

The BioFun project is examining how long different PHB variants will be capable of biodegrading, petroleum- based plastics pro-

duced by BASF.

Scientists are also examining the extent to which PHB may be suitable for use with mecha-

nistic systems, since PHB surfaces could be metalized, in which case they could perform the functions carried out by natural cell pathways. “You could then mount electronic compo-

diments directly on the PHB housing’s metal coating,” says Kleinert. This would eliminate the need for conventional circuit boards, thus conserving space and materials. Naturally, one of the most important criteria here is price. “For our plastics to have a chance on the mar-

tet, they can’t be any more expensive than es-

established products,” Kleinert explains. “They also have to be of equal or better quality.”

At Siemens Medical Solutions, environmental en-

traffic of raw materials. “We can use the same materials used in packaging and non-durable products such as disposable dishes, as many of these plastics are biodegradable.” A major boom in demand for such materials began in 2006, according to the European Bioplastics Association. This rising popularity is largely brought about by greater environmental awareness on the part of consumers, a growing interest in sustainable development and agriculture, and higher raw material and energy prices. The Asso-
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