Sustainability Newsletter

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Back to the (Re)Grind

Cover image courtesy of Plastics Industry Association (NPE 2018 RelFocus)

Chairman's Corner

A lot has occurred since our last edition. NPE enjoyed record-setting attendance numbers, SPE hosted another successful ANTEC, and we at the Sustainability Division provided technical content and speakers for the 2018 ISRI National Conference, 2018 ReFocus Sustainability and Recycling Summit.In addition, we co-hosted the inaugural workshop on Circular Economy in Automotive with ISRI and SPE Detroit Section. At the ISRI Conference, we provided a track on different methods for plastics identification. Bill Schreiber and speakers from testing instrument suppliers hosted a 90-minute session. At ReFocus, I led one session on composite recycling co-located at the NPE in Orlando. I was joined by speakers, Brian Pillay from the University of Alabama, and Mark Janney from Carbon Conversions, who provided information on recycling carbon fibers from aerospace applications amongst others.

Last June we started a discussion with our friends at ISRI about the need for greater communication regarding Circular Economy within the Automotive Industry, from manufacturing to end-of-original use. That discussion lead to us co-host a workshop that brought together stakeholders from throughout the automotive community to talk about the benefits of "closing the loop" with plastic materials. The SPE Detroit Section was kind enough to allow us to join their AutoEPCON TopCon, and even expanded their event by an extra day to accommodate our workshop. The event was 3 hours broken into 2 sessions. The first session covered successful closed-loop recycling practices, and the second session explored the needs and opportunities for closing the loop inside automotive. Attendance was light, but efforts to improve attendance next year are already being discussed.

There is also exciting news about our new website update. Conor Carlin, Larry Koester, Adrian Merrington and myself havegathered a tremendous amount of content originally provided by the SPE Sustainability Division over the years. This update is currently underway and should start to roll out during Q3 2018. Please visit the website often to see how we are helping our members get information and support for their sustainability efforts.

Since this is my last Chairman's Corner, I would like to thank the members that volunteer their time to make the SPE Sustainability Division a vibrant community. These people include Susan Kozora, Kari Bliss, Adrian Merrington, Bill Schreiber, George Staniulus, Girish Bhatt, Ken Nichols, Allan Griff, Conor Carlin, Steve Fosgard, and Rick Wagner. Thank you for all your support and hard work. I ask every member of the Sustainability Division to please consider volunteering your time to help us grow. The issue of sustainability touches every aspect of plastics engineering. This means that every member's choice to join a second division inside SPE should be to join the Sustainability Division. We have been asked to provide content and to support to every division. Feel free to contact me at csurbrook@midlandcompounding.com to find out more about the opportunities to volunteer. Help us grow to provide the support that our society, and our industry, needs on this important topic.

Best regards,

Chris Surbrook

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Sustainability in the News

Electricity Switch Lowers rPET Emissions to Below Virgin PET

By *Plastics in Packaging*

March 21, 2018—Greenhouse gas emissions at a recycling plant in Austria have been reduced to a tenth of the level for new PET material, said PET Recycling Team GmbH (PRT), a subsidiary of Alpla, after a recent investigation.

Last year, PRT in Wöllersdorf, Austria, which produces PET pellets from post-consumer drink bottles, obtained a measurement of the environmental impact of recycled PET (rPET) produced in-house. The calculated value was a carbon dioxide equivalent of 0.45 kg for every kilogram of material produced. A new calculation by c7-consult takes into account the now optimised power mix, resulting in a carbon dioxide equivalent of just 0.21 kg.

PET Recycling Team GmbH (PRT), based in Wöllersdorf, became a subsidiary of ALPLA in 2010

"By switching to electricity from renewable sources, we have again managed to reduce carbon dioxide emissions by a considerable margin,' said Peter Fröschel, plant manager. "Our annual production of rPET amounts to around 31,000 tonnes. It would take a mixed forest area the size of 6,231 football pitches to absorb the same amount of carbon dioxide emissions we are saving each year compared to the production of new PET material."

New material, also known as virgin PET, has a carbon dioxide equivalent of 2.15 kg per kilogram. Chief executive Günther Lehner sees this as confirmation of the sustainability strategy at Alpla: "We have noticed greater demand for products made from recycled materials. In recent years, we have managed to move away from discussions that focus purely on cost, establishing sustainability as a core value."

The environmental impact (carbon footprint) was calculated in accordance with ISO 14044, starting with the collection and sorting of used PET bottles and covering transportation to the Wöllersdorf plant as well as washing, processing and granulating. The analysis is based on the mass and energy balance (electricity and gas consumption) for 2016, which has remained constant since.

"Our customers are committed to sustainability, and we support them with our expertise. We believe that recycling is appropriate and important not just for legal reasons: it is an economic sector of great significance for the environment and the future of our industry," said Lehner.

Alpla operates recycling plants in three locations. In addition to the wholly owned subsidiary in Wöllersdorf, a plant was established in 2013 in Radomsko, Poland, and there is a joint venture in Mexico. In total, 65,000 tonnes of food-grade rPET is produced from post-consumer material at the three plants each year.

PRT was founded in 2005 with Alpla becoming a majority shareholder five years later and taking total control in 2014. The company has 50 employees in Austria and 75 in Poland.

Why a Virgin Plastics Giant Entered the Recycling Business

By Jared Paben, *Plastics Recycling*

March 28, 2018—The QCP recycled plastics facility in the Netherlands is now partially owned by prime plastic producer LyondellBasell.

LyondellBasell, one of biggest plastic and chemical companies on the planet, has stepped into the plastics recycling sector for the first time. A high-level executive recently explained what drove the decision.

The Netherlands-headquartered operation announced earlier this month it has completed a transaction making it a 50-50 partner in plastics recycling company Quality Circular Polymers (QCP). The other partner is Paris-headquartered utilities and waste management giant Suez.

Founded in 2014, QCP processes recovered HDPE and PP at its plant in Sittard-Geleen, Netherlands.

With the acquisition of the 50 percent stake in QCP, LyondellBasell will begin marketing recycled resins alongside its prime plastics portfolio.

"For several years, we have been seeing an increased demand for recycled and reused products from our customers, especially in Europe," said Richard Roudeix, LyondellBasell's senior vice president of Olefins and Polyolefins for Europe, Asia and International. "We are intrigued by the growing conversation around the 'circular economy' and believe that an increased global focus on recycling presents business opportunities for our company."Despite headlines about strict new plastics recycling targets and rules being formulated by the European Union, LyondellBasell's move was driven simply by markets.

"We made the decision to acquire a stake in QCP because of the business opportunity that we believe exists in recycled and reused plastics – not because of any regulations," Roudeix told Plastics Recycling Update. "We believe that in the future, demand will increase for both virgin materials and recycled polymers, and this joint venture allows us to expand our product offerings to our customers."

Roudeix also noted that the ability to partner with Suez, which is already in the business of collecting and sorting recyclables, made the joint venture appealing. Suez has been involved with supplying feedstock to QCP since it opened. As part of the new joint venture, Suez will continue collecting recyclables from the region and sorting them for delivery to QCP. LyondellBasell will market the recycled plastics to its customers. The plant is located in Sittard-Geleen, in southern Netherlands, between major Belgian and German urban areas.

Roudeix described the partnership as a "competitive differentiator."

"This joint venture is the first time that a plastics company has partnered with a leader in resource management to manufacture recycled polymer," he said.

Before the 50-50 joint venture, Suez held a 45 percent ownership stake in QCP, managers of QCP owned 20 percent and outside investors owned 35 percent. Roudeix declined to provide financial details on LyondellBasell's move.

When asked whether LyondellBasell expects the virgin plastics industry as a whole to move into the plastics recycling business in coming years, Roudeix said that while he can't speak to the intent of his company's competitors, "it is clear that the industry as a whole has focused more intensely on recycling and reusability in the past few years. Some of this conversation is driven by governments and regulators, but we have also seen increased customer demand for recycled plastics."

QCP specializes in recycling HDPE and PP, producing two grades of HDPE and eight grades of PP copolymer. The plastics are not sold into food and beverage packaging markets.

Suez has already established end markets for QCP's recycled plastics. For example, earlier this month, it helped bring to market a medical waste receptacle made with a QCP high-impact modified PP copolymer. It allowed Suez to offer a more sustainable container to its Dutch customers in the health care sector.

No changes in day-to-day management will take place at QCP as a result of the new ownership, Roudeix said. But the new owners will invest in expanding capacities. When the partners announced last November they'd signed agreements to buy stakes in QCP, the facility was capable of producing 25,000 metric tons per year. The partners plan to expand that capacity to 35,000 metric tons by the end of 2018.

"We plan to continue to expand QCP's capacity until it reaches 100,000 [metric tons] per year of material sometime in 2020," Roudeix said.

From the facility's launch in 2014, QCP's founders have planned a series of expansions bringing the total capacity up to 100,000 metric tons. At the time, they estimated the cost of the full build-out at 75 million euros (about $93 million).

Suez already has deep involvement in the plastics recycling industry. The company operates nine dedicated plastics recycling facilities across Europe. Together, they produced 150,000 metric tons of recycled plastics in 2017. The company plans to boost its processing capacity by 50 percent by 2020.

In the future, LyondellBasell will continue to use sustainability as one of several criteria for evaluating investment decisions, Roudeix said.

"We view this as a great first step in this space," Roudeix said. "We believe that interest in the circular economy and potentially the demand for recycled materials will continue to grow, which could create more opportunities for us in the future."

China Poised to Accept PET Flake Imports

By Colin Staub, *Plastics Recycling*

May 16, 2018—Clean PET flake may be allowed into China instead of being considered a waste prohibited from import, according to several sources with knowledge of the situation.

As is, flake is generally understood to be included in a customs commodity classification that is banned by China's restrictions that took effect this year, alongside other scrap plastic materials. But that could change, according to the Bureau of International Recycling (BIR) and Steve Wong, executive president of the China Scrap Plastics Association.

"According to reliable source, the General Administration of Customs of China is expected to soon announce the guidelines for accepting good quality recycled PET flakes as a commodity import," Wong wrote in a May 15 market report provided to Plastics Recycling Update.

BIR also cited sources noting flake would be allowed in "without the need for a licence." China issues licenses imposing quotas for imports of scrap materials.

The potential change would be a rare example of China relaxing its import regulations, which have so far steadily decreased the amount of material allowed into the country. "Whether that is to signify the flexibility in policy implementation is yet to be seen," said Wong, who is chairman of Hong Kong plastics recycling company Fukutomi.

The regulatory allowance would present opportunities for companies that have set up processing plants outside China. Some of those operations process scrap plastic into pellet form, allowing import into China. In other cases, such as a Chinese investment in the U.S. that was recently profiled by Plastics Recycling Update, companies are shredding plastic, sending it to Southeast Asia, and pelletizing it before shipping into China. With flake allowed in, the companies could ship directly into China without pelletizing.

If the measure is indeed finalized, it would line up with what Wong first reported in November, when he described a conversation with a top Chinese customs official who was supportive of allowing in washed flake. At that time, Wong described a possibility of flake being classified as post-industrial material, allowing it to get around the ban. But since then, China has announced it will ban post-industrial plastics by the end of this year.

Instead, in the recent announcement BIR said PET flake would be treated as "general goods for import without the need for a licence." |

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Plastics Sustainability

Excerpted from *Plastics Sustainability* (2012) by Michael Tolinski with permission from Scrivener Publishing LLC.

[***Editor's note****: This is the fifth article in a series that will run over 6 installments. We are grateful to the publisher for granting us this unique opportunity to share excerpts from an important (and enjoyable) book on a topic that is central to our industry. The SPE Sustainability Division is proud to offer this benefit to our members. We encourage everyone to purchase the complete book which is available on Amazon.]*

Chapter 5: Design Guidelines for Sustainability

The design of plastic products has a major impact on how much material they consume and how efficiently they fulfill consumer needs. Designs need to be optimized for both the material's capabilities and product requirements – as well as for making the products recyclable or reusable. Although this chapter is not a complete guide on the principles of plastics design, it does cover design considerations that influence the environmental impact of products.

Starting in the 1990s or even earlier, organizations such as the American Plastics Council distributed publications providing guidelines on Designing for the Environment (DFE), Designing for Recycling (DFR), and similar subjects (e.g.,[1]). Many of these publications' guidelines were simply good business practice because they focused on ways of using material efficiently in a part, such as using the thinnest possible wall or gauge thickness. Other DFE / DFR guidelines concerned designing for disassembly (so that parts can be separated for recycling), designing molded-in fastening features as alternatives to separate fasteners or adhesives, and designing molded-in decorative elements as a way of avoiding external coatings and finishes, which increase plant emissions and make the part less recyclable. These remain sound and usually cost-effective principles and will be touched on below.

Packaging experts agree that the design stage is where the biggest sustainability gains can be made[2]. But many also say that the era may be ending for making big improvements by redesigning packaging with thinner walls or reduced material usage. There is indeed a limit to how thin a PET bottle can be and still function, for example, and this limit is being approached. Thus, new directions are required for more sustainable plastic parts. New designs may be needed to accommodate the properties of post-consumer recycled, bio-based, and/or biodegradable materials. Meanwhile, as with the above rice package example, the consumer may need to be educated and persuaded more to recognize and accept the product changes in greener packaging, especially if there are trade-offs in functionality. The new directions for green design of plastic products need to be re-envisioned in this context for contemporary decision making in the real marketplace.

5.1 Green Design Principles

In Chapters 2 and 3, the "Twelve Principles of Green Chemistry" helped guide the discussion about evaluating the sustainability of plastic materials. In this chapter, Anastas and Zimmerman's related "Twelve Principles of Green Engineering" from their 2006 book[3] include useful and relevant guidelines for plastics green design. I propose the following versions of [their] statements:

- Product designs should require as little plastic as possible while still allowing the product to function and be aesthetically acceptable.
- Higher-value, more complex plastics should only be used when required, and the design should fully exploit their special properties. The plastic materials should also be recoverable for recycling, according to their value.
- Plastic products should be designed only to be durable enough for their expected use-lives and situations of use.
- The use of excess plastic in a product for reasons other than minimum functionality should always be questioned. And plastics products should be customized for their required function.
- Single-material plastic products are preferable so that the manufacturing process is simple and efficient and the product retains the practical value of being a pure, uncontaminated material, making recycling simpler and cost-effective. (This principle also means that diverse additives in plastics are generally unwanted, when their function can be integrated into the polymer or design itself.)
- Designs should allow the use of materials that are based on efficiently made renewable feedstocks

The principles do not focus only on recyclability or the use of bio-based materials. Rather, a common theme behind many of the green principles is simply: "Do not overdesign." Even though alternative materials have been heavily focused on in this book thus far, most green design situations are far too complex to have a simple answer such as: "Design to use more recycled material." Thus, this chapter and the remainder of this book will view bio-based or recycled materials simply as options for addressing principles of green design and minimizing life-cycle impacts in material selection.

5.1.1 Minimize Material Content

Product designs must of course always be functional and have a good or acceptable appearance, while requiring as little plastic as possible. Apart from the benefits of a reduced environmental footprint, minimizing material content is simply good business practice that contributes to the bottom line. For common plastics, this kind of "light-weighting" usually depends on reducing the thickness of a product, and/or using a less dense plastic. In a rigid container, stiffening features such as ribs may allow wall thickness to be reduced. Or a container might be designed to accommodate a stiff but low-density plastic like polypropylene, rather than PET, for example. In engineering applications, thin-wall molding allows weight reduction of the entire engineered system, multiplying its benefits, especially if the system is weight sensitive, like an automobile, aircraft, or portable electronic device.

Another, less often discussed approach for reducing mass in a design is to radically reduce the density of the plastic by foaming it, giving it a cellular structure. Foaming allows for structures with relatively thick and stiff walls that are lighter overall when compared to a structure of equivalent stiffness using a solid resin. Most thermoplastics can be foamed. The molding process can create a "sandwich" structure having a foamed core and solid resin skin, resulting in a material with a high stiffness-to-weight ratio and a good appearance. To maintain the tensile strength of the foamed structure for an engineering application, glass fiber or, better yet, lightweight plant-based reinforcing fibers can be introduced[4]. An alternative like this may become important if the emphasis on material reduction shifts more from the packaging arena to engineered materials.

5.1.3 Design Only to Fulfill Service Durability Requirements

In the early years of plastics use, materials and designs often did not survive their products' service use lives. This contributed to plastic products' initial reputation of being "cheap". Perhaps in reaction to this, resin quality quickly improved and designers paid extra attention to making durable products, perhaps even overcompensating for design flaws, as they learned the tricks of plastic part design. Now, if anything, we may be in a world in which plastic products are over-designed for many of their applications, being discarded with much "life" still left in them.

Plastics have other durability limits to design for. For instance, plastic pipe is stressed by pressure and threatened by environmental stress cracking, meaning that the pipe wall ideally should only be as thick and strong as needed to last until the pipe's normally scheduled replacement. Walls any thicker than an engineering degree of safety would violate the green guideline. In other words, any extra material or features for an excessively durable product create unnecessary environmental impacts, energies, and wastes associated with the product's production.

5.1.5 Focus on Single-Material Designs

Using multiple materials in a design adds complexity and potential waste to a manufacturing process. It also makes a part harder (or impossible) to recycle. Thus, single-material product design, properly done, results in a potentially smaller environmental footprint.

For achieving desirable aesthetics using a single plastic material, these practices should be favored:

- *Favor transparent or unpigmented products, or a series of designs with a common color orientation.* Pigmented or other filled plastics are difficult to incorporate into a recycling stream. Even within a plant, scrap in multiple colors requires special handling for reintroducing it into the production process. Moreover, the pigments themselves sometimes have complex environmental impacts and handling issues in the plant. On the other hand, transparent or "natural" unpigmented plastics, sometimes made clearer with nucleating/clarifying agents, can be extremely attractive and are easier to recycle.
- *Consider useful kinds of molded-in aesthetics.* A variety

of surface textures and grains can be molded into a part's plastic. These effects do not require a special finishing operation, but still allow a part to be differentiated or to seem unique. Part identifying codes can also be molded into the plastic itself. On the other hand, molded-in labels or decorative elements made from other materials can be diffi cult or impossible to remove from a part, and, depending on their composition, are likely contaminants in the part's recycling stream.

5.2 The Wildcard: Consumer Preferences in Green Design

Are consumers motivated to support green design goals? Might they even perhaps see themselves as participants in a company's efforts, by purchasing products that can be shown to be more environmentally sustainable? Yes and no – it is a matter of degree, at least when speaking about the performance of functional products. The more the product's cost seems excessive for its resulting performance – or the more the expected product properties seem sacrificed by green design – the smaller the proportion of consumers who are willing to collaborate in the company's efforts in sustainability.

And finally, what about green design changes that a consumer cannot see or might not even be aware of? As in the case of the rice packaging mentioned at the beginning of this chapter, such a product might have to include a message to the consumer explaining and even arguing for the green design change the consumer may or may not have noticed. Material changes in the design can be even harder for a consumer to notice (unless we are talking about the notoriously noisy PLA SunChips® bag discussed in Chapter 4). Such external, marketing-oriented considerations make the material- selection process, discussed in the next chapter, even more difficult than it traditionally has been for engineers and designers.

1. American Plastics Council (n.d.). Designing for the Environment [Guide], Washington: American Plastics Council and The Society of the Plastics Industry, Inc.

2. Packaging experts say sustainability remains elusive (2010, February 5). Plastics News, http://www.plasticsnews.com, 2010.

3. Anastas, P.T., and Zimmerman, J.B. (2006). The twelve principles of green engineering as a foundation for sustainability. In M.A. Abraham (ed.), Sustainability Science and Engineering: Defi ning Principles, Amsterdam: Elsevier B.V.

4. Schmiemann, A., Otten, A. (2010). Natural fiber reinforced thermoplastics foams – a new material group for lightweight structures, ANTEC 2010 (Proceedings), Society of Plastics Engineers.

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