



PLASTICS AND ENVIRONMENTAL SUSTAINABILITY

ANTHONY L. ANDRADY

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PLASTICS AND ENVIRONMENTAL SUSTAINABILITY

*This book is dedicated to my children
and my grandchildren.*

PREFACE

How quickly a concept is grasped, adopted, and assimilated into the general culture is indicative of how germane a human need it addresses. If that is indeed the case, the notion of sustainable development seemed to have struck a vibrant sympathetic chord with the contemporary society. Since its emergence in the 1980s, the general tenet of sustainability has gained rapid worldwide salience and broad global appeal in some form or the other. Though it is easy to identify with and even subscribe to it in general terms, the goal of sustainability and how to achieve it remain unclear. In addition to being a dictionary term, “sustainability”¹ has also become a buzzword in the business world. Today’s message of sustainability reaches way beyond that of the early environmental movements of the 1960s and 1970s in that it includes an ethical component based on social justice for future generations.

With the global carrying capacity already exceeded, energy/materials shortages looming in the medium term, and the climate already compromised by anthropogenic impacts, many believe that we have arrived at decisive crossroads with no time to spare. The only way out of the quagmire is a radical change in thinking that encompasses the core values of sustainable growth. The message of sustainable growth has also reached chemical industry at large including the plastics industry. In a recent global survey of consumer packaged goods companies by DuPont in 2011, a majority (40%) of the respondents identified attaining sustainability (not costs or profits) as the leading challenge facing their industry today. Environmental movements including the call for sustainability have hitherto evolved along strict conservationist pathways over the decades that saw economic development inextricably linked with polluting externalities and tragedy of the commons. This invariably pitted business

¹ The word is derived from the Latin root *sustinere*, which means to uphold.

enterprise against the health of global environment. Industry was still identified a significant polluter and generator of waste. This has led to the plethora of environmental regulations promulgated in the United States during those decades aiming to “regulate” their operations. The knee-jerk response has been greenwashing, a mere defensive stance by industry, seeking to make small visible changes to nudge existing practices and products into a form that might be construed as being sustainable.

The entrenched belief that business and technological development must necessarily adversely impact the environment remained entrenched in the 1970s and 1980s. In 1992, at the UN Conference in Rio, this notion was finally challenged and the dictum that economic development (so badly needed to eradicate world poverty) can occur alongside environmental preservation was finally proposed. But preservation means maintaining the environmental quality and services at least in its current state for the future generations to enjoy. Without a clearly articulated mechanism of how to achieve this rather dubious goal or the metrics to monitor the progress along the path to sustainability, the notion blossomed out into a popular sociopolitical ideal. Consumers appear to have accepted the notion and are demanding sustainable goods and services from the marketplace.

The allure of sustainable development is that it promises to somehow disengage the market growth from environmental damage. It frees up businesses from having to continually defend and justify their manufacturing practices to the consumer and the environmentalists who continually criticize them. Industry and trade associations still continue under this old paradigm perhaps by the force of habit but the rhetoric and dialogue with environmentalists are slowly changing. Accepting in principal that the need for a certain metamorphosis in their operation that reshuffles their priorities is a prerequisite to fruitful collaboration with environmental interests. The effort toward sustainability is one where industry, the consumer, and the regulators work together, ideally in a nonadversarial relationship. In this awkward allegiance, the business will move beyond meeting the regulatory minima or “room to operate” in terms of environmental compliance and respond positively to burgeoning “green consciousness” in their marketplace. It frees up the environmental movements to do what it does best, and facilitates stewardship of the ecosystem in collaboration with business interest, rather than be a watchdog. This is not an easy transformation in attitudes to envision. Yet it is a change that needs to be achieved to ensure not only continued growth and profitability but the very survivability of the planet and life as we know it.

The Consumer

Primarily, it is the mindset of traditional consumption that determines the demand for market goods, that needs to change. Businesses do not exist to preserve the environment; they exist to make profit for their owners. But to do so, they must meet the demands in the marketplace. With the rich supply of easily-accessible (albeit sometimes erroneous) information via the internet, interested consumers are rapidly becoming knowledgeable. The consumer demand for sustainable goods will grow rapidly, automatically driving business into sustainable modes of operation. Consumers need to be well informed and educated so that they are aware of the need and know what exactly to change.

In such a future scenario, the industry will be called upon to justify not only their economic objectives but also explicitly consider environmental (and social) objectives. This shift from the solely fiscally-driven business plans to the triple bottom-line business plan will propel the marked shift in corporate function. To be successful, the change in corporate orientation must encompass the entire value chain with free flow of communication across the traditional boundaries and interphases with suppliers, customers, and waste managers. This cannot be achieved by a few analysts embedded within a single department but requires champions that represent all aspects of the value chain.

Plastics Industry and Change

Why would a growing, robust, and profitable industry providing a unique class of material that is of great societal value want to change? The plastic industry certainly is not an inordinate energy user (such as cement production or livestock management) and does not place a significant demand on nonrenewable resources. The benefits provided by plastics justify the 4% fossil fuel raw materials and another 3–4% energy resources devoted to manufacturing it. In building applications, plastics save more energy than they use. In packaging (where the energy/material cost can be high), plastics reduce wastage and afford protection from spoilage to the packaged material with savings in healthcare costs. Plastics are a very desirable invention in general. However, the customer base and operating environment are changing rapidly; responding to the challenge posed by these changes is a good business strategy.

The plastics industry has its share of environmental issues. It is based on a linear flow of nonrenewable fossil fuel resources via useful consumer goods into the landfills. Lack of cradle-to-cradle corporate responsibility and design innovations to allow conservation of resources is responsible for this deficiency. For instance, there is not enough emphasis on design options for recovery of post-use waste. The move toward bio-based plastics, an essential component of sustainability, is too slow with not enough incentive to fully implement even what little has been achieved. Though good progress has been made, over-packaging and over-gauging are still seen across the plastics product range. While the plastics litter problem is at its root a social-behavioral issue, the industry is still held at least partially accountable. The issue of endocrine disruptors and other chemicals in plastics potentially contaminating human food still remains a controversial issue. Complaints on plastics in litter, microplastics in the ocean, endocrine disruptors in plastic products, and emissions from unsafe combustion have been highlighted in popular press as well as in research literature. Proactive stance by industry to design the next generation production systems is clearly the need of the day.

Any effort toward sustainability must reach well beyond mere greening of processes and products. Not that greening is bad (unless it is “greenwashing” which is unethical) but because it alone will not be enough to save the day. Sustainability starts at the design stage. Visionaries in the industry need to reassess the supply of energy, materials, and operational demands of the products. Can the present products still remain competitive, profitable, and acceptable despite perhaps more stringent regulatory scrutiny in a future world? What are the ways to increase the efficiency of

energy use, materials use, and processes for the leading products? What potential health hazards (perceived as well as real) can the product pose? What technologies are missing that need to be adapted to achieve sustainability? Sustainable growth is a process (not a goal) that has a high level of uncertainty as we are planning for the present as well as for a clouded undefined future. This uncertainty has forced it to be grounded on precautionary strategies.

This Volume

This work is an attempt to survey the issues typically raised in discussions of sustainability and plastics. The author has attempted to separate scientific fact from overstatement and bias in popular discussions on the topics, based on research literature. Strong minority claims have also been presented. Understandably, there are those where plastics have been unfairly portrayed in the media and those where sections of the industry in aggressively protecting their domain have understated the adverse environmental impacts of plastics. The author has attempted to remain neutral in this exercise and he was not funded either by the plastics industry or by any environmental organization in writing this volume.

A work of this nature can never expect to satisfy all stakeholders on all topics covered. Depending on his or her affiliation, the reader will either feel environmental impacts of plastics are exaggerated or that they are too conservatively portrayed and do not capture their full adverse impact. Despite this anticipated criticism, a discussion of the science behind personal judgments and public policy is critical to the cause of sustainability. If the work serves as a catalyst for engagement between industrial and environmental interests or at least generates enough interest in either party to dig deeper into the science behind the claims, the author's objective would have been served.

Raleigh, NC
2014

ANTHONY L. ANDRADY

We did not inherit the Earth from our fathers; we merely borrowed it from our children.

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LIST OF PLASTIC MATERIALS

LDPE—Low density polyethylene
HDPE—High density polyethylene
PP—Polypropylene
PS—Polystyrene
PVC—Poly(vinyl chloride)
CPVC—Chlorinated poly(vinyl chloride)
PB—Polybutene
GPPS—General purpose polystyrene
HIPS—High impact polystyrene
EPS—Expendable polystyrene
PMMA—Poly(methyl methacrylate)
PET—Poly(ethylene terephthalate)
PBT—Poly(butylene terephthalate)
PC—Polycarbonate
PA—Polyamide
PA-6—Polyamide 6
PA-66—Nylon 66 or polyamide 66
CA—Cellulose acetate
EVA—(Ethylene-vinyl acetate) copolymer
SAN—(Styrene-acrylonitrile) copolymer
ABS—(Acrylonitrile-butadiene-styrene) copolymer
SBS—(Styrene-butadiene-styrene) copolymer

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