

Integrating green chemistry and sustainability into a specialty chemical company*

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Abstract: Most companies have embraced the American Chemistry Council (ACC) Responsible Care[®] program, including Product Stewardship, and are integrating ISO 14001 and other environmental management systems. The Rohm and Haas Company uses environmental improvement objectives that not only focus on compliance with existing regulations and industry trends, but for developing business unit-driven objectives to reduce our environmental footprints for processes and systems. To attain the next level of strategic environmental management, integration of sustainable concepts and activities into a general management framework, new product development and corporate decision-making processes must occur. Businesses need to internalize that operating sustainably creates long-term value, achieves a greater competitive edge, and is not solely a short-term cost-reduction activity. They must recognize and foster implementation of technological advances in green chemistry, life-cycle analysis, risk assessment, and engineering consistent with specific business goals. Development of sustainability improvement objectives for each business unit assists in meeting our global sustainability goals. The process, measures and metrics, challenges, and results for integrating sustainability into the culture at Rohm and Haas will be described during this presentation.

INTRODUCTION

Sustainability and sustainable development have been called the next industrial revolution [1]—a requirement for doing business in a globally competitive and resource-strapped environment. Sustainable development requires balancing the 3 E's—economics, environment, and equity (social) components. Companies can no longer be compliant with environmental regulations, believing that they will be economically secure. They must develop a sustainable outlook to business vision and conduct that embraces the concepts of green chemistry, life-cycle thinking, and risk assessment.

CURRENT PROGRAMS AND SUSTAINABLE DIRECTIONS AT THE ROHM AND HAAS COMPANY

Some global specialty chemical companies, like the Rohm and Haas Company, have been working on going beyond mere compliance with regulations for many years. Programs such as the following have been developed and embraced with loftier goals and objectives—that of reducing the environmental footprint of processes and systems while generating substantive economic gains:

- American Chemistry Council (ACC) Responsible Care[®]—Product Stewardship (formerly CMA);
- ISO 14001; Environmental Management and Audit Scheme (EMAS) in EU; and
- Rohm and Haas Environmental Improvement Objectives (EIOs)

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This eco-efficiency approach, while on the correct track, does not lead to a sustainable approach to business. A strong social component is needed, as well as integration of sustainability concepts and activities into a general management framework, new product development, and corporate decision-making. Business leaders within the company need to internalize that operating sustainability creates long-term value, achieves a greater competitive edge, and is more than just a short-term activity.

Using a sustainable development (SD) network, Rohm and Haas was able to rapidly develop and begin to implement sustainability improvement objectives (SIOs) for each business unit that are tied to overall corporate goals. This network used benchmarking with other leading companies, trade groups, and advocacy relationships, and knowledge of risk assessment (use in product and process decision-making) and life-cycle (understanding and sharing product responsibility over the entire life cycle) thinking to move SD into the mainstream business processes within the company.

SIOs, such as:

- assess new business opportunities (products, acquisitions, etc.) with respect to environmental and social benefits, not just traditional metrics;
- replace problem chemistries with environmentally comparable ones;
- replace nonrenewable materials with renewable resource-based materials; and
- use scheduling to minimize downtime process changeovers and cleanup waste

are included in each business team's corporate agreement, and success of that business will be partially measured using attainment of these annually modified targets.

GREEN CHEMISTRY

Of course, products and processes must be designed appropriately from their start. Some 80–90% of the life-cycle economic and environmental costs (including social aspects) have already been committed by the time product design is completed [2]. Green chemistry—the design, manufacture, and use of efficient, effective, more environmentally benign chemicals, products and processes—is an essential component in our embrace of sustainability. One can use atom economics (nanoscale approaches) to improve process selectivity and reduce energy need and matter flow [3,4]. This leads to creation of durable, reusable, recyclable products that can be considered low environmental-impact goods and services. In addition to an SD driver, use of green chemistry also gets a push from the need to develop a less-costly product with the same functionality or a more effective (more functionality) product at a comparable cost.

The American Chemical Society (ACS) [5] has listed 12 principles of green chemistry:

1. prevention
2. atom efficiency
3. less-hazardous chemical synthesis
4. designing safer chemicals
5. safer solvents and auxiliaries
6. design for energy efficiency
7. use of renewable feedstocks
8. reduce derivatives
9. catalysis
10. design for degradation
11. real-time analysis for pollution prevention
12. inherently safer chemistry for accident prevention

There are barriers to the acceptability and practice of green chemistry. Programs and policies need to be put in place to promote research and appropriate rewards—economic incentives. Often, such programs do not rapidly produce results and publications and may be of lessened interest in academia and

other research organizations. Also, before research can commence, green-sustainable chemistry must become an integral part of a chemical education curriculum [4,6].

Rohm and Haas has numerous examples of green chemistry in practice, including the following:

- development of environmentally friendly replacements for TBT;
- use of renewable, resource based materials to replace nonrenewable raw materials;
- development and registration of pest-specific insecticides and herbicides leading to minimal non-target effects;
- replacement of solvent-based systems with water-based, solvent-free or powder systems; and
- reducing the level and/or number of inert, nonessential ingredients in formulations.

In fact, Rohm and Haas has received 2 of the 26 Presidential Green Chemistry Challenge Awards since 1996—for the Molting Accelerating Compound (MAC) Insecticides and for the Marine Antifoulant Formulated (MAF) paint Biocide. Ultimately, green chemistry, in conjunction with risk assessment and life-cycle analysis, contributes to our ability to use the triple bottom line in our everyday business.

SUSTAINABLE CONSUMPTION

Recent work [7,8] notes that sustainable development/sustainability is better captured using concepts of sustainable consumption (SC), in which one improves the standard of living for all while creating major business opportunities. Holliday and Pepper describe SC as optimization of markets to promote and sustain social equity, economic prosperity, and environmental integrity. Business cannot succeed if society fails and/or our global environment continues to deteriorate. They believe in making the market work for everyone by enabling less-developed areas to have market access and to spread consumer purchasing power to those areas. This is not a “zero-sum” game—SC is not about consuming less, but is about consuming differently, more efficiently, and holistically, thereby improving the quality of life. Such an approach does work to solve the current SD dilemma—developed countries must give up some of their quality of life to help the world economy to become more sustainable, and/or the less-developed countries cannot use their resources and potentially repeat the mistakes of the past in order to elevate their economic and social stature.

SUMMARY

Companies must embrace the triple bottom line, providing balance among the economic, environmental, and social components of sustainability. This occurs via creation of partnerships and alliances among various groups both within and external to a business. Business teams need to develop sustainable business goals, objectives, and strategies, as well as measure and communicate progress and success. Green chemistry, in conjunction with concepts of risk assessment and life-cycle analysis, is essential to our developing benign products and processes that support a sustainable business and global economy. Companies positioned to create value and open markets with less resource use will gain a sustainable competitive advantage. Perhaps the concept of sustainable consumption will lead us to a more equitable and timely resolution to creating a sustainable world.

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