

VECAP™ - Controlling Emissions, Protecting the Environment, Continuous Improvement – The Voluntary Emissions Control Action Program for Brominated Flame Retardants

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ABSTRACT

This paper addresses a proactive product stewardship initiative designed to monitor, manage, and minimize emissions of particular additives used in plastics, including those in automobiles. These plastics additives are brominated flame retardants. They are used in certain automobile plastics and textile applications to help prevent fires from starting, delay the spread of fires, or delay the time to flashover, providing people more time to escape burning vehicles.

The Voluntary Emissions Control Action Plan (VECAP) is a practical product stewardship initiative designed to manage, monitor, and minimize industrial emissions of brominated flame retardants into the environment.

INTRODUCTION

The automotive industry used approximately 250 pounds of plastics and textiles per vehicle in 2000 [1]. The substitution of metal components with plastics contributes to overall automobile weight reduction. Weight reduction contributes significantly to improved gas mileage and, consequently, has an overall positive effect on the reduction of greenhouse gases emitted by automobiles. With the drive to increase fuel efficiency, a further increase in plastics use in automobiles should be anticipated.

Automobiles currently use plastics in a variety of areas, such as exterior (panels, trim, bumper), interior (foam and textiles), and under-the-hood (engine, electrical, and structural parts). Most plastics are flammable. For reasons of fire safety, flame retardants have been used in automobiles for many years. In fact, the MVSS-302 flammability test was adopted more than 30 years ago to prevent rapid flame spread from small ignition sources in a vehicle passenger compartment to help improve passenger survivability [2].

Flame retardants reduce fire risk at various stages of the combustion process. They help prevent fires from starting, delay the spread of fires, or delay the time until flashover to provide people more time to escape. Fire prevention is essential from a number of perspectives:

- Protection of life
- Protection of property and the environment
- Prevention of immediate local pollution to air and water
- Prevention of lesser-known long term environmental effects [3].

Even with our best efforts, fire continues to be a major cause of death, injury and property loss around the world. In the United States in 2005, more than 3,900 fire deaths occurred, including more than 100 firefighters who died fighting fires and protecting lives [4]. In 2005, vehicle fires represented 18% of all US fires. [4]. During this time, public fire departments responded to an estimated 290,000 vehicle fires in the US. [4].

EMISSIONS REDUCTION

Concerns have been raised about finding chemicals, including some flame retardants, in humans or the environment. Even though the levels detected are extremely low and have not been shown to pose a risk to the environment or to human health, every effort should be made to minimize the release of chemicals, including flame retardants, during manufacture and use.

As global producers of chemicals, the Bromine Science and Environmental Forum (BSEF) member companies are deeply committed to protecting the environment, ensuring the safety and security of our operations, and safeguarding the health and safety of our employees and the communities in which we live and work [5]. With those commitments in mind, BSEF has voluntarily

developed a unique emissions control program to address industrial emissions of BFRs. This program, known as the Voluntary Emissions Control Action Program, or VECAP, is currently being applied by BSEF to BFRs but can be used to address industrial emissions of almost any chemical.

THE FUNDAMENTALS OF VECAP

VECAP is a proactive product stewardship initiative established by the brominated flame retardant (BFR) industry that uses a mass-balance approach to determine emissions [6]. The aim of VECAP is to manage, monitor, and minimize industrial emissions of brominated flame retardant into the environment through partnership with the supply chain. The emphasis to date has been directed at those flame retardants with the highest production volumes, such as decabromodiphenyl ether (Deca-BDE), tetrabromobisphenol A (TBBPA), and hexabromocyclododecane (HBCD). These flame retardants have been, or are currently, used to improve fire safety in automobiles.

VECAP is a program in which manufacturers and users of brominated flame retardants have worked together to establish and share “best practices” on the handling of BFRs. The ultimate goal is to prevent or eliminate emissions to the environment in a sustainable and measurable manner, both from manufacturing facilities and from all end user sites throughout the supply chain. Currently, there are no regulations that require such a plan be prepared for chemicals. Under the European REACH (Registration, Evaluation, Authorization and restrictions of Chemicals) Directive, producers are required to have a management system in place that ensures that releases to the environment, or potential human exposures, are controlled at levels below that which could pose a risk at either the manufacturing facility or elsewhere in the supply chain. VECAP represents a voluntary, progressive practice of industry self-regulation to reduce emissions to the environment in advance of such requirements.

The “VECAP model” approach is based on recognized environmental management programs such as ISO 14001 and the EU Eco-Management and Audit System (EMAS), but simplified to focus on the target chemicals, which make it easier for small and medium-sized enterprises to participate in the program.

VECAP is built on the following principles:

- **VOLUNTARY INITIATIVE:** Demonstrating the commitment of the industries involved to act in a manner that supports the interests of society and the environment

- **CONTINUOUS IMPROVEMENT:** Recognizing that processes can always be further improved and, if technically and economically justified, such improvements should be made
- **PROMOTING SUSTAINABILITY:** Reducing the impact of chemicals on the environment while enhancing the competitiveness of local industries
- **TRANSPARENCY:** Publishing reports and information for the parties involved, collected by an independent Product Steward
- **DIALOGUE:** Promoting an open dialogue with all interested bodies and at Federal and State levels; this dialogue will progress with timely feedback
- **BEST PRACTICE SHARING:** Offering all companies – small, medium or large – equal access to the industry’s best practice expertise in environmental and process performance; such access allows benchmarking and drives continuous improvement
- **SAFE USE:** Providing detailed information ensuring safe and eco-efficient use of brominated flame retardants
- **VECAP CERTIFICATION:** Having an independent, third-party VECAP audit procedure, using principles aligned with ISO 9001/14001.

Companies participating in VECAP follow a cycle of continuous improvement, beginning with a commitment to the Code of Good Practice. A company’s actual working procedures are then compared with those required in the Code of Good Practice, and each company critically assesses and analyzes its by-product flows and processes to identify the potential for emissions. Measuring and recording the relevant data identifies a company’s actual baseline emissions throughout their entire production process. Once this emissions balance is known, an emissions report can be developed, which will enable “closing” the mass balance, i.e., accounting for the difference in volume between the amount of a product entering a process and the amount exiting the process.

The VECAP continuous improvement process consists of six steps, as depicted in Figure 1. These steps are:

1. **COMMITMENT TO THE VECAP CODE OF GOOD PRACTICE:** The VECAP system starts with the user’s commitment to the program, adopting the Industry’s Code of Good Practice and implementing these principles in the procedures and work instructions of daily operations.
2. **SELF AUDIT:** With the self-audit, the company identifies the production flow sheet of its operations.

3. **MASS BALANCE APPROACH:** The company completes and closes the BFR mass balance (defining the gap in the amount of BFR entering and leaving the production process).
4. **BASELINE EMISSIONS SURVEY:** The company uses the results obtained in the initial survey as a baseline to measure current actual performance and to assess and assign future emission reduction opportunities and priorities.
5. **EMISSIONS IMPROVEMENT PLAN** - An emission improvement plan is determined in accordance with the company's own objectives and policies.
6. **IMPLEMENTATION AND CONTINUOUS IMPROVEMENT** - Once the improvement plan is implemented, operational results are evaluated and the potential for further emission reductions is investigated, ensuring effective continuous improvement.

chemical used if the entire volume of the chemicals put into the industrial process is not accounted for at the end of the process. This leads to an exhaustive examination of the process, which should identify any new potential emission sources.

Some sources of potential emissions include:

- Manufacturing
 - Production
 - Packaging
 - Shipping
- Processing
 - Dust from unloading and feed operations
 - Leaks in feed equipment on production lines
 - Improper clean-up of spills
- Waste disposal
 - Residues in packaging
 - Poorly treated wastewater from system wash-outs
 - Waste not reprocessed.

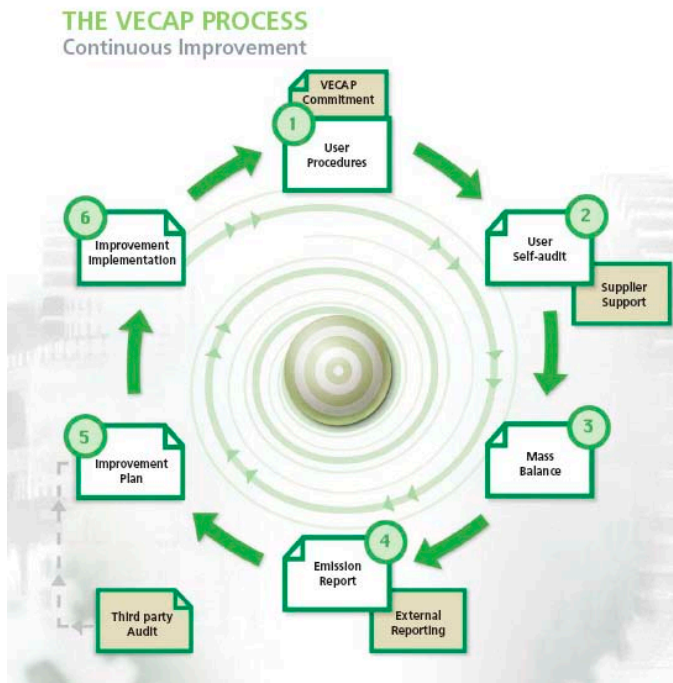


FIGURE 1. THE VECAP PROCESS OF CONTINUOUS IMPROVEMENT

Once a user has agreed to implement the VECAP principles, a mass balance is performed to assess potential emissions to land, air and water. The objective of this baseline assessment is to collect data for an evaluation of environmental performance and to obtain a reference point to allow the measurement of future improvements.

The methodology and discipline of the VECAP mass balance requires producers and users to assume that there is a “loss” that might result in an “emission” of the

VECAP ALIGNMENT WITH OTHER PROGRAMS

Though VECAP is a new and revolutionary initiative on the part of the bromine industry, it has its basis in several established programs. For instance, VECAP aligns well with the tenets of Responsible Care® [7].

Responsible Care is the US chemical industry's award-winning performance improvement initiative. The American Chemistry Council (ACC) launched the US Responsible Care initiative more than seventeen years ago to ensure that the chemical industry makes health, safety, security and the environment top priorities. Participation in the Responsible Care initiative is mandatory for members of ACC. Widely recognized as one of the largest and most successful voluntary performance initiatives advanced by any industry, Responsible Care helps America's leading chemical companies go above and beyond government requirements, and collectively share their progress with the public.

VECAP also aligns well with the principles used to determine certification under ISO 9001 and 14001. VECAP is similar to those programs in that it uses an auditing process to identify process deficiencies and provides a means to seek constant improvement.