



## **Sustainable Textile Development at Victor Innovatex**

Within the architecture and design community, issues associated with sustainable product design have been rapidly emerging. In fact, the term “sustainable” is in the process of being defined by a variety of stakeholders within industry, academia and advocacy organizations.

At Victor Innovatex, we have chosen the following measures of sustainability:

- Product/material transparency
- Material and chemical input safety
- Recyclability and recycled content
- Renewable energy and resource efficiency

We believe that each of the attribute categories above is interdependent and critical to sustainability, and therefore it is not appropriate to focus entirely on one measure to the exclusion or detriment of the others.

### **Product/Material Transparency**

Victor realized that if our company was to set a goal of knowing what we are sending out into the world, we had to begin by understanding what is in our products. . To that end, when designing our Eco Intelligent Polyester we completed an inventory of all chemical inputs considered for use in the product to a level of 100 parts per million. Victor can confidently say that it now understands all of the components being used in its Eco Intelligent Polyester product line.

### **Chemical and Material Safety**

After creating a detailed chemical “map” of the components we intended to use to manufacture Eco Intelligent Polyester, we began the process of benchmarking those components against a set of human health and ecological toxicity criteria as defined by the consulting group McDonough Braungart Design Chemistry (MBDC). All of Victor’s chemical inputs passed through two assessment “filters” that have been developed by MBDC. The first filter is used to identify all chemical substances that could potentially pose a hazard to humans and/or the environment. The second filter is used to analyze the relationship between the chemical and the parent material and draw conclusions about the various routes of exposure for the

hazardous chemical at different stages of its life cycle. MBDC's material assessment methodology has been created with the goal of prioritizing chemicals and, consequently, materials by their level of safety within a more precautionary framework than is currently mandated by most regulations. As a result, the level of safety of chemical inputs and resulting materials is significantly higher than regulated levels.

Victor's Eco Intelligent Polyester is a "Level 4" product within the MBDC rating system for different levels of product optimization (with 5 as the highest level of achievement). To attain a Level 4 product, all of the dyes and auxiliary chemicals used to make Eco Intelligent Polyester have passed MBDC's stringent measures of safety.

Victor recognized the need to optimize polyester fiber by removing a toxic heavy metal, antimony trioxide, which is most commonly used as a catalyst for polymerizing commodity PET fibers. The following are some of the human and environmental health characteristics of this particular antimony salt and why there is sufficient concern to find an alternative catalyst:

- Antimony trioxide is classified as a carcinogen in the state of California since 1990. The following toxicological agencies also list antimony trioxide as a suspected carcinogen: ACGIH (A2); OSHA (possible select carcinogen); IARC (Group 2B). Antimony trioxide is also on the Danish list of Unwanted Substances and classified as a "class 3 carcinogen" by the EU Council Directive 67/548/EEC.
- The European Community is reviewing antimony trioxide (with Sweden as rapporteur) for inclusion in the following chemical classifications under Council Directive 93/793/EEC:
  - R50 – Very toxic to aquatic organisms
  - R51 – Toxic to aquatic organisms
  - R52 – Harmful to aquatic organisms
  - R53 – May cause long term adverse effects in the aquatic environment
- The primary routes of exposure to antimony trioxide in its various life cycle stages as a catalyst are 1) inhalative exposure from bags of catalyst in powder form; 2) water releases from dyeing of PET (extraction from fiber increases with higher water temperature and time) and precipitate wastewater sludge; 3) solid waste from glycol still bottoms or "sludge" from the distillation and recycling of ethylene glycol from polymerizing operations; 4) possible inhalation from incinerated sludge. There are many stages in antimony trioxide's life cycle as catalyst that create potential for exposure to this hazardous substance.

PET fiber typically has an antimony concentration anywhere as low as 160ppm to as high as 650-700ppm. Assuming a beginning value of 375ppm in an undyed PET fiber, as much as 175ppm of antimony can be leached from the fiber during the dyeing process. This seemingly insignificant amount translates into a burden on water treatment facilities when multiplied by 19 million lbs each year and is still a hazardous waste when precipitated out during treatment. EPA lists the allowable limit for antimony in drinking water to be 6 parts per billion (ppb). Countries that can afford technologies that precipitate the metals out of the solution are left with a hazardous sludge that must then be disposed of in a properly managed landfill or incinerator operations. Countries who cannot or who are unwilling to employ these end-of-pipe treatments release antimony along with a host of other dangerous substances to open waters.

Approximately 19M lbs of PET were produced in 2002. In the United States, alone, an estimated 1 billion lbs of spent Ethylene Glycol is generated each year. The EG distillation process creates 40 million pounds of still bottom sludge. When incinerated, the sludge produces 800,000 lbs of fly ash containing antimony, arsenic and other metals (Mobile Process Technology site – info from Crystar, DuPont Co.).

We at Victor asked ourselves, “why spend all this money to control a problematic substance when you can eliminate it by selecting an alternative material?” We decided to try and eliminate the hazard rather than spend our resources trying to reduce the risks associated with it. As a result, Victor was able to find an alternative titanium-based catalyst that has no toxicity issues associated with it. Victor believes that this improvement in the toxicity of such a common textile fiber is a design change that could motivate the rest of our industry to eliminate this hazardous substance and make alternatives more affordable.

### **Recyclability and recycled content**

There has been much discussion in the textile industry about the role that recycled materials could play in our transition to a more sustainable industry. Fiber with recycled content is associated with less greenhouse gas emissions than an equivalent amount of virgin feedstock fiber due to the reduced need for material resources and energy.

Victor fully supports the goal of using recycled materials (we have been recycling wool since 1958). However, we realize that recycled content is only one measure of a sustainable fiber, and the other critical measures cannot be ignored. Currently, there are no sources of post consumer recycled bottle PET that are antimony free. The only way to encourage safer alternatives to these harmful catalysts is to take a leadership role in developing the market for these options. When other companies and industries have first introduced safer inputs to their products, recycling then becomes a logical next step. In this way, we can work toward developing a ready supply of antimony trioxide free PET that can be recycled and is safe for human health during all lifecycle phases.

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## **Renewable energy and resource efficiency**

### *Feedstock and Process energy*

Fabrics made from recycled polyester have the benefit of reduced fossil fuel consumption and fewer emissions of associated greenhouse gases when compared to the energy required to make an equivalent amount of virgin fiber. We also believe in using energy resources wisely, and although we consider using recycled feedstock to be one step along a company's path toward sustainability, we believe that stressing recycling initiatives while disregarding the safety of inputs is not a complete view of sustainability.

There are two important measures of sustainable energy use: the source from which it is derived and how efficiently it is utilized. With the impacts of climate change becoming increasingly evident, the importance of using renewable forms of energy becomes obvious. Victor is fortunate to have access to a renewable source of energy, hydroelectric, which is used to power 80% of our manufacturing operations. The other 20% of our energy mix comes from natural gas that, while also a fossil fuel, when burned releases significantly fewer emissions for particulates, CO<sub>2</sub>, sulfur and nitrogen oxides than coal and oil derived sources.

So how should one view the benefits of using recycled feedstock versus renewably sourced process energy in relative terms? This is a complex question because we are measuring two different phases in the life cycle of a textile. It might be useful to look at the energy used for each of these processes:

	Coal (lbs/MWH)	Nat. gas (lbs/MWH)	% less in NG	hydro	wind	solar	
CO2	2071	1205	41.815548		0	0	0
SOX	13.8	0.008	99.942029		0	0	0
NOX	4.8	4.3	10.4166667		0	0	0
P. mat.	3.2	0	100		0	0	0

Source: Renewable Northwest project/Seattle times

	Coal (lbs/MWH)	Nat. gas (lbs/MWH)		
CO2	2716	1630	39.9852725	
SOX	8.35	0	100	
NOX	6.9	4.14	40	
P. mat.	0.99	0	100	

Source: Minnesota public utilities commission

Lifecycle stage	Associated energy
Extraction of oil/Oil to intermediate products	39.25 MJ/kg PET (3)
Polymerization of PET	37.95 MJ/kg PET (1)
Extrusion/weaving/finishing	74.69 MJ/kg fabric (1)
Weaving/finishing	(32.71 MJ/kg fabric (2))

(1) "Energy Analysis of 108 Industrial Processes" from Drexel University and the U.S. Department of Energy.

(2) Victor Innovatex

(3) Boustead: "When all operations are traced from the extraction of raw materials from the earth, the average total, gross, cumulative energy requirements are 77.2 MJ/kg." When 37.95 MJ/kg (polymerization of PET) is subtracted from this total, the value of these intermediates is determined.

Any consideration of energy savings must consider all steps in the entire lifecycle of the product. The data above demonstrate that the stage of the lifecycle is critical to any discussion of energy efficiency and associated environmental impacts. Specifying 100% recycled content fiber provides a potential net energy savings of 77.20 MJ/kg (all energy related to transportation is included in this figure). However, equal savings and environmental benefits are potentially available for energy used in textile manufacturing operations – 74.69 MJ/kg (does not include energy related to transportation).

Not only does the process of extruding/weaving/finishing fabrics offer equal benefits, but these processes are in the direct control of textile manufacturers and the benefits will accrue to all of the products they make. A manufacturer who makes significant gains in using a renewable source of energy or using conventional sources more efficiently is making a greater investment in sustainable product manufacturing than one that simply specifies recycled content in one product.

## **Conclusion**

The definition of the term “sustainable” is highly variable and each company needs to be transparent in how they define this idea and implement it in their manufacturing of products. Victor has developed an approach that we think is holistic and, hopefully, regenerative. While the benefits of using the safest ingredients possible are not as readily measurable as the number of barrels of oil saved by using recycled fiber or even by using renewable energy, they are no less important to achieving more sustainable manufacturing practices. We think sustainable product design is an example of where the whole is truly greater than the sum of its parts.

## **Source:**

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