

CHELSEA CENTER FOR RECYCLING AND ECONOMIC DEVELOPMENT

UNIVERSITY OF MASSACHUSETTS

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### Development of New Colors and Style for Recycled Polypropylene Toothbrushes

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# **Development of New Colors and Style for Recycled Polypropylene Toothbrushes**

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## **Chelsea Center for Recycling and Economic Development Technical Research Program**

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## **1. Abstract**

Recycline, Inc., of Somerville, Massachusetts, has manufactured the Preserve® toothbrush (the Preserve) using recycled polypropylene since 1997. The toothbrush handle is made from both pre-consumer and post-consumer #5 polypropylene, which is supplied predominately by Massachusetts sources. To date, Recycline has sourced approximately 14,000 lbs. of polypropylene to manufacture the Preserve. Over 1,000 retailers and 15 distributors currently sell the Preserve in all 50 states.

Through focus groups and ongoing market research, Recycline learned that a large percentage of consumers list handle color as one of their primary considerations when purchasing a toothbrush. Recycline currently manufactures the Preserve in three colors: red, green, and royal blue. To increase its market share and, correspondingly, the number of people purchasing a recycled product, the company is planning to introduce three new colors (purple, periwinkle blue, and yellow). Recycline also learned from its existing client base that a large percentage of them would carry a children's toothbrush from Recycline (Children's Preserve).

With Product Development and Testing Grants from the Chelsea Center for Recycling and Economic Development, Recycline determined the optimal ratios of color to recycled material for its new Preserve colors. Recycline also determined that introducing color to the polypropylene feedstock during the molding step was most effective and cost-efficient.

The company also researched market and consumer interests to determine the most appealing design for the Children's Preserve. Working with two industrial design firms, Recycline developed two prototypes, which were presented at a retail industry trade show in October 1999. The computer files that developed these prototypes will also be used to create the production molds for the Children's Preserve.

## **2. Background**

Each year, discarded toothbrushes account for an estimated 50 million pounds of plastic waste in the United States. With dentists recommending more frequent toothbrush replacement, this number is expected to increase. By manufacturing the Preserve from recycled polypropylene and by providing a postage-paid recycling envelope with each toothbrush, Recycline helps consumers frequently replace their toothbrushes without contributing to landfill waste.

The Preserve's unique combination of environmental and functional advantages has led to sizeable market share gains in its first two years at market. Recent research by SPINS, an information service company for the natural foods industry, cited the Preserve as the third best-selling brand of toothbrush in the fast-growing natural food segment of the supermarket industry. The competitive nature of the toothbrush market has led Recycline to explore new ways to expand market share, including the introduction of new colors and a children's toothbrush.

### **3. Development of New Colors**

#### **3.1 Scope of Work**

Recycline research shows that a large percentage of consumers list handle color as a primary consideration when buying a particular brand of toothbrush. Recycline currently manufactures the Preserve in three colors (red, green, and royal blue) and plans to introduce three additional colors (purple, periwinkle blue, and yellow).

The addition of color to the polypropylene resin takes place late in the Preserve's production process. The steps prior to the coloring process are as follows:

1. Sourcing of post-consumer plastic canisters
2. Removal of labels from canisters to prevent contamination of plastic stream
3. Grinding of plastic canisters
4. Shipment of ground canisters to compounding facility
5. Purchase of colors and shipment to molding facility
6. Compounding of plastics
7. Shipment of plastics from compounding facility to molding facility
8. Addition of color to compounded plastics at the molding facility

Recycline chose post-consumer computer chip canisters as the polypropylene feedstock for this production run of the Preserve. Computer chip canisters make an attractive feedstock because of their physical properties (i.e., natural/clear color and melt flow rate) and because they are clean and available in large quantities. The canisters were obtained from Conigliaro Industries in Framingham, Massachusetts.

While the canisters make an excellent feedstock, many are affixed with labels that would contaminate the plastic stream. Residents at Somerville's Walnut Street Center, a residential and occupational facility for the mentally impaired, were hired to remove the labels and prepare the canisters for grinding.

Following the removal of the labels, the canisters were shipped to Conigliaro where they were ground in preparation for compounding. Recycline then shipped the ground canisters to Discas, Inc. in Waterbury, Connecticut, its original compounding company. Unfortunately, for financial reasons, Discas halted the compounding aspect of its business. Discas' decision forced Recycline to ship the ground plastics to a second compounding company, Groupe Lavergne in Montreal, Canada.

After completing the compounding stage, Recycline shipped the materials from Groupe Lavergne to Bradrock Industries in Des Plaines, IL. Bradrock added color to the compounded plastics during the molding process to ensure the most efficient use of color.

Recycline's use of different grades of recycled material makes coloring a more complex process than if it used virgin polypropylene. Since different sources of polypropylene have different melt rates, Recycline must adjust the mix of its fillers to reach the desired property formulation. (A common melt rate greatly improves the injection molding manufacturing process.) Calcium carbonate, a filler used to reduce shrinkage, also acts as a natural whitener and affects the coloring process. It is necessary, therefore, to test and adjust the color ratio, percent of fillers,

and the percent of different materials used in order to produce the finished product of each color compounded material.

### **3.2 Results and Lessons Learned**

Recycline has learned three valuable lessons from the new color test:

#### ***Lesson #1: Consolidate production steps to minimize shipping costs.***

Through this test production run, Recycline discovered that a disproportionate percentage of its expenditures involved shipping. In particular, transporting the plastic canisters between Conigliaro and the Walnut Street Center cost \$250.00, while the plastic material itself (1,744 lbs.) cost only \$174.40.

On future production runs, to reduce shipping costs and use of recycled material, Recycline will have Walnut Street Center workers remove the labels at the Conigliaro facility. The cost to transport the workers is significantly less than the material transport cost.

#### ***Lesson #2: Add color during the molding step.***

On past production runs of the Preserve, Recycline added color to the ground polypropylene during the compounding step. This proved costly, as the compounding company would charge Recycline for the time it spent setting up and cleaning up each color.

Shifting the coloring process to the molding step enabled Recycline to reduce the cost of coloring significantly. Also, adding the color during the molding step enabled Recycline and Bradrock to control more effectively the amount of color used and the final color hue.

#### ***Lesson #3: Determine the ratio of color to material needed for the three new colors.***

During the molding process, Recycline and Bradrock determined the optimal ratio of color to material. For each of the three new colors, the companies determined the optimal ratio to be 1 part color to 25 parts material (1:25). This ratio took into account Recycline's addition of 10% calcium carbonate filler as well as its substitution of zinc for titanium dioxide as the whitening agent in the three colors. Titanium dioxide is a mineral sourced through an invasive mining process and, consequently, it is one that Recycline avoids using.

## **4. Development of the Children's Preserve**

### **4.1 Scope of Work**

Recycline commissioned the development of ten designs for the Children's Preserve from two autonomous design houses, Innova of York, Maine and Fred L. Hudson Industrial Design of Miami, Florida. Draft drawings were presented to more than twenty-five consumers, including children. The three most preferred designs were developed further and then produced in formal manual designs with measured specifications. The manual designs were reviewed again by groups of consumers. After this second review process, Recycline selected which designs to produce by computer aided design (CAD) and finally which ones to develop into steriolithograph prototypes. The completed prototype models will receive further consumer review.

Recycline believes that hiring autonomous design houses and the execution of a two-stage review process was critical to the development of a Children's Preserve that will be well received

in the marketplace. The two design houses delivered significantly different designs in concept and style, providing more choices than if only one design firm had been used. The two-stage review process allowed the design houses to focus their more time-consuming work on the most promising designs.

#### **4.2 Results and Lessons Learned**

Recycline now has three potential designs for the Children's Preserve. Following another review of these designs, the company will determine which designs to produce as prototypes. A steriolithographed part will allow users to test the effectiveness of the handle design and to suggest additional design changes. Slight modifications may be made to the CAD file, which will then be used to produce the Children's Preserve production mold.

The development of the Children's Preserve confirmed the merits of producing a working prototype prior to investing in production equipment, a common practice but one not always chosen by companies. The project has enabled Recycline to present the Children's Preserve to clients for their feedback, to vendors for development of packaging ideas, to consumers for suggestions and feedback, and to marketing teams for the development of brand names, collateral, and copy ideas. The combination of many unbiased ideas from the design houses and critiques from consumers has been essential to the development of a unique product.

#### **5. Conclusions**

Color testing on polypropylene resins enabled Recycline to significantly improve its material production and coloring processes. The lessons learned will also enable Recycline to streamline production and save money on future production runs using recycled materials. This financial savings, coupled with the obvious environmental advantages of buying recovered feedstocks, makes the use of recycled instead of virgin materials easier for Recycline.

Based upon initial consumer and retailer feedback to the Preserve's three new colors, Recycline anticipates increased market share for the Preserve in the natural food channel as well as increased presence in mainstream supermarket and pharmacy channels by the end of 1999. This increased market share will result in the company sourcing over 20,000 lbs. of recycled polypropylene in the upcoming year to produce the Preserve, compared to approximately 10,000 lbs. in the previous year.

Recycline is hopeful that the research and development conducted on a children's toothbrush will lead to a successful product. Recycline would like to organize additional market and consumer research efforts to understand further the interests of consumers when choosing a toothbrush for children. This research would help the company to better understand the buying criteria of shoppers and to design the Children's Preserve packaging and marketing most effectively.