CloudBlue
Environmental Solutions for Electronic Assets

Franklin W. Olin College of Engineering

Liaisons: Ken Beyer
Randy Altschuler

Advisor: Ben Linder
Students: Anna von Reden
Bennett Chabot
Hector Lefbad
Lauren Glanville
Pratik Gandhi
Vivian Lee

SCOPE
Senior Consulting Program for Engineering

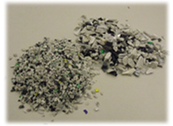
Electronics Waste Plastic Recycling

CloudBlue is an aggregator of electronic waste: they receive post-consumer electronic material, sort it, and sell it to recyclers. One of the many problems with recycling this waste is dealing with the plastic that houses most electonic products. The plastic materials found in the electronics waste stream are difficult to recycle because there are many diferent types of plastics that are all highly engineered and include many additives and coatings. Very few companies even have the capability of dealing with these plastics because of their variability. Therefore our team set out to help CloudBlue solve their plastic problem by developing a product that can be made from their mixed plastic wastestream.

Example products from the waste stream. CloudBlue receives many components such as laptops, desktops, printers, and other electronic equipment.

After dismantling, plastic components such as these are left behind. Plastic piles like these contain several differen types of plastics, but most notably HIPS, ABS, and PPE.

Our team was dedicated to exploring the characteristics of the mixed plastics in CloudBlue's waste stream, ideating products that capitalize on these characteristics, and outlining the manufacturing and financial strategies for large-scale production of one final product. The strategy throughout was to add design value by developing a repeatable shape.



Foam

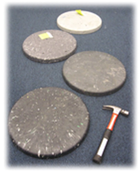
Foam was a good area of exploration; however it did not make it to the experimentation phase. This was due to the fact that there was not enough research to date into the foaming of the types of plastic in our waste stream and as a team we did not have the available resources to explore this area most suitable for plastics Ph.D's.

Fiber

Fibers were created by melting plastic and pulling it using experimental methods. The plastic was not sorted before melting or during pulling. While fibers were an important study in our project, they were not taken forward because the development time for fibrous products was longer than the sponsor desired.

These pellets were used to do much testing both in house and through external venders.Two size grinds were used as shown above.

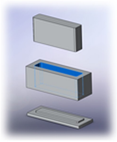
Blocks



Stepping stones were created as an example product with CloudBlue's plastic using a proprietary compression molding process by Rotational Molding of Utah.

Layering and Compression Molding

Compression molded blocks were chosen for a more in depth study because our exploration showed promise in the material and our ideation lead to viable product concepts. While contamination from the recycled materials was a main concern, initial tests suggest that this is not a huge issue. Regardless, we decided to explore processing techniques that would reduce this problem as well as other concerns such as surface finish. Layering virgin and recycled plastic in the compression molding process allowed us to create a material to resolve these issues.



SolidWorks model of the mold used to make the 1inch by 4.75 inch samples.

A sanded, finished sample.

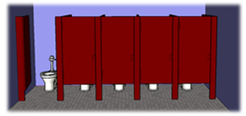
Some of our samples were water jet cut into dogbone shapes for tension test samples.

CloudBlue
Environmental Solutions for Electronic Assets

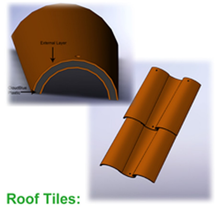
Franklin W. Olin College of Engineering

Product Concepts

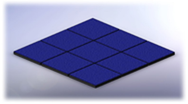
As we learned more about product applications, we discovered a large area of opportunity: building materials. There are construction standards such as LEED that encourage builders to use much recycled content. We therefore wanted to find an application in this area. Below are the three product concepts that we believe are most feasible for CloudBlue.



Bathroom Stall Partitions:
- easy manufacturing
- high volume market
- low human interaction
- controlled environment
- LEED points



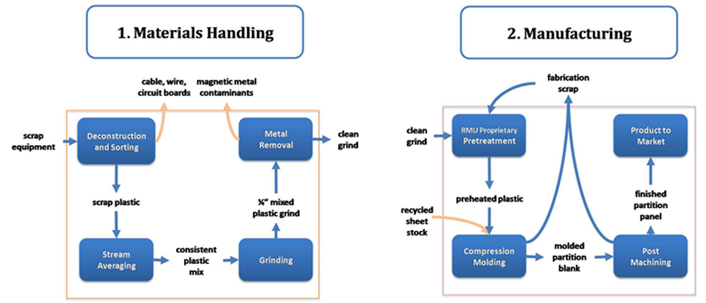
Roof Tiles:
- more complex shape
- uncontrolled environment
- low structural requirement
- no human interaction
- LEED points



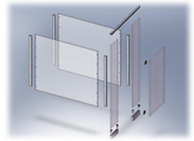
Floor Tiles:
- easy manufacturing
- higher human interaction
- only loaded in compression
- LEED points

Implementation Strategy

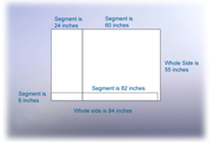
Case Study: Bathroom Stalls



In addition to ideating product concepts, we have developed stategies for the implementation of the bathroom partition product. The two diagrams above map the steps to the process. In order to develop this process we talked with many people in industry and assessed the financial viability of this product. We have established contacts with manufactures who can help CloudBlue push this product to market.



This figure shows an exploded view of the installation of a bathroom stall including necessary hardware. Notice the three panel sizes.



This figure shows one of the ways to manufacture these three panel sizes. If one large sheet is made, either a door panel and a side panel can be cut from it or nine pilasters. However, post manufacturing costs are high, so for large volumes it makes more sense to mold each panel size individually.

This project will be ongoing for CloudBlue in the next few years. Our team has developed a good starting point for CloudBlue, but there is still more research and testing that needs to be completed before the product can go to market. There are three important issues that need to be resolved by CloudBlue.

1. While we were able to create a layering process on a bench scale, this technique needs to be perfected for industrial production.
2. Initial tests showed the plastic had no leaching problems, but more comprehensive tests need to be completed to ensure product safety.
3. Due to our limited sample size, additional mechanical testing needs to be conducted to ensure product performance.