Plantee Bioplastic's *BioSwitch*

Plantee Bioplastic's *BioSwitch* thermoplastic resins are made from unique proprietary technology that coverts any commercially available bioplastic into a pH responsive plastic resin. In response to the pH, the *BioSwitch* technology changes the water uptake behaviour of the plastic. This change in water uptake translates to a change in biodegradation.

Plantee's resins can have up to 96.9% bio-based content. The bioplastics used in Plantee's formulations are USDA certified and biopreferred. The *BioSwitch* resins reduce fossil fuel-based plastic use and greenhouse gas emissions. Most importantly, their performance can match the performance of traditional plastics.

Plantee's *BioSwitch* has many properties that are desirable for manufacturing a variety of products including films and bags, injection molded parts, blow-molded bottles, and thermoformed parts. Primary applications are in fishing gear.

The Technology

Plantee's patent-pending technology features a pH-responsive biopolymer that fully degrades in marine environments within two years, and results in no microplastics at the end of its life.

The biopolymer responds to the lower pH that is present at deeper ocean depths to degrade more quickly (for when the gear is lost or discarded). Conversely, the item will last longer while in use and at more shallow depths due to the slightly higher pH of the water.

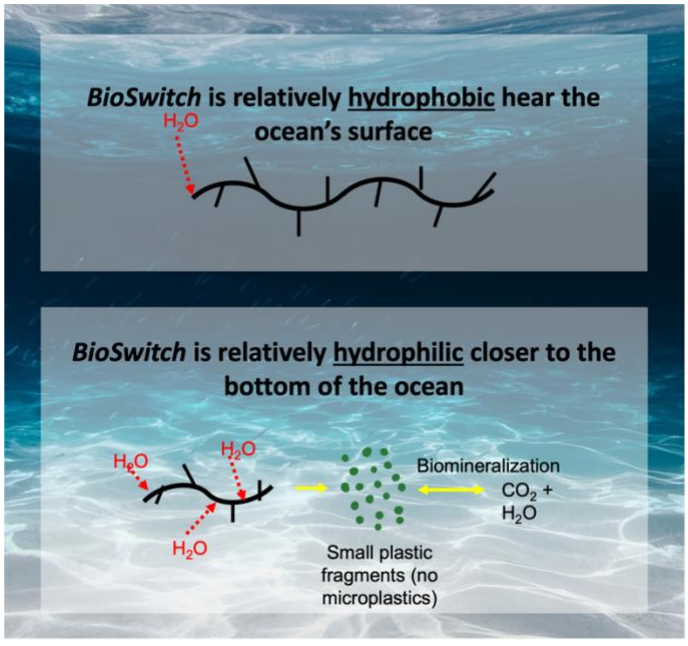
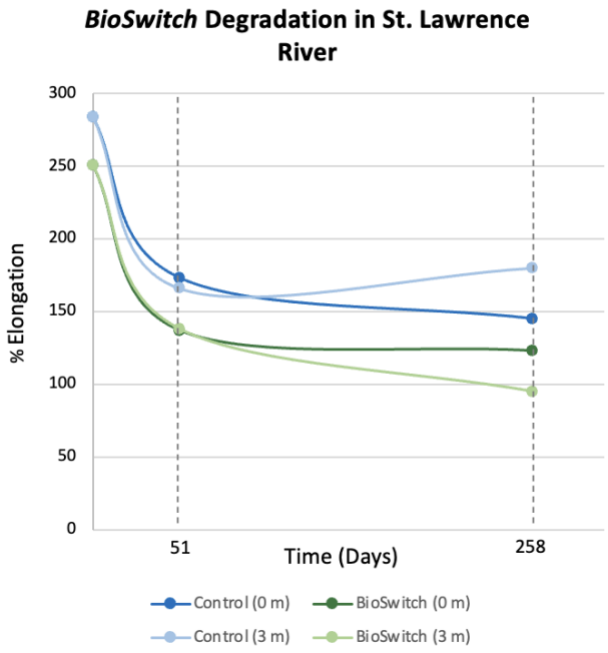


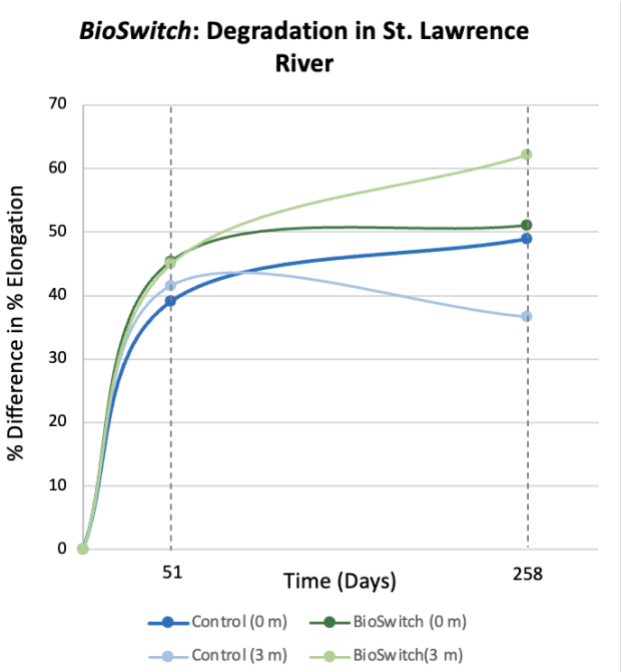
Figure 1: Image showing the difference in water uptake and degradation of BioSwitch at the surface and at deeper depths.

Field Testing Results

Field testing was performed on *BioSwitch* on the St. Lawrence River in Cornwall, Ontario. Tensile specimens were placed at depths [S-Surface (0.3 m), B-Bottom (3m)] to provide insight regarding the effects that the natural environment could have on *BioSwitch*. The test specimen was a dog bone (ASTM yyyy). The Control samples were the bioplastic blends without Plantee's proprietary pH-responsive chemical.



Graph 1: % elongation at break for control and BioSwitch specimen in St. Lawrence River after 0 days, 51 days and 258 days.



Graph 2: % difference in % elongation at break for control and BioSwitch specimen in St. Lawrence River after 0 days, 51 days and 258 days.

The pH at the time of sampling at 0.3 m depth was higher than the pH at 3m depth. This validates the theoretical data that the pH at the surface is higher than at the bottom.

We measured percent elongation overtime of the plastic as a measure of the biodegradability. The percent elongation is a measure of how much a material can be elongated at a given time. A reduction in percent elongation means that the plastic is becoming more brittle which, in our case, is mainly due to the biodegradation.

The field testing shows that both the Control and *BioSwitch* samples degrade in water over time. However, the trial samples at the 3 m mark degrade significantly faster than the *BioSwitch* samples at the surface, since the percent elongation for the samples at the bottom is lower than the ones at the surface. The same is not true for the Control samples. Hence, the difference in degradation behaviour must be due to the presence of pH-responsive ingredients.

The percent difference in percent elongation is higher for the *BioSwitch* samples compared to the control ones showing the higher degree of biodegradation at the 3 m depth. These results prove the success of our product in-field.

The samples were not tested in saltwater. However, we believe that the technology will be similarly successful in saltwater.

Figure 2: Plantee's bioplastic firm before being put in the St. Lawrence River for biodegradation testing

Figure 3: Plantee's bioplastic firm after 4 months in the St. Lawrence River. Demonstrates clear signs of degradation and tearing

Application of *BioSwitch*

Plantee's *BioSwitch* is designed to be used on standard plastics processing equipment. Processing is generally in line with existing processes but may require minor adjustments to process conditions, such as processing temperatures. Products made with *BioSwitch* are durable and shelf stable.

Our resins can be used as a "drop-in" replacement of polyethylene, polypropylene, polystyrene, etc. No special equipment is required for manufacturers to use our resins and there is no increase in labor costs. It simply works.

BioSwitch is made as pellets using a twin-screw extruder. The thermoplastic pellets can then easily be used in an injection moulder to make tags, lures, weak-links, etc. or a blown film extruded to make fish feed bags or in a melt spinner to make lines, ropes, nets or in a roto-moulder to make floaters or buoys.

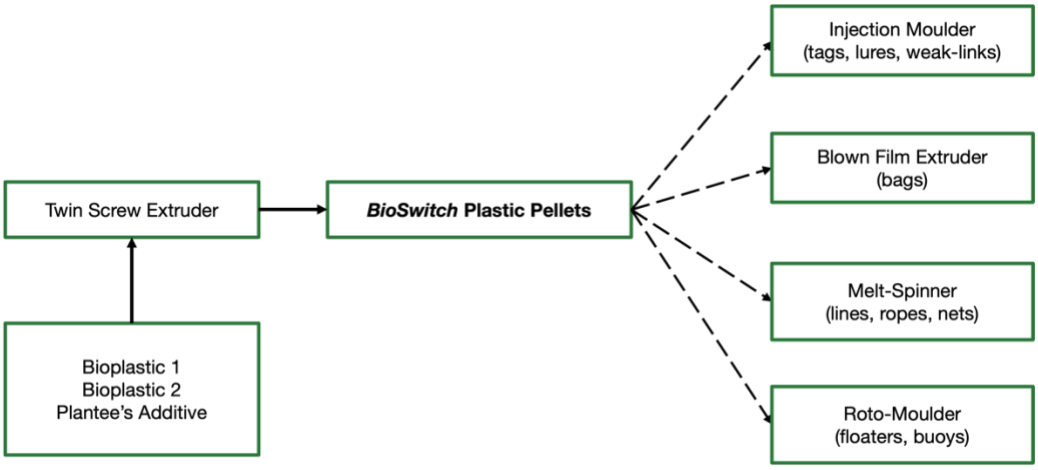


Figure 4: Application process using BioSwitch

Production of *BioSwitch*

The *BioSwitch* production process uses a blend of two bioplastics. One of these bioplastics is hard and the other is soft. Hence, the mechanical properties of *BioSwitch* can be tailored to specifications by adjusting the ratio of bioplastic 1 and bioplastic 2.

Currently we offer 3 types of *BioSwitch*: *BioSwitch Xi* is soft and is suitable to blown film applications; *BioSwitch Xii* and *Xiii* are harder plastics which are suitable for injection molding and roto-moulding applications.

We are working on a suitable plastic for melt spinning applications. We are also more than happy to work with our customers to find a custom solution that works best for them.