



BIOSCRUB[®]

Technical Review

INTRODUCTION

Bioscrub products are naturally derived high molecular weight powders based on polyhydroxybutyrate (PHB). PHB is a biopolymer produced from renewable resources via the sustainable bio-fermentation of sugars. PHB is Readily Biodegradable under OECD test standards for marine and freshwater environments. PHB is hydrolytically stable and will not affect formulation pH. Bioscrub grades are designed for use as non-irritating scrub and exfoliating agents, providing the same effectiveness of polyethylene microbead plastic exfoliants. Independent blind consumer panel testing has confirmed that Bioscrub provides a similar level of exfoliation when compared with traditional polyethylene microplastic beads. These products are covered by one or more patent claims that have been allowed by the United States Patent and Trademark Office.

WHAT IS PHB?

Polyhydroxybutyrate (PHB) belongs to a group of polyesters known as polyhydroxyalkanoates (PHA). PHA's are produced by direct bacterial fermentation of glucose and sugar-containing substances such as molasses, lactose, cellulose or starch. Other sources such as alcohols, alkanes and vegetable oils are also suitable nutrient sources. The bacteria typically eat the sugar source and then produce the PHA directly in their cells. The PHA is extracted, harvested and purified and the biodegradable plastic is made into pellets. The materials derived from this process are a sustainable alternative to petrochemical-derived products. PHB is a homopolymer and is the most prominent of the PHA biopolymer family.

Micro Powders' Bioscrubs use a source of PHB that provides the following advantages:

- No genetically modified bacteria are used in the fermentation process
- All dextrose is from non-GMO sources
- Exclusive patented extraction technology: water-based, no solvent or enzyme used which results in low odor when compared to other available PHB polymers
- Smaller carbon footprint: lower energy consumption due to the use of a natural strain which allows for fermentation at low temperatures

PHB BIODEGRADABILITY

Regulatory standards from ASTM and OECD are the most widely accepted biodegradability guidelines. PHB is recognized as biodegradable in the following environments:

- **Aerobic Industrial Composting**

ASTM D6400: Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities

- **Soil**

ASTM D5988: Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials in Soil

- **Fresh Water**

OECD 301: Ready Biodegradability (aqueous anaerobic)

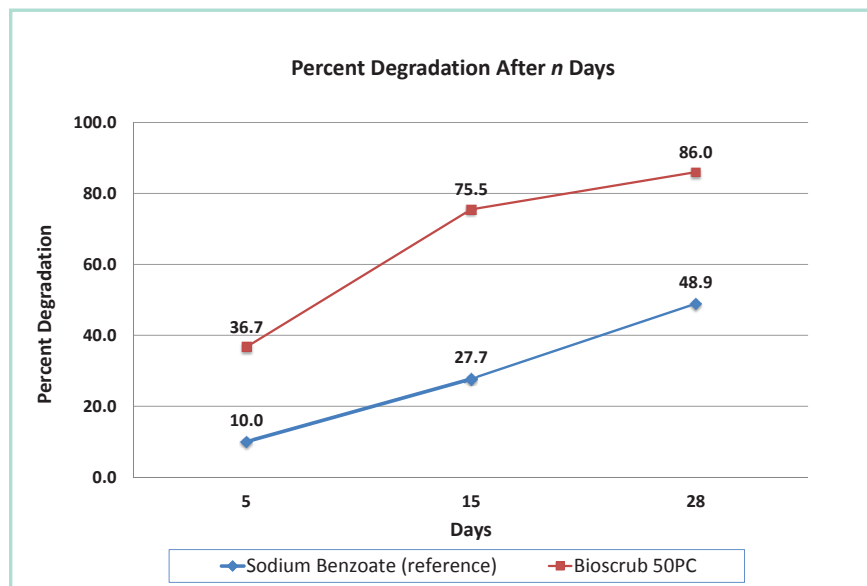
- **Salt Water**

OECD 306: Biodegradability in Seawater

ASTM D7081: Standard Specification for Non-Floating Biodegradable Plastics in the Marine Environment

Bioscrub 50PC was tested for biodegradability in seawater using OECD Method 306 (closed bottle method). The following results were obtained:

	DO Depletion after <i>n</i> days		
%	5	15	28
Degradation	36.7 %	75.5 %	86.0 %



The above results indicate that Bioscrub is biodegradable per OECD 306, with biodegradation reaching 86%, surpassing the 60% Theoretical Oxygen Demand (ThOD) required to assume a potential biodegradation in seawater.

A copy of the full report is available on request.

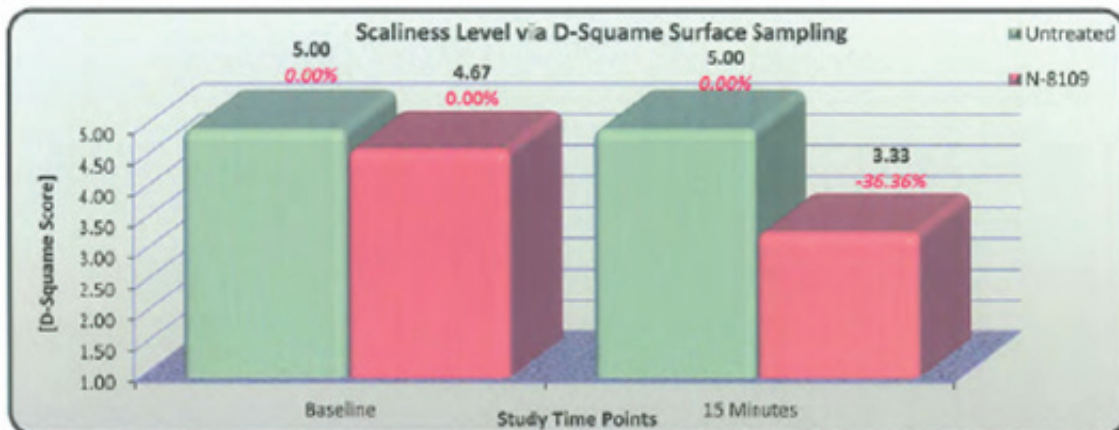
BIOSCRUB PERFORMANCE

This study demonstrates the efficacy of Bioscrub 20PC. A double blind study was performed by AMA Laboratories using a topically applied test material containing Bioscrub 20PC which was intended to reduce the scaliness level associated with dry and flaky skin. D-SQUAME skin sampling discs were used to sample and measure the amount of exfoliation by observing the scaliness level before and after treatment. These adhesive discs take the trial and error out of sampling the cells of the superficial stratum corneum (top layer of skin). The crystal clear discs provide the required rigidity and adhesion to uniformly sample a fixed area of skin surface. The clear polymer discs provide optimum visibility of adhering skin cells and allow staining by many histological preparations. D-SQUAME disc is applied to clean, dry skin surface. It is pressed firmly for a few seconds using thumb or fingertips, and then transferred to a black square on the storage card where it is compared with reference patterns. Heavy amount of scaling represents pattern 5. Normal skin, producing a few areas of small clumps of cells or a fine even single layer of cells, represents pattern 1.



The following results were obtained:

Scaliness Level via D-Squame Surface Sampling						
AMA Lab No.:	Client No.:					
N-8109	Bioscrub 20PC 7%					
Panelist ID No.:	Untreated			N-8109		
	Baseline	15 Minutes	Individual % Difference	Baseline	15 Minutes	Individual % Difference
46 4620	5	5	0.00%	5	3	-50.00%
79 7520	5	5	0.00%	5	4	-25.00%
50 2051	5	5	0.00%	4	3	-33.33%
Average:	5.00	5.00		4.67	3.33	
% Difference		0.00%			-36.36%	



Bioscrub Typical Properties

PROPERTIES	TEST METHOD	BIOSCRUB 20PC	BIOSCRUB 50PC
Composition (INCI Name)	IR	Polyhydroxybutyrate	Polyhydroxybutyrate
CAS No(s).		26744-04-7	26744-04-7
EINECS No(s).		210-909-6	210-909-6
Appearance	Visual	Light Tan Powder	Light Tan Powder
Melting Point (°C)	ASTM D 3418	162-172	162-172
Density @25°C (g/cc)	ASTM D 792	1.4	1.4
Particle Size Analysis (Microtrac)	ASTM D 4464		
Mesh Size - Maximum		20	50
Maximum Particle Size (microns)		840	297

Applications: face, body, foot and bath scrubs, creams and lotions, bar and liquid soaps



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