

# Minerv-Pha<sup>TM</sup>

Bio-on S.p.A.

[www.bio-on.it](http://www.bio-on.it)



**NATURALS**  
Derived from  
Microorganism

## MATERIAL FEATURES AND COMPOSITION

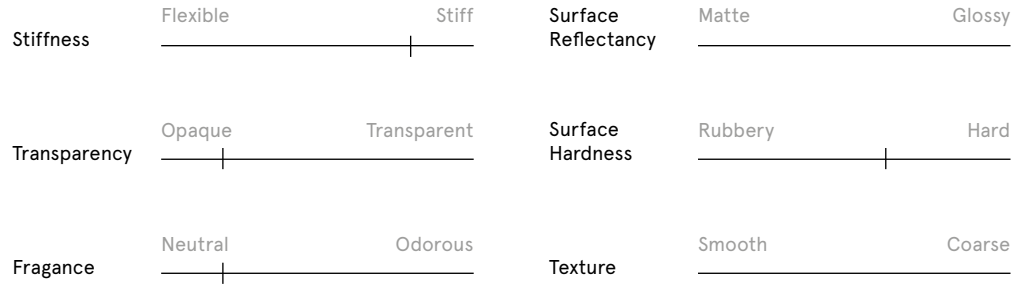
A biopolymer made of polyhydroxyalkanoate (PHA), a linear polyester produced through the microbial fermentation of sugars beets, which is naturally biodegradable in soil and water.

## AVAILABILITY

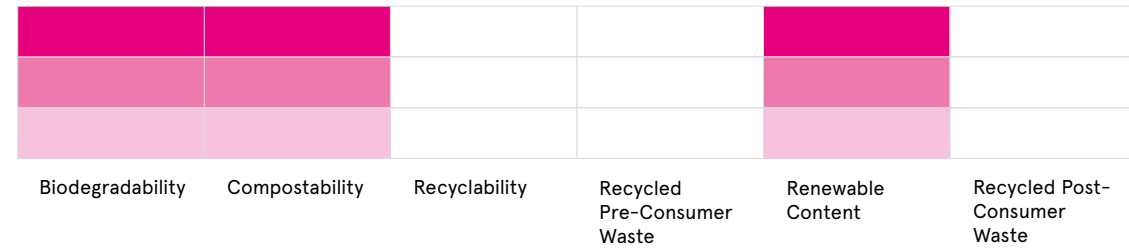
TRL 8 - System complete and qualified  
Commercially available in small amount

TRL8

## PHYSICAL QUALITIES

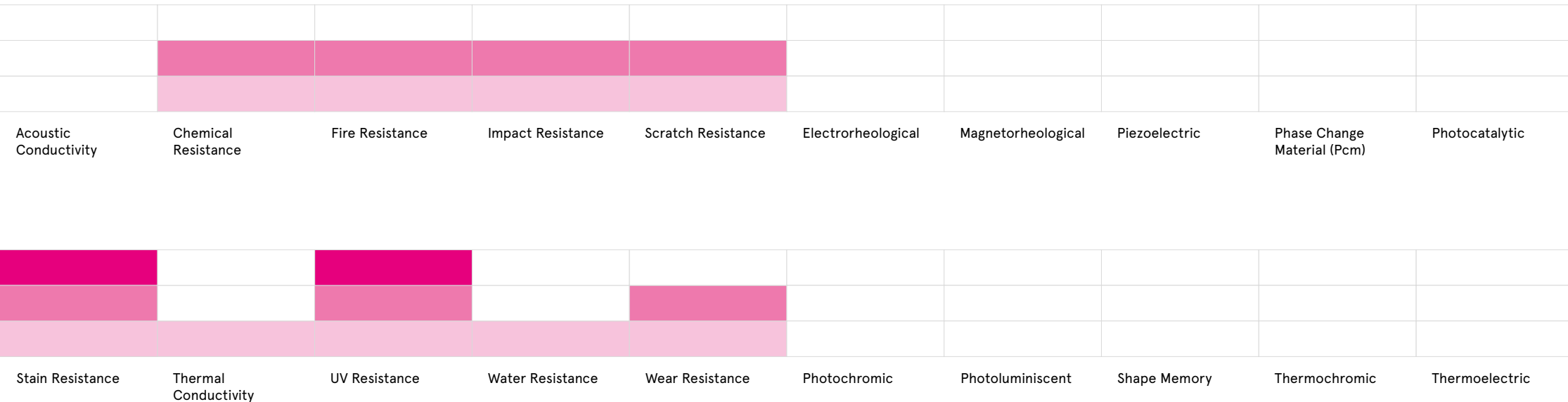


## SUSTAINABILITY PROPERTIES\*



## PERFORMANCE PROPERTIES

## SMART PROPERTIES\*



## UNDERSTANDING

\*Please see the Glossary at the end of this booklet for more explanation on the terminology.

## CERTIFICATES & TESTS

- "OK Biodegradable Water" certification by Vincotte, confirms the complete biodegradability of MinervPHA in water at ambient temperature. - "BIOBASED PRODUCT" label and certification assigned to Bio-on's MinervPHA by the United States Department of Agriculture (USDA). All information has been provided by the companies and/or material suppliers that delivered the EM&Ts samples.

## SUPPLY

Raw Material

Processed Material

System / Product

## SHAPE



Pellet

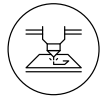
## MANUFACTURING PROCESSES

Polyhydroxyalkanoate (PHA) is a product of energy storage techniques in certain microbes after being 'fed' sugars, in this case from sugar beets or sugar cane. To induce polymer production the microorganisms are stressed, through the lack of certain elements in the system or the excess of carbon in the system. The microorganisms produce PHA granules in their bodies for energy storage; this can be up to 80% of their body weight. After the PHA is produced the microbial cells are ruptured and the PHA is extracted. The material is offered in pellets for further processing with injection or extrusion techniques.

## TRANSFORMATION PROCESSES



Additive Manufacturing



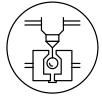
Die Cutting



Lamination



Textile Processing



Blow Molding



Extrusion



Metal Working Tools



Thermoforming  
Compression Molding



Casting



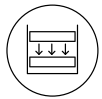
Injection Molding



Printing



Welding



Cold Pressing /  
Deep Drawing



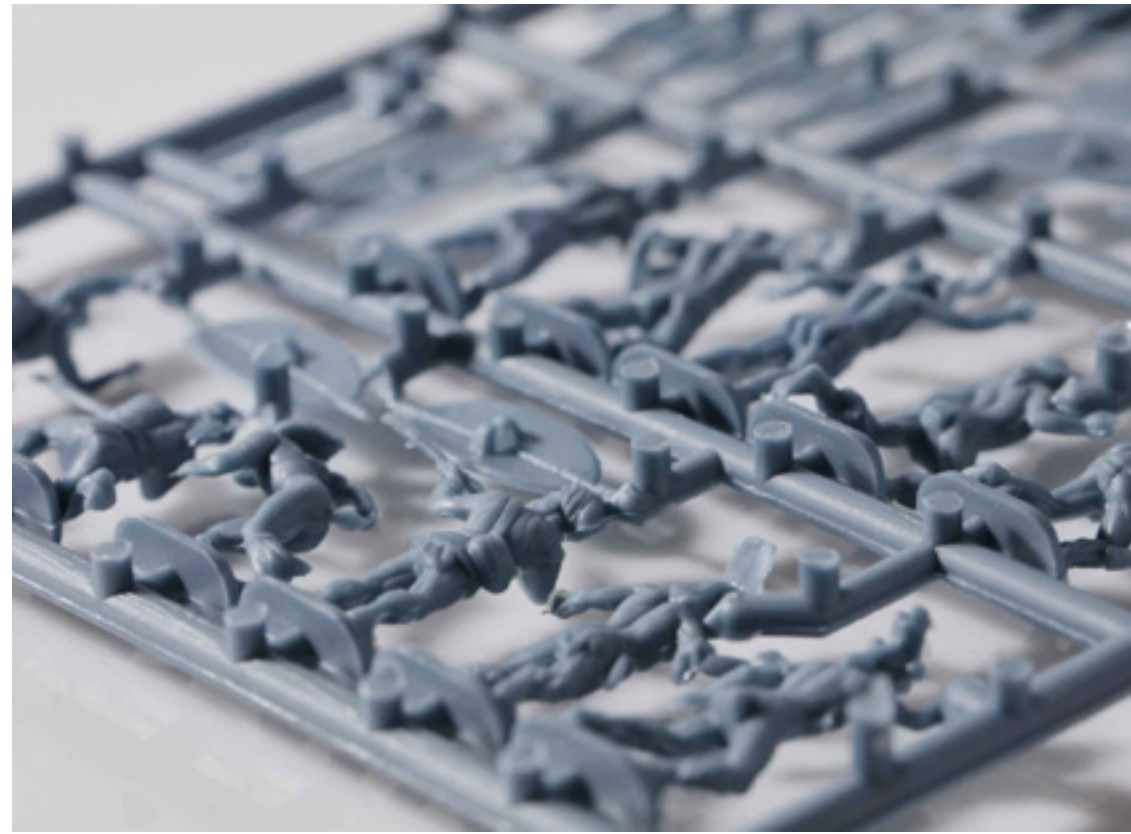
Lab Growing



Rotomolding



Wood Working Tools



## SHAPING

## APPLICATION FIELDS

Potential applications are for packaging, bags, containers, housewares, lighting, textiles, vehicle parts and electronics.



## CASE STUDY

The Minerv PHA Supertoys project, launched by Bio-on, has no commercial goal and aims solely to demonstrate whether or not specific, eco-sustainable and completely biodegradable formulations can be created for making toys that are safe for children and the environment, without losing out on the end product's functionality and aesthetic.

## COMPARISON & INNOVATION

It is similar to other bio-based polymers like PLA, having better and shorter biodegradability in natural waters and a wider range of productive temperatures.



## APPLYING

## SUSTAINABILITY PROPERTIES

### Biodegradability

Ability to be broken down into carbon dioxide, water, and biomass by the natural action of microorganisms (aerobic and/or anaerobic). It is misleading to merely claim biodegradability without any standard specification. If a material or product is advertised to be biodegradable, further information about the timeframe, the level of biodegradation, and the required surrounding conditions should be provided, too.

### Composting

Ability to go through the process by which materials biodegrade through the action of naturally occurring microorganisms and do so to a large extent within a specified timeframe. The associated biological processes will yield CO<sub>2</sub>, water, inorganic compounds, and biomass which leaves no visible contaminants or toxic residues. The products can be classified in "Home compostable" or "Industrial compostable", having each of them specific temperatures, conditions and timeframes defined by international regulations.

### Recyclability

The capacity of a product to be reduced all the way back to its basic materials, reprocessing those materials, and using them to make new products, components or materials. Recycling refers to materials that are processed in practice (as opposed to materials for which recycling is technically feasible), this varies from one region to the other invoking the regulations and technologies of each country.

### Recycled pre-consumer waste

Pre-consumer waste refers to waste produced by manufacturers or industries before released for consumer use. Pre-consumer waste refers also to the reintroduction of manufacturing discards back into the manufacturing process, in this case it is often not considered "recycling" in the traditional sense. Pre-consumer waste is produced in large quantities, while this is easier to collect and sort, high amounts of pre-consumer waste are non-recovered.

### Renewable content

Materials that are replenished at a rate equal to or greater than the rate of depletion and must be produced using regenerative practices or, in a transition phase, using sustainable practices.

### Recycled post-consumer waste

Post-consumer waste is the waste produced at the end of a consumer-product lifecycle. Post-consumer waste has served its intended purpose, passed through the hands of a final consumer, and has been discarded for disposal or recovery. It usually refers to the household waste we generate every day, and does not include manufacturing or converting wastes. Depending on the type of waste, governmental legislation and the action taken by the consumer, post-consumer waste is recycled, sent to landfill or incinerated.

## SMART PROPERTIES

### Electrorheological

Change in the rheological properties (viscosity and viscoelasticity) of a material caused by an electrical stimulus.

### Magnetorheological

Change in rheological properties (viscosity and viscoelasticity) of a material caused by a magnetic field.

### Piezoelectric

Phenomenon exhibited by certain materials, which when applying mechanical stress, generate electrical energy. The effect can also be inverse, that is, they can present small deformations when an electrical current is applied.

### Phase Change Material (PCM)

Materials considered latent heat storage units: They are capable of absorbing or releasing a large amount of thermal energy when they undergo a phase change (from solid to liquid, from liquid to gas, or vice versa).

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## GLOSSARY

### Photocatalytic

A substance that increases the speed of a chemical reaction by the effect of light or other forms of radiant energy.

### Photochromic

Reversible color change induced by the indication of sunlight or UV. The color disappears when the fountain ceases.

### Photoluminiscent

Is the emission of cold light caused by the absorption of electromagnetic radiation (visible light, UV, X and cathode rays). There are two types of luminescence: fluorescence (emits light only during absorption of radiation) and phosphorescence (stores absorbed radiation, so that it continues to emit light for a time after the stimulus subsides).

### Shape Memory

The material with this property recovers its initial shape after being permanently deformed (plastically) when heated above a characteristic transition temperature of the material. In addition, while regaining its form, in some cases it is able to perform work. The characteristics of these materials, depending on the temperature, contemplate superelasticity (which grants large elastic deformations in a specific range of temperatures), simple shape memory effect (in which the material

remembers a single shape, when heated) and which can be educated to achieve a double shape memory effect (in which the material memorises two shapes in a hot and cold state).

### Thermochromic

Reversible or irreversible color change induced by temperature changes.

### Thermoelectric

Property that supposes a change of voltage in response to a variation of temperature and vice versa.

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## ADVANCED GROWING EM&TS

The EM&T sample described on this datasheet is one of the materials from a controlled cultivation of organisms (bacteria, yeast, algae, mycelium, etc.) that are directly grown and/or manufactured into their subsequent form, function and performance by tapping into the organisms natural growth behaviour (bio-fabrication). SELF-HEALING EMTs: Material capable to repair damages occurring within 'themselves', in part or whole.