GRUPPO MAIP

GREENHOPE

GREEN POLYMERS

i)amNature®

THE FIRST BIO TECHNOPOLYMER
- WINNER OF THE BIOPLASTICS AWARD 2017 -

GREEN POLYMERS

BIO PLASTICS, as stated by European Bioplastics, is a term to describe two types of plastic that are completely different from each other:

a) Plastics based on renewable sources (the focus is the origin of the material being used)
b) Bio-degradable and compostable plastics in compliance with EN 13432 or ASTM D 6400 or similar standards (the focus is the compostability of the final product)

Then we can supply 3 families of materials:

BIOS	From renewable sources, partially or entirely, and **BIODEGRADABLE**
KIOS	From renewable sources, partially or entirely, but **NON-BIODEGRADABLE**
ORIOS	From fossil resources, but **BIODEGRADABLE**

REQUIREMENTS FOR COMPOSTABILITY

Materials can be defined compostable, in compliance with the European norm EN 13432, if they meet the following requirements:

Chemical properties
Minimum 50% content of solid volatile substances (organic material)
Very limited presence of metals and other toxic and dangerous metals, reported in a separate table.

Biodegradability
It must be determined for each significant constituent (>1%)
The test can be carried out for maximum 6 months.
The percentage of biodegradability must be at least 90%.

Disintegratability
Specimens of the test material are composted with biowaste.
The final compost is then screened with a 2 mm sieve.
The mass of test material residues with dimensions > 2 mm shall be less than 10% of the original mass

Ecotoxic effect evaluation
The percentage of germination of higher plants, on the compost obtained after disintegration of the specimen, must be 90% higher than those germinated using a reference compost.

BIOS FAMILY

Although we were producing compounds in the various families listed above, we have mainly focused on BIOS family that divides in several under families. The most important ones are:

BIOS B1 and B2:
Polymers produced by means of the classic chemical synthesis of polylactic acid PLA (polyester polymerized by lactic acid), using monomers from renewable sources.

BIOS B3:
Polymers directly coming/removed by biomass.They differ for source and restructuring process (from starch,from corn scraps,from potato skin),from cereals without prior extraction of the starch and so on.

BIOS B5/B6:
Polymers produced by microorganism or bacteria that are genetically modified. Up to today, this group of bio based polymers are mainly composed by polyhydroxyalkanoates (PHA,PHB, linear polyesters naturally produced by the bacteria fermentation of sugar or lipid).

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Starting from these evaluations, besides the families Bios, Kios and Orios,
we have created this special family of products.

iamNature®

THE REVOLUTIONARY BIO-PLASTIC

Formulations
Neat resin
Biobased
Biodegradable
For semidurable products
Compostable
No toxic
Properties
ABB Case history
Bioplastics Award

1 Formulations

IamNature® is a compound made of one or more polymers of BIOS family, all of them strictly coming from renewable sources (bio-polymers).

The basic polymer is a polyhydroxyalkanoate that can be used as it is or blended with other bio-based products such as PLA or with other biodegradable materials such as PBS, PBSA, PBAT, and others.
To these blends, we add mineral fillers, with water-repellent properties or vegetal fibers, natural based colours and all a series of vegetal based additives that are normally used for the cosmetic market. Practically, all chemical synthesis products are completely eliminated.

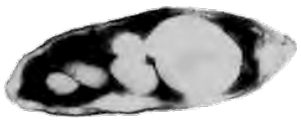
IamNature®
is NATURAL

All formulations have this composition:

BIOPOLYMER
VEGETAL ADDITIVES
MINERAL FILLERS
NATURAL COLOURS

2 Neat resin

The main basic polymer comes from the fermentation of some bacteria.
There are a variety of studies in literature focused on over 50 types of different bacteria.
The bacterium chosen for **IamNature®** produces a special grade of polyhydroxyalkanoate which has the specific property of biodegrade either in aerobic and in anaerobic conditions.
The bacterial culture gets quickly multiplied with appropriate nourishment and this creates macromolecules that bacteria accumulate as a backup carbon source, becoming a sort of 'inner fat' of the bacterium (white part of the photo).

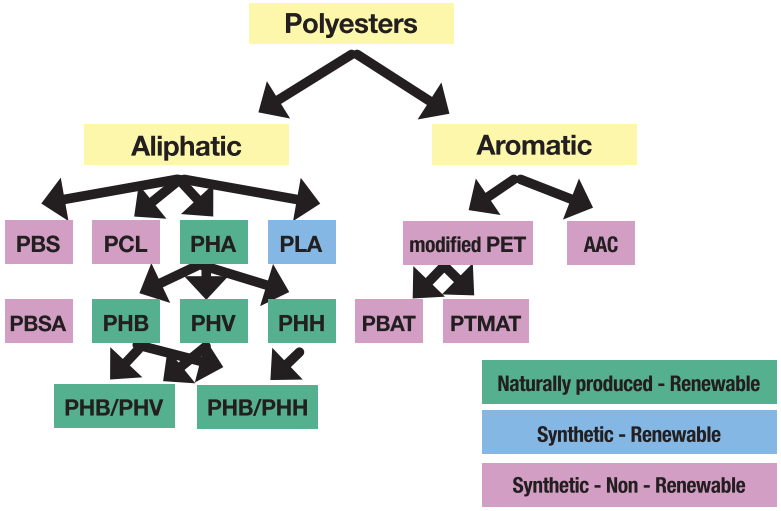


Once the bacterial population has reached a good biomass, the composition of the nourishment changes so that the microorganism can synthetize and accumulate PHA.
This synthesised fat is a real polyester that gets extracted and represents the basic polymer of the compounds

Polyesters

All these polymers are part of the polyester family that includes:

- products of natural origin and by renewable sources
- synthetic products but by renewable sources
- oil based synthetic products but biodegradable



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How to define a Biobased Carbon Content?

ASTM 6866

ASTM 6866 determines the carbon content from renewable source, using the radiocarbon analysis, the ratio is the following:

$$\frac{\%\ \text{“New Carbon”}}{(\%\ \text{“New Carbon”} + \%\ \text{“Old Carbon”})}$$

The higher the ratio, the more the material is bio-based.
Standard chemical polymers (ABS, PP and so on) have a value = 0
Some polyamides, polyurethane or also other bio-polymers have values between roughly 40 and 90.

Old carbon:the carbon of fossil origin that comes from oil, natural gas and carbon.
New carbon: The carbon coming from renewable resources, in the organic materials where the carbon is linked to other atoms of carbon, hydrogen, oxygen or other elements.

IamNature® can go up to 100

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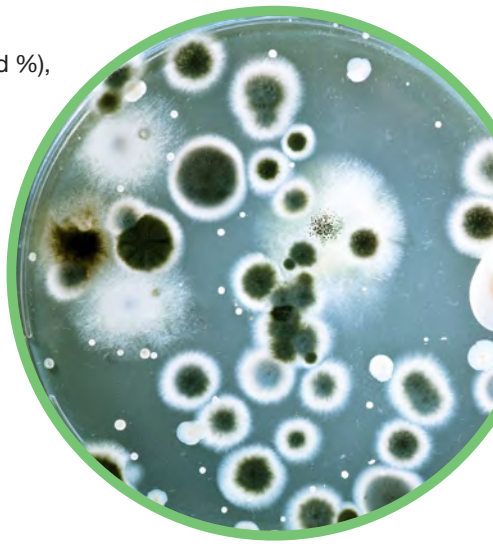
Ok biobased!

In view of a sustainable development, many Companies are looking for alternative materials to avoid using fossil raw materials.
As a consequence of the higher environmental awareness among the customers, there is a growing market of products that come from renewable sources. The continuous urgent demand of sustainable raw materials has caused the need of a certification body that guarantees the actual quality of the renewability of the materials.
The “ok biobased” certification by TuV Austria is fully meeting this request.
The survey method behind this “Ok biobased” certification is very simple and the exact value can be measured and calculated in a very precise and scientific way.
This makes all checks and controls very transparent.
Depending on the percentage of renewable raw material content (bio-based %), the material can be classified as bio in class 1-2-3-4.

OK biobased — TÜV AUSTRIA ★★★★ S0679



IamNature® is classified 4, which means with a biocarbon content between 80 and 100%.

The ‘Ok Biobased’ certification has been approved by the Certification Committee with licence code No. S679

PARAMETERS	BLH 50 B104	BLH 180 A20	BLH 180 AW20
Biobased Carbon Content (BCC)	100 %	100 %	96 %
Total Organic Carbon Fraction (TOC)	50 %	47 %	49 %
Assigned to class (number of stars)	4	4	4

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IamNature® is biodegradable

Every polymer degrades to some extent on a certain time-scale depending on environmental conditions. In biodegradable polymers chain scission is caused by cell (human, animal, fungi, etc.) activity, thus it is an enzymatic process, although it is usually accompanied and promoted by physicochemical phenomena as well. The two types of processes, i.e. physical and enzymatic, cannot be distinguished and/or separated in general, their combined effect leads to the complete degradation of the polymer (CEN/TR 15932:2010).
The laboratory evaluation and testing of the biodegradability of polymeric materials is well defined in European standards (EN ISO 14851:2004, EN ISO 14852:2004, EN ISO 17556:2004, EN ISO 14855-1:2007/AC:2009, EN ISO 14855-2:2009).

The tests are based either on the measurement of oxygen demand or on the amount of carbon dioxide evolved in the process.IamNature gives 100% of conversion rate to $C0_2$ in most part of formulations.

IamNature® is intelligent too!

As a matter of fact, it is degradable like an ultimate natural material: the wood.
Like wood, it can ben used for years and years,but, in some conditions, it starts rotting and degrading, creating a biologic cycle.

For years, the study in the biopolymer world has been focusing on the shelf life a finished part and by consequence on the biodegradability of the material.

Today, the research of biopolymers is focusing more and more towards technical solutions that might combine the renewable source to the durability of the material and to its compostability.Sustainable material alternatives that can replace the traditional ones, above all for applications that are more technical and lasting.

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IamNature® is born for the production of durable and semi-durable goods

incredible soft-touch effect with specific embossed mould

Games
Household/crockery, pottery
Office
Gardening accessories
Brushes/handles
Food&beverage

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IamNature® is compostable

IamNature® is now available in more than hundreds formulations. Some time ago we decided to chose one that was proved to show good results in marine degradation and we started preliminary tests on the degree of disintegration under simulated composting conditions in a laboratory scale test.
We chose the test method ISO 20200:2015 to determinate the degree of disintegration.

DISINTEGRATION IN A LABORATORY

Principle of the assessment

The purpose of this test is to evaluate the disintegration of the sample in a laboratory-scale test in a composting bin in the presence of a freshly prepared synthetic waste according to the standard. The composting process is monitored regularly and conducted until the compost is fully stabilized (3 months). At the end of the process the compost is sieved and the disintegration of the sample is carefully measured.
Based on these first excellent results made on thin components, we have therefore decided to run the disintegration tests at higher thickness and precisely at 1, 2 and 3mm. Moreover we decided to test 3 different formulations, one of which also in colored version in white:
IamNATURE AH12 AC80 - IamNATURE AH150 AW 40G1 - IamNATURE BLH180 A20Z2

Biowaste after 84 days

Disintegration of the sample specimens after 84 days

Disintegration of the sample after 12 weeks

End of the test (12 weeks), compost obtained from the sieving by different sieves.

The complete disintegration took place in 12 weeks The aspect of the black and of the waste with IamNature® is identical at the end of the test.

TEST RESULTS

When the disintegration limit required is 90%, we obtained the excellent result of 100% of disintegration at a thickness of 1 mm and abt 92-98% until 3 mm.These extraordinary results mean that the various formulations of IamNature® are good for injection moulding or extrusion also at high thicknesses, i.e. those normally used for the production of durable and semi-durable goods.

N	Sample	Thickness	Disintegration (%)	Disintegration limit required (%)
1	AH150AW40 G1	1mm	**100**	≥90
2	AH150AW40 G1	2mm	97,12	
3	AH150AW40 G1	3mm	91,08	
4	AH12 AC80	1mm	**100**	
5	AH12 AC80	2mm	97,66	
6	AH12 AC80	3mm	93,01	
7	BLH 180A20	1mm	**100**	
8	BLH 180A20	2mm	94,57	
9	BLH 180A20	3mm	92,25	

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IamNature® is absolutely no toxic

Of course the law requires that the compost obtained after disintegration cannot be the source of toxicological problems, therefore the germination index of standard higher plants, with compost obtained after disintegration test, must be 90% higher than the one of those germinated using the reference compost.

ECOTOXIC EFFECT EVALUATION OF HIGHER PLANTS OF THE COMPOST RESULTING FROM THE DISINTEGRATION TEST.

The test was conducted according to EN 13432:2000 Annex E "Determination of ecotoxic effects to higher plants" on the compost obtained from the disintegration test carried out according to ISO

Seeds used far ecotoxic test.

Plant	Brand	Lot N.	Germination index (%)
Mung bean (Vigna radiata)	Marca Bavicchi, linea GEO	161411	97
Barley (Hordeum vulgare)	Marca Bavicchi, linea GEO	161462	95

TEST RESULTS

Ecotoxicity test validity

Requirements	YES	NO
Seed germination capacity > 70%	X	
No visible signs of phytotoxic effects (chlorosis, necrosis, leaf deformation; etc.) and morphological variations of the plant species characteristics.	X	
Ave rage number of germinateci seeds on the growth contro l pots > 90%.	X	
Are requirements respected?	X	

Percentage of germination and growth on the Sample Compost with respect the values obtained with the Reference Compost.

Compost concentration	BARLEY		MUNG BEAN	
Compost concentration	% Germination	% Growth	% Germination	% Growth
25%	102.1	106.2	98.6	103.9
50%	102.6	101.7	98.0	100.5

SUMMARY AND CONCLUSIONS OF ECOTOXIC TEST

The compost obtained from the disintegration test in the presence of the sample in AH12AC80 has not determined an inhibiting effect on either the germination or growth of both plants analysed at the different tested compost concentrations.

The growth of the plants is therefore optimal.

Start of the Ecotoxicity test

End of the Ecotoxicity test

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9 Properties

THE ELASTIC MODULUS

The elastic modulus can go from 900 MPa to over 5000 MPa, with elongation at break from about 2% to 20% and a density that can go from 1,20 to 1,50 g/cm3.

Specific formulations have been studied to meet particular requests of the customers, such as higher UV resistance, higher resilience, water resistance etc. In particolar, we have studied some specific grades with higher scratch resistance, combined with very good tactile experience.

THE THERMAL RESISTANCE

All grades show an excellent thermal resistance that, during the VIcat test at 1Kg, lead to values between 100 and 130°C, among the highest you can get with Bio-polymers.
Therefore they can be used for repeated cycles in the dish washer.

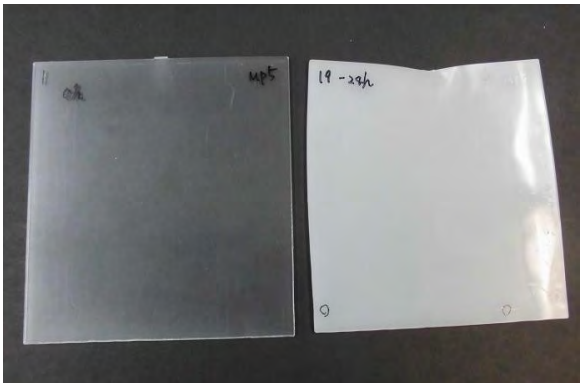
DENSITY

The material shows a high density due to the natural filler that gives dimensional stability, surface hardness (abrasion resistance) and water repellent properties to the surface of the moulded parts.

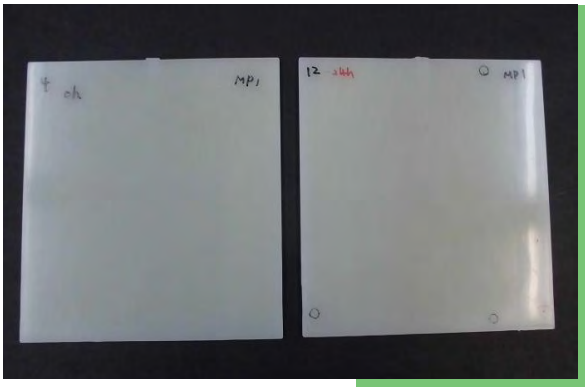
SHRINKAGE

The product has an isotropic behaviour and a shrinkage that is similar to the one of amorphous materials. therefore you can use the standard tools for PS and ABS moulding, with no particular constraint for the moulding.
Also the post shrinkage, in case of thermal ageing tests at high temperatures, shows very limited figures of warpage up to 110°C.

Shrinkage of PLA compound after annealing at 70°C



Shrinkage of IamNature® after annealing at 70°C



GLOW WIRE RESISTANCE

The compound passed Glow wire test at 650°C at 2 mm.

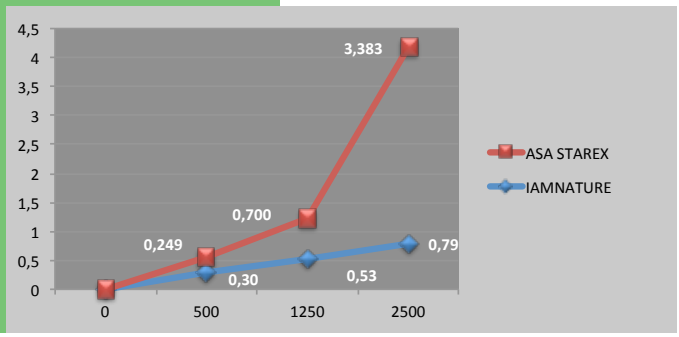
NO MORE PAINTING NEEDED

Also the painting method preserves the eco-sustainability of the product: the dyes are added in very low percentage during the moulding process, avoiding any superficial coating.

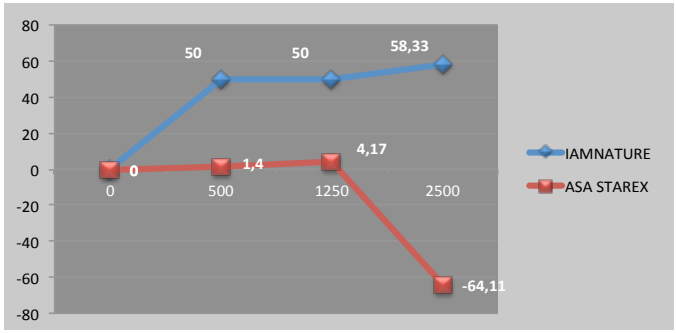
UV RESISTANCE

Besides the standard Xenotest in use for the electric market, the material has been tested with the most severe and common test of the automotive market, i.e. SAE J 2527.
The test is considered successful if after 2500 KJ/m2 of irradiation in several climate conditions, the change in the colour is below 3 and the gloss change is below 50%.

The material showed higher UV resistance compared not just to ABS, which was obvious, but even to ASA, that is the preferential material for the automotive market for outdoor applications thanks to its resistance properties, as showed in the chart hereunder.



ΔE - Color variation, before and after UV test



GLOSS measurement - Analisi comparativa

CHRYSLER EXTERIOR ACCELERATED WEATHERING - Document n.° MS-JP-9-5; SAE J2527 Q/B 2500KJ=1894h (1894h:24h= 78,9gg)(2500kj:78,9gg= 31,6 kj al giorno)

Test Conditions			COLORIMETRIC LECTURES										GLOSS		
			NEW			AFTER			D				NEW	AFT.	D
TRADE NAME	COLOUR EMBOSSED	ENERGY OR TEST TIME DEMANDED	l	a	b	l	a	b	DL	DA	DB	DE			
IamNature BLH180AW10 ZM5	BLACK 303N	reference	24,55	0,3	0,67								6		
		379 h	24,58	0,31	0,71	25,00	0,29	0,62	0,42	-0,02	-0,09	0,43	6	9	50%
		947 h	24,29	0,31	0,67	24,62	0,28	0,54	0,33	-0,03	-0,13	0,36	6	8	33%
		1894 h	24,64	0,27	0,7	25,43	0,29	0,68	0,79	0,02	-0,02	0,79	6	9,5	50%

PROCESS CONDITIONS

The fluidity of the material is always high in order to allow the moulding of thin walls, also in multi cavity moulds.
We have been able to easily fill the 36 cavities mould of a pen body with 3 micro pin point gates.
The pen has a wall thickness below one millimetre and path length higher than 400mm!

THE MATERIAL IS VERY FLUID!

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Case History
Development of ABB's switch cover

ABB, leading Company in the technologies for energy and automation, has developed a project for a series of switch cover frame, showing an advanced design and an evident environment sustainability connotation.

That's why they decided to look for a bioplastic with particular properties that could replace the thermoplastics that are normally used for this application, such as ABS or PC ABS.

The PHB-based bio-technopolymer IamNature®, available with different formulations with natural additives and reinforcements, stood out for its dimensional stability, high temperature (up to 130°C), light and UV resistance.

A HIGHLY TECHNICAL PROFILE

ABB was looking for a material with the capacity of combining many properties, amongst which a considerable dimensional stability, as well as mechanical strength, thermal, light and UV ray resistance, colour stability, hardness, processing ease in multi-cavity molds, industrial molding cycles and the possibility of such a highly precise surface texture reproduction as to make it possible to avoid painting.

So that the development and formulation stage has required a close and ongoing collaboration between ABB and Maip, which has involved about two years of work, and the formulation of over 150 compounds, each being subjected to prior testing and inspection by Maip the addition of specific additives and fillers has allowed Maip to develop a grade with a isotropic shrinkage value similar to an amorphous engineering plastic such as ABS, that means equal to 0.6% on a thickness of approximately 2 millimetres, and with a high degree of thermal resistance.

The material has also shown to have good electrical and flame retardant properties, passing the glow wire test with a temperature of 650 °C at 2 millimetres.

The ageing tests involving Xenotesting, that is often required by the electrical industry, as well as the more stringent SAE J 2527 tests, imposed by automotive standards, have demonstrated it to have excellent resistance to UV rays.

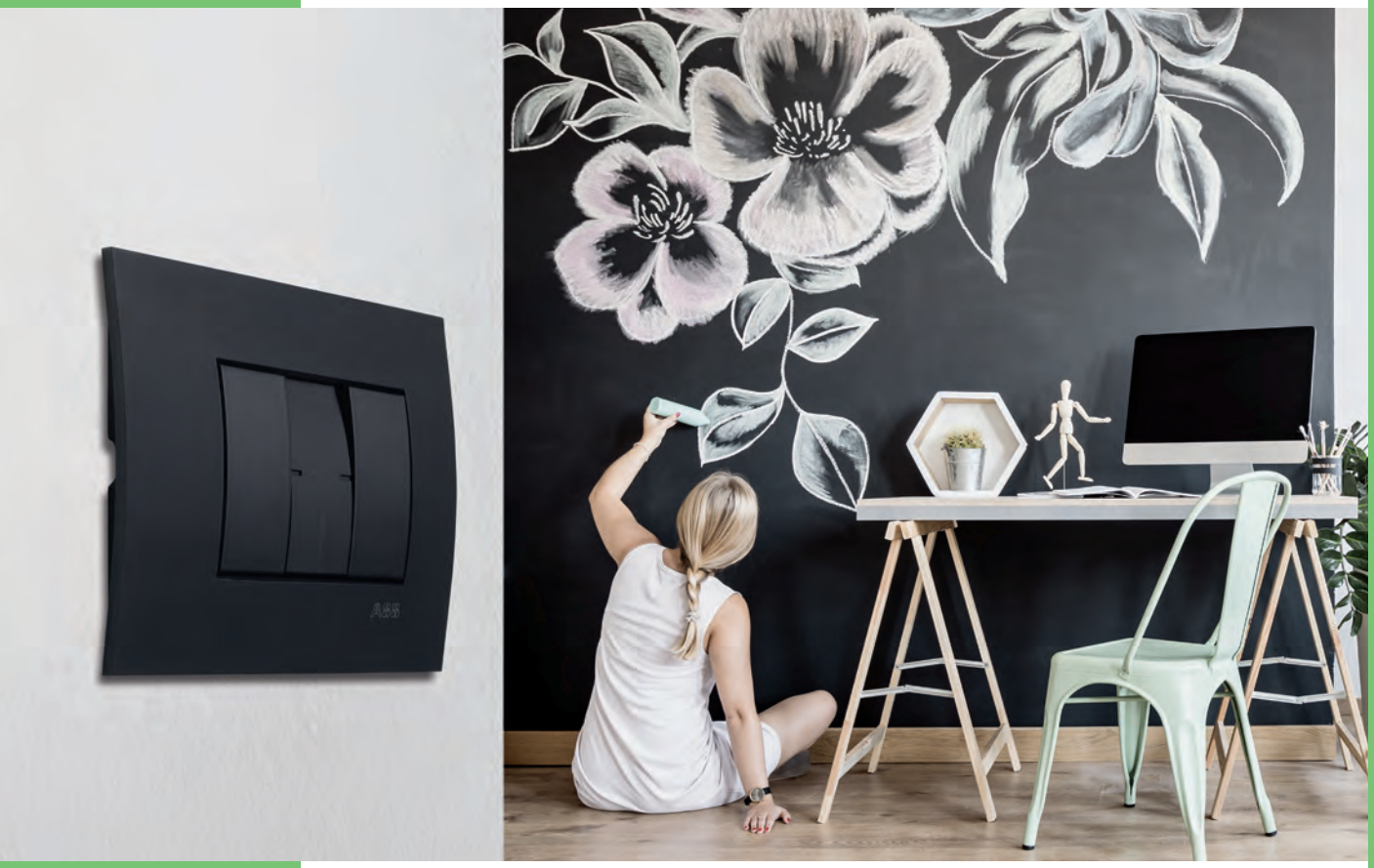
RESISTANCE AND SILKY FEEL

A particularly demanding, but essential test for this kind of product, especially on the matt textures that ABB wanted, to promote the natural feel of Mytos Etik, is the scratch resistance test.

We chose the most critical colour, black, and used two evaluation methods:
an objective parameter being the measurement of the colour and gloss variations,
a subjective parameter, taking the form of visual evaluation by several observers.
The brilliance and colour intensity were measured using a glossmeter and a spectrophotometer.
While the simulations of resistance to “scratch and mar” and to abrasion, were undertaken using an Erichsen scratch tester, an alternating Crock meter and a rotary Taber abrasion tester, also gauging the comparative data in accordance with the various textures.

800 laboratory tests

The testing undertaken to assess resistance to different loads, also according to type and texture, has shown that the performance levels of our material are superior to those of ABS, that in the case of some textures it was found to be particularly sensitive to load. A total of 800 laboratory tests have been undertaken in order to assess the scratch and mar resistance.



We have also developed a highly innovative test that simulates the action of a woman’s particularly sharp nail. The passing of the woman’s nail test, finally convinced ABB.

Thanks to the introduction of a special additive, we have been able to obtain a highly fluid compound, that has made it possible for us to reduce the cycle time and to perfectly reproduce the texture of the mold, whether it be matt or gloss.

For these tests, ABB commissioned an interchangeable insert mold, to be able to determine both the scratch and touch resistance, in order to understand the kind of user experience provided according to the texture. The final choice was a matt finish and black and white colours.

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11 Winner of Bioplastics Award!

Maip's Group wins the prestigious Bioplastics Award 2017 in Berlin.

The bioplastic **IamNature®** created by bacteria wins the first prize

The prestigious award is promoted by Bioplastics Magazine and has been announced by its founder and editor, Mr. Michael Thielen during one of the most influential appointments in the world calendar of bioplastics, the European Bioplastics Conference.

IamNature® has been selected out of 5 finalists, by an International jury coming from the Academic world, from the press and Associations of the sector in America, Europe and Asia.

The 100% Italian victory is the result of a co-operation and co-engineering between MAIP, the moulder (STPS) and the end user (ABB).

This information and our technical advice – whether verbal, in writing or by way of trials – are given in good faith but without warranty, and this also applies where proprietary rights or third parties are involved. Our advice does not release you from the obligation to verify the information currently provided – especially that contained in our safety data and technical information sheets – and to test our products as to their suitability for the intended processes and uses. This product is not designated for the manufacture of medical devices / in-vitro medical devices or for their intermediate products. This product is also not designated for Food Contact. The application, use and processing of our products and the products manufactured by you on the basis of our technical advice are beyond out control and, therefore, entirely your own responsability. Our products are sold and our advisory service is given in accordance with the current version of our Generale Conditions of Sale and Delivery. Please read the MATERIAL SAFETY DATA SHEET "MSDS" before using this product. Test values The numerical data described are average values obtained by measurement under prescribed conditions; they are not guaranteed values and must be regarded as guide values only and not as binding minimum values. The above data refer to the use of the product in natural colour. Under certain conditions the properties can be affected to a considerable extent by the design of the mould/ die, the processing conditions and the colouring.

	PROPERTIES	METODO VERFAHREN STANDARD	UNITA' UNIT EINHEIT	COND.PROVA TEST COND. TEST BED.	BIOS B1 D1523 PLA modif. alta fluidità trasparenti	BIOS B1 316 PLA modif. 15% carica minerale di fillosilicato	BIOS B1 624 PLA modif. 30% carica minerale antiacida
					mod. PLA high flow transparent	mod. PLA 15% phillosilicate mineral filled	mod. PLA 30% anti acid mineral filled
1	**BASIC PROPERTIES**						
2	Ash content	ISO 3451-1	%	Met. A	-	15	30
3	Density	ISO 1183-1	g/cm³	23° Met. A	1.24	1.35	1.48
4	Melt Mass Flow (MFR)	ISO 1133-2	g/10min	different	38(190°C 2.16Kg)	-	-
5	Parallel mould shrinkage	ISO 294-5	%	internal	0.30-0.50	0.20-0.40	0.20-0.40
6	Across mould shrinkage	ISO 294-5	%	internal	0.30-0.50	0.20-0.40	0.20-0.40
7	**THERMAL PROPERTIES**						
8	CLTE parallel	ISO 11359	10^{-6}/K	23°-55°	40	-	-
9	CLTE across	ISO 11359	10^{-6}/K	23°-55°	40	-	-
10	Melting point	ISO 11357	°C	DSC (10°C/min)	165	165	165
11	Glass Transition Temp.	ISO 11357	°C	DSC (10°C/min)	55-60	55-60	55-60
12	Vicat, Softening Temp.	ISO 306	°C	1/5kg-50°C/h	60/49	65/60	65/60
13	Heat Distorsion Temp.	ISO 75	°C	0.45/1.8 MPa	55/	-	-
14	**MECHANICAL PROPERTIES**						
15	Stress at yield	ISO 527-1-2	MPa	v=50mm/min	62	57	53
16	Tensile Modulus	ISO 527-1-2	MPa	v=1mm/min	-	-	-
17	Tensile stress at break	ISO 527-1-2	MPa	v=5mm/min	-	55	50
18	Strain at break	ISO 527-1-2	%	v=5mm/min	4	3.5	3.8
19	Flexural strength	ISO 178	MPa	v=2mm/min	70	90	75
20	Flexural modulus	ISO 178	MPa	v=2mm/min	3450	5400	4600
21	Izod impact strength	ISO 180-1U	kJ/m²	23°C	-	-	-
22	Izod notched impact	ISO 180-1A	kJ/m²	23°C	1.8	3.5	2.5
23	Charpy notched impact	ISO 179/1eA	kJ/m²	23°C	-	-	-
24	**OTHER PROPERTIES**						
25	Flammability	UL-94	Class.	/mm	-	HB	HB
26	Burning rate	ISO 3795	mm/min	FMVSS302	-	<100	<100
27	G.W.F.I.	IEC 60695	°C/mm		-	-	-
28	Vol.(V) Resistivity	IEC 60093	ohm/cm		-	-	-
29	Thermal conductivity		W/(mK)	in/trough plane	0.13	-	-
30	Hardness (Shore/Rockwell)	ISO 868 / 2039-2	D/A-R/M	15 sec.	-	-	-
31	Transmittance	ISO 13468	%	/mm	90	-	-
32	Haze H	ISO 14782	% / GU	/mm	1/0.5	-	-
33	Gloss G	Erichsen		60° angle	-	-	-
34	**PROCESSING CONDITIONS**						
35	Drying temperature	-	°C		50	50	50
36	Drying time	-	h		4-24	4-12	4-12
37	Suggested moisture content	internal	ppm		250	250	250
38	Melt temperature	-	°C		185-210	185-210	185-210
39	Mould temperature	-	°C		20-40	20-40	20-40

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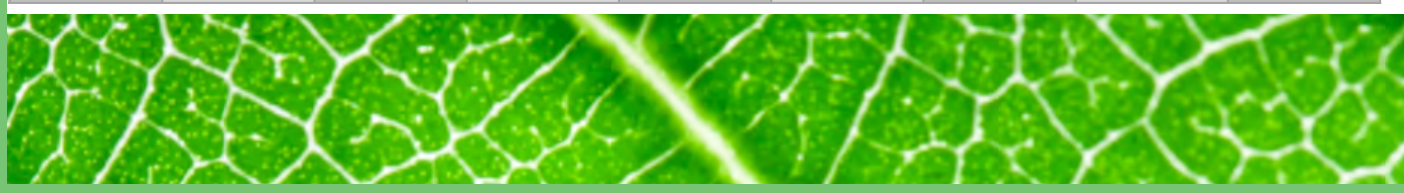
PASSED THE LABORATORY TESTS
FOR ECOTOXICITY
AND DISINTEGRATION

OK BIOBASED GRADES
TuV APPROVED

i)amNature®

IamNATURE				IamNATURE				
B6H N13	**B6H N15**	**AH150 AW40G1**	**AH12AC80**	**BL100**	**BLH180 A20Z2**	**BLH180 AW20Z G1**	**BLH172 A28**	**BLH160/440 E22F**
PHB usi generali	PHB stampaggio, estrusione	PHB 20% CM alta resist. termica antiscratch alta stab.dimens.	PHB con carica minerale antiacida, per degradabilità marina	BIO BLEND con speciali additivi di processo	BIO BLEND con fillosilicato buona fluidità BIOBASED	BIO BLEND con metasilicato, antiscratch, ottima stab. dimension. alta fluidità	BIO BLEND 15% filler con speciali additivi di processo	BIO BLEND 20% FV alta fluidità mod. all'urto
PHB general purpose	PHB general purpose for molding, extrusion	PHB 20% MF high thermal resist.; antiscratch; high dim. stability	PHB mineral filled anti acid, for marine degradability	BIO BLEND with special proces. additives modified	BIO BLEND phillosilicate filled, good flow with special proces. additives modified BIOBASED	BIO BLEND metasilicate filled, antiscratch, very low warpage high flow BIOBASED	BIO BLEND 15% filler with special process additives modified	BIO BLEND 20% GF reinf.; high flowability; impact modified
ex AH131	**ex AH151**	**Award 2017**						
-	-	20	40	-	<15	<15	15	20
1.20	1.20	1.30	1.57	1.22	1.23	1.23	1.38	-
3(170°C 5 Kg)	-	15(170°C 5 Kg)	-	-	20(170°C 5 Kg)	23(170°C 5 Kg)	-	40(170°C 10 Kg)
0.50-0.90	0.50-0.80	0.60-0.70	0.40-0.60	0.40-0.70	0.50-0.90	0.40-0.50	0.40-0.60	-
0.50-0.90	0.50-0.80	0.60-0.70	0.40-0.60	0.40-0.70	0.50-0.70	0.40-0.50	0.40-0.60	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
145	135	145	145	155	155	155	155	155
2	0	2	2	-	-	-	-	-
125/105	105/90	120/-	-/-	120/61	129/60	129/-	115/59	125/-
110/-	90/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
28	20	20	-	40	43	30	-	-
1.450	1000	-	-	-	-	-	-	-
25	19	18	20	-	38	28	37	50
7	24	3.2	4	8	4.2	3.5	2	4
37	37	25	35	63	70	50	57	75
1.350	900	2400	3.200	2.350	3200	2.500	3.700	5.030
32	-	-	-	-	-	-	-	-
3.5	4	2.8	2.5	3.4	4	3.5	4.4	6
-	-	-	-	-	-	-	-	-
HB	HB	HB	HB	HB	HB	HB	HB	HB
<100	<100	<100	<100	-	<100	<100	-	<100
-	-	650/3	-	750/2	-	650/3	750/3	-
-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
40/0.1	25/0.1	-	-	30/1	-	-	95	-
-	-	-	-	-	-	-	-	-
80	80	80	80	50-60	50-60	50-60	50-60	50-60
3-9	3-9	3-9	3-9	4-12	4-12	4-12	4-12	4-12
200-400	200-400	200-400	200-400	200-400	200-400	200-400	200-400	200-400
135-155	130-150	135-155	140-160	160-180	160-180	160-180	160-180	160-180
25-35	25-35	25-35	25-35	30-40	30-40	30-40	30-40	30-40



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