

# VESTAMID<sup>®</sup> *Terra*

Because we care



Ricinus Communis, the castor bean plant grows in arid areas which do not affect food production and does not cause land use change.

## Biobased Polyamides

About achieving performance with natural means

Evonik Industries AG has recently developed and commercialized a new line of bio-based polymers under the existing family trade name VESTAMID®. There are currently three products within this new group of polyamides available that are partially or entirely based on renewable feedstocks:

**VESTAMID® Terra HS** (PA610)  
**VESTAMID® Terra DS** (PA1010)  
**VESTAMID® Terra DD** (PA1012)

The castor bean plant forms the basis and source of the renewable monomers, in particular sebacic acid "S" and decamethylene diamine "D".

For example, VESTAMID® Terra DS is 100% biosourced being derived from the polycondensation of decamethylene diamine and sebacic acid. Technically speaking, this group of polyamides occupy the gap between the long-chain high-performance polyamides (such as 12 and 12,12) and the standard short-chain polyamides (such as 6 and 6,6). These polymer types are renowned for low water uptake and therefore a high dimensional stability under real environmental conditions, high temperature deflection, extreme chemical resistance, and other such properties which facilitate their use in demanding application areas. This makes them unique in the field of biopolymers, as the VESTAMID® Terra line creates products that last while providing high performance with the added benefit of a reduced ecological impact.

# Life Cycle Assessments

## About sustainable development

In order to quantify the sustainability of new biobased products against existing products, detailed life cycle assessments (LCA) have been conducted. At Evonik Industries AG, a team of LCA practitioners have been certified and positively appraised to conduct LCA's. For polymers, the scope "the cradle-to-factory gate" (hence pellets) is generally chosen and focus is currently placed on determining the global warming potential, the so-called carbon footprint (CO<sub>2</sub>eq).

The reduction is currently attributed to the natural carbon cycle of biomass crops. With further optimization of process conditions and supply chain, the values can be lowered even further.

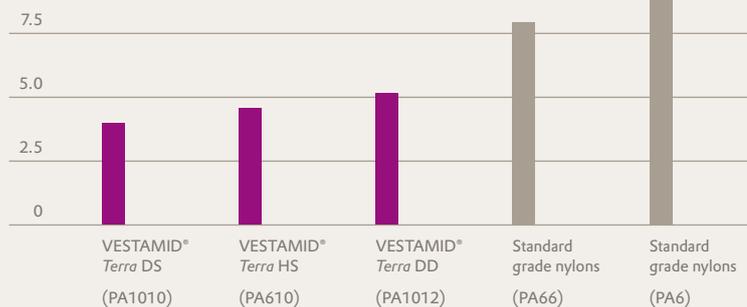
Employing products derived from biomass is becoming one of the most important methods in which companies and corporations can meet their sustainable development goals and ambitions. Hereby, VESTAMID® *Terra* supports the reduction in finite fossil fuel usage (especially naphtha) by using renewable resources.

Compared to existing polyamides the VESTAMID® *Terra* line presents a noticeable reduction in carbon footprint.

Date of calculation: 2009

### Carbon footprint

kg CO<sub>2</sub>eq / kg product



All VESTAMID® *Terra* products have been analysed and independently certified by DIN ISO 10694; 1996-08 and within the USDA's BioPreferred® program for their biobased content.





Multifilament yarns for silky, stain resistant flooring

## Fibers and Filaments

About providing safe, hygienic and comfortable solutions

As a thermoplastic semi-crystalline polyamide, the VESTAMID® *Terra* can be melt spun to create a wide variety of different fiber and filaments products. Each of the polyamides has been and can be adjusted to meet the thermal spinning processing parameters. Depending on the material chosen, the filaments can provide unique technical and sustainable solutions.

In general, the lower water uptake, high chemical resistance and slightly reduced melting point of the VESTAMID® *Terra* products compared to the short-chain polyamides will lead to lower energy demands in the spinning process, heightened stain resistance and an improved color fastness, as well as a softer touch of the fibers without compromising mechanical properties.



Multifilament reinforcement fibers  
for safe, dynamic tires



**Guided cooperation along the value chain.**

The Business Unit Performance Polymers is not a fiber manufacturer nor is it intended to be. Therefore modified VESTAMID® Terra material has been and can be developed upon request to meet the specific needs of the respective fiber industries.



Monofilament  
50 - 500  $\mu\text{m}$

Multifilament  
10 - 50  $\mu\text{m}$

The VESTAMID® Terra products can be used to create a wide variety of fibers and filaments, from performance to engineering driven applications.

**Fibers**



Monofilament bristles for flexible, durable toothbrushes



Multifilament weavings for strong, temperature stable fabrics and membranes



Mixed filaments for hygienic, soft bandages (VESTAMID® Terra is USP Class VI tested and approved)



Parts with a flexible nature  
and brilliant coloring

## Injection Molding

About creating aesthetically pleasant  
and technically sound products

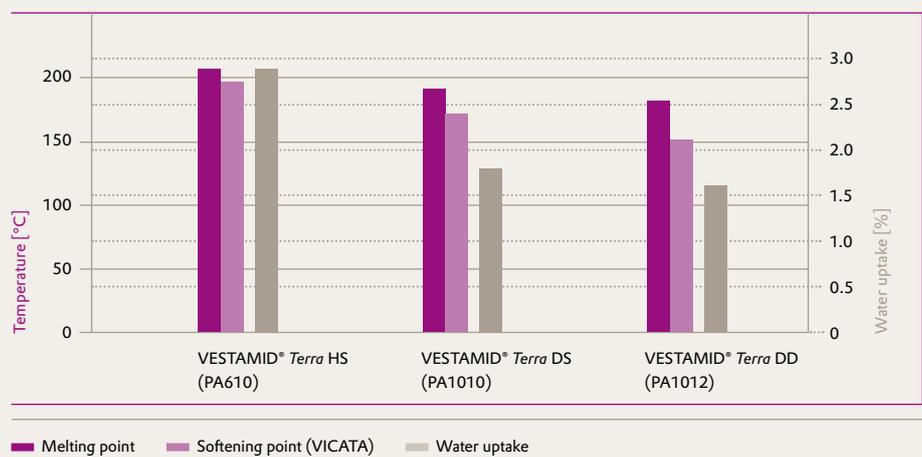
The innate nature of polyamides induced during injection molding processing creates macromolecule chain interaction which thereby substantially promotes crystalline formation. This attribute leads to increased mechanical strength, melting point and heat deflection properties. In addition to this, the VESTAMID® Terra products are also attributed to a low coefficient of resistance and have been tailored to increase the flowability into complex mold structures and parts.

Many different compounds have been developed and are available to meet the needs of the wide injection molding field. Fiber reinforcement grades, composing of glass fibers or natural fibers are commercially available. Special flame retardant grades and stabilized grades are available. Colors can be matched using master batches or direct feeding.



VESTAMID® Terra products are characterised by a low water uptake and relatively high melting point and softening temperatures.

### Basic characteristics



Parts with a glossy surface and movable parts, such as for writing utensils



Parts with thin walls and static resistance, such as for electronic component



Parts with a strong cold impact and scratch resistance, such as for winter sport equipment



Fluidizing bed coating: Powder used to protect the surface of metals.

## Powders

### About protecting valuables against the elements

Over the course of decades, Evonik Industries has amassed expertise in the field of powder development, production and technical services. Marketed under the well-known family name VESTOSINT®, the expertise has been utilized to develop new VESTOSINT® *Terra* powder products.

Fine powders are used for a broad variety of applications, using a wide span of technologies. Ranging anywhere from metal coatings, to the matrix of composites, to epoxy tougheners, to color coatings or to even oil dispersion particles for cosmetics. To be able to achieve such diversity, the powders are custom tailored to meet the application and processing technique incurred (such as electrostatic, fluidized bed or minicoating or flame spraying).



Powder oil dispersion:  
Powder can be used to protect  
against sunrays.



### Important key characteristics of powders for all applications

- particle distribution
- particle surface area
- melting point
- purity



Small batch production utilizes  
powders for Additive Manufacturing.



Powder production  
utilizes unique technology.



Extruded profiles for building components which require critical mechanical stability and rigorous safety measures such as for windows.



Extruded casings for electrical systems such as for lighting.

## Extrusion

About systemic quality  
for endless consistency

Due to the higher peak temperature stability of the VESTAMID® *Terra* products, many extrusion applications in the automobile sector [typical of long-chain polyamides (like PA12)] are especially suitable. High burst pressure and service temperatures are possible. The materials also exhibit excellent chemical resistance to e.g. greases, oils, fuels, hydraulic fluids and salts.

VESTAMID® *Terra* compounds have a consistent quality which allow reproducible extrusion. Extensive internal quality control and testing procedures ensure this. A wide variant of filling agents can be added to meet the specific requirements of extruded products.

Reflective films for photovoltaic enable the bundling of renewable energy systems with sustainable products.



## Films

About even the thinnest applications

Depending on its crystallinity and thickness, the VESTAMID® *Terra* products can be manufactured into either transparent or translucent films. Furthermore, these special extrusion compound-grades can be tailored to the film properties needed, should it be low permeation, high reflection, long-term bonding or good scratch resistance.

In combination with their low water uptake, such films are ideally employed as protection barrier films. The overall properties of VESTAMID® *Terra* also accompany the needs of special films for packaging or food preservation such as multilayered films.



Process standardization enables a high quality of material for many films applications.

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