Significantly improve nylon 6's performance in humid environments by using Novadyn™ DT/DI blend additive.

NOVADYN™

Face any of the following challenges? Start a discussion with INVISTA.

- Do you want to specify nylon 6, but its poor performance in humid environments is holding you back?
- Could you reduce wall thickness, lower material costs and lightweight your part if nylon 6 were stronger and stiffer in humid environments?
- Would nylon 6 with lower crystallinity improve processability, enable thinner parts, reduce voids in large parts, and shorten cycle times?
- Could you benefit from a lower-cost alternative to current transparent nylon offerings?

Innovate with Novadyn™ DT/DI[1] additive — because the nylon 6 world is not "dry as molded."[2]

There are many reasons to use nylon 6 in injection molded applications, including excellent surface, low cost, processability, weldability, thin-walled, and large part cavity avoidance.

However, many parts must perform in wet or humid environments — either regularly or occasionally — where nylon 6 suffers from a dramatic loss of strength and stiffness.

Today, designers have few choices to compensate for nylon 6's shortcomings. They can design a thicker part, adding cost, part weight and limiting design options. Or they can blend nylon 6 with an expensive transparent nylon to achieve a modest improvement in conditioned properties.

Novadyn™ DT/DI is a blend additive that greatly improves nylon 6's performance in humid environments, offering a combination of performance, cost effectiveness and recycled content.

[1] Novadyn™ DT/DI is sometimes abbreviated as "DT/DI" in this document.

[2] Dry as molded (DAM) measurements give some insight into basic material properties. These measurements are directly applicable for applications that are air conditioned around-the-clock and throughout the year.

[3] Recycled content is defined by ISO 14021, section 7.8.

Performance

Novadyn™ DT/DI blends can extend the performance range of nylon 6:

- Improved strength, stiffness and dimensional stability in humid environments
- Differentiated performance versus competing nylon 6I/6T
- Reduced crystallinity, potentially enabling use in thin-walled parts, reducing voids in large parts, enhancing processability, improving appearance, and shortening cycle times
- Increased glass transition temperature and improved strength and stiffness at moderately elevated temperatures

Cost effectiveness

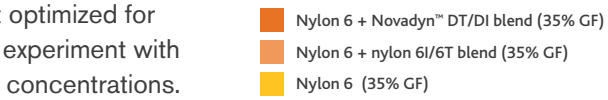
- INVISTA is committed to being the transparent nylon cost leader, building on its integration and low-cost raw material position
- Improved properties can enable designs with reduced wall thickness, lowering material costs
- Prices that empower compounders and designers to create value-added products without significant impact on nylon 6 formulation cost
- Access to markets and applications that were previously off-limits due to the influence of water on nylon 6's mechanical properties
- Water-moldable blends can replace nylon 6 with minimum disruption in processing

Recycled content

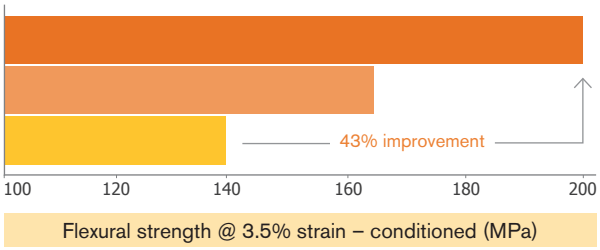
Novadyn™ DT/DI's unique combination of properties is derived from DYTEK® A Amine, a monomer which is used in many high-performance polyamides. DYTEK® A Amine is typically 99% pure and manufactured from recovered and refined materials that would otherwise be burned with heat recovery, giving DT/DI at least 43% recycled content[3].

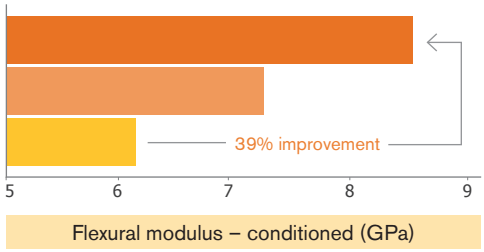
Novadyn™ DT/DI performance advantages

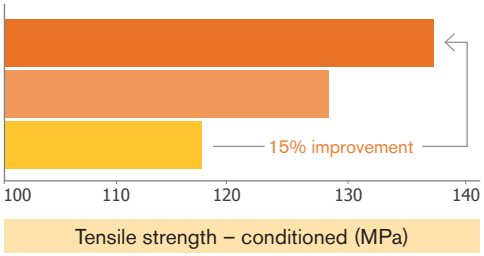
The following charts and data illustrate properties of a 35% glass-fiber (GF) reinforced compound with resin ratio of 25% DT/DI and 75% nylon 6[4]. This compound is designed to illustrate general properties and is not optimized for any particular end-use application. We encourage customers to experiment with different resin ratios, reinforcement types, additives and additive concentrations.



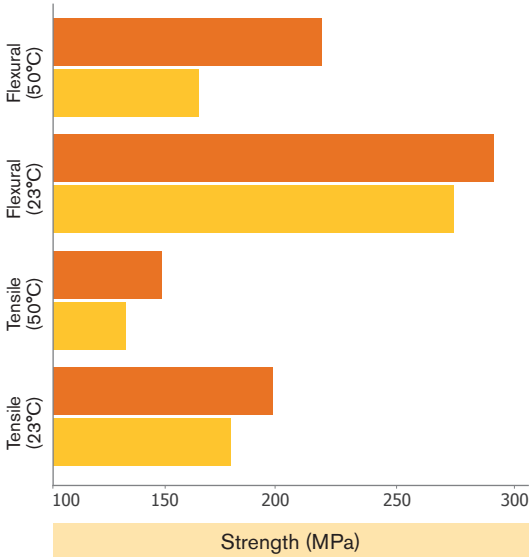
Differentiated performance versus competitive transparent nylons



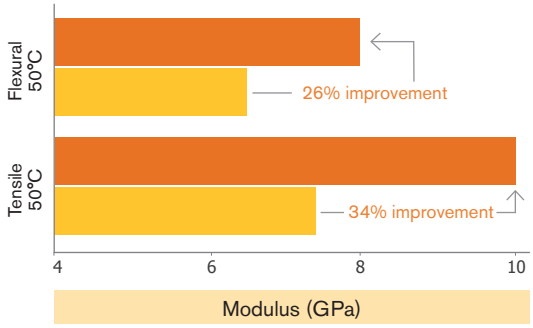




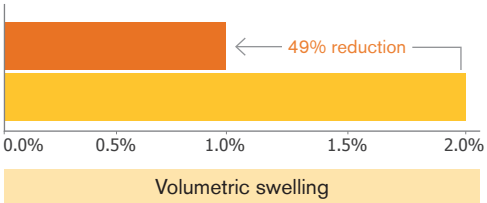
Improved strength at ambient and slightly elevated temperatures



Significantly improved stiffness at moderately elevated temperatures

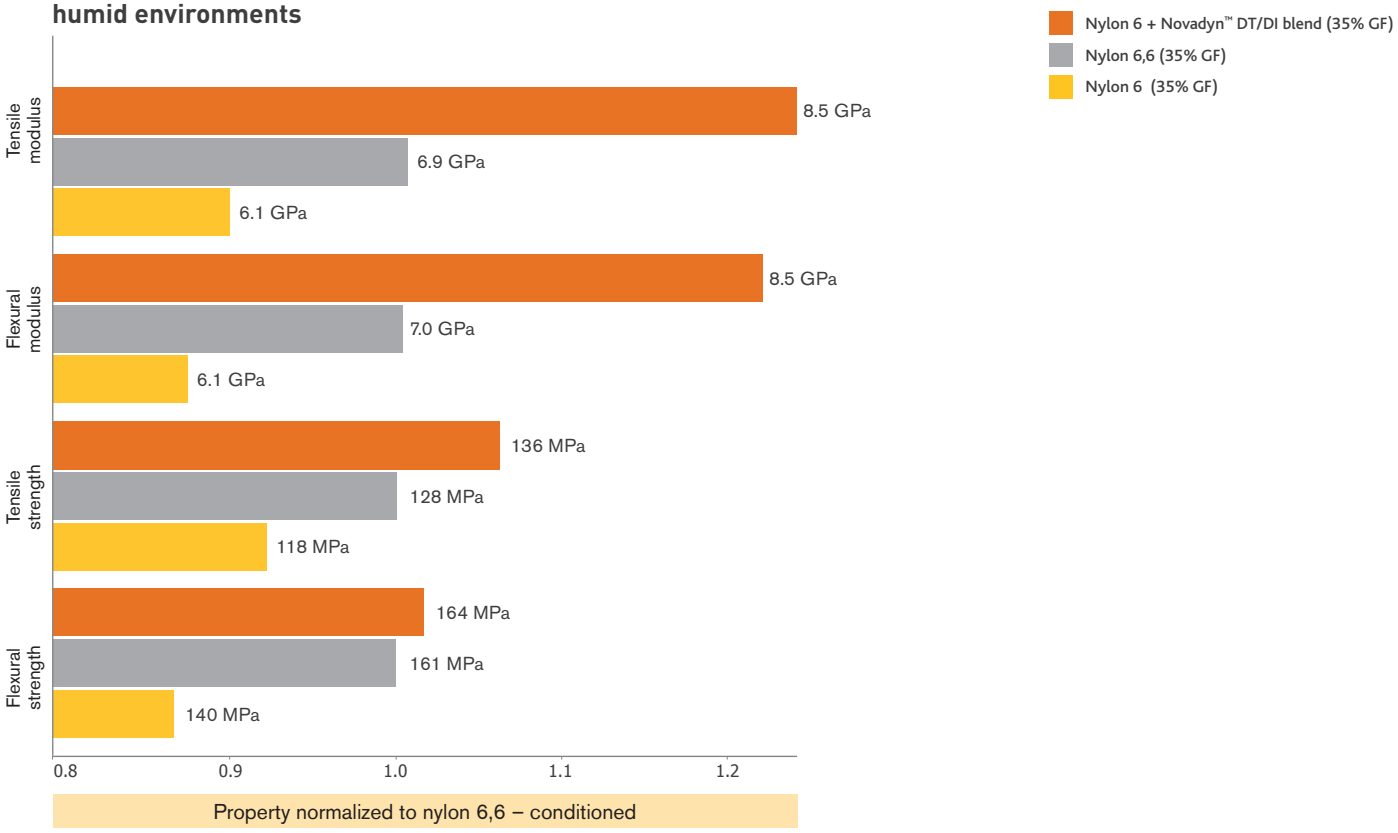


Excellent dimensional stability in humid environments



[4] Heat stabilized and lubricated.

Improved nylon 6 surpasses nylon 6,6 in humid environments



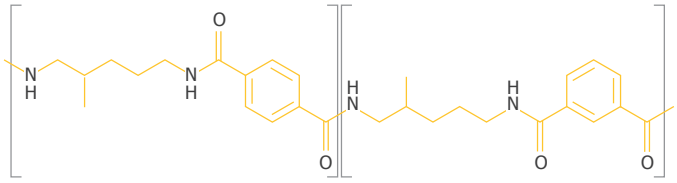
Technical properties

PROPERTY	TEST METHOD	NYLON 6 (35% GF[5])		NYLON 6 + NOVADYN™ DT/DI (35%GF)	
		DAM[6]	COND[7]	DAM	COND
Tensile strength (MPa)	ISO 527 (5 mm/min)	187	118	196	136
Tensile modulus (GPa)	ISO 527 (1 mm/min)	10.9	6.2	10.8	8.5
Elongation @ break (%)	ISO 527 (5 mm/min)	3.8	7.5	3.6	6.0
Flexural strength @ 3.5% strain (MPa)	ISO 178 (2 mm/min)	278	140	291	200
Flexural modulus (GPa)	ISO 178 (2 mm/min)	9.5	6.1	9.5	8.5
Notched Izod impact strength (kJ/m^2)	ISO 180	14	23	12	14
Melting point (°C)	DSC (20°C/min)	221	–	218	–
Glass transition temperature (°C)	DMA (peak of tan δ)	62	–	87	–
HDT @ 1.8 MPa (°C)	ISO 75	207	195	180	155
HDT @ 0.45 MPa (°C)	ISO 75	220	218	215	215
Density (g/cm^3)	ISO 1183-1	1.41	1.41	1.42	1.43
Volumetric swelling (%)	ISO 1110 – 70°C, 62% RH	1.97		1.01	

[5] GF = glass fiber. [6] DAM – dry as molded; all mechanical tests performed at 23°C.
[7] COND – conditioned as per ISO 1110 (70°C, 62% RH) to equilibrium; all mechanical tests performed at 23°C.

About Novadyn™ DT/DI

Novadyn™ DT/DI is made from monomers DYTEK® A diamine, purified terephthalic acid (PTA) and purified isophthalic acid (PIA).



Potential applications and processing methods

Novadyn™ DT/DI is available as a base resin (i.e., no additives). INVISTA is actively seeking partners to investigate the use of DT/DI as a nylon 6 blend additive. Based on differentiated properties, cost effectiveness and recycled content, Novadyn™ DT/DI could be considered for a wide range of existing and new applications, including the following:

- Automotive: wire harness connectors, fuse boxes, cylinder head covers, crankcases, timing wheels, interior trim, exterior trim, door handles, motorcycle body frames, electrical/control system components, housings, etc.
- Industrial: gears, fittings, bearings, etc.
- Building and construction: scaffolding, sprinkler nozzles, coat racks, etc.
- Electrical and electronics: connectors, lighting drivers, enclosure materials, bobbin supports, contact armature, circuit breakers, housing, etc.
- Consumer electronics: computer components, electronic components, etc.
- Consumer durables: power tools, lawn and garden tools, large appliances, small appliances, etc.
- Sports and leisure equipment, toys, etc.
- Furniture and office furniture parts: gears, casters, mounting brackets, etc.
- Plumbing components: fittings, housing, fixtures, etc.
- 3-D printing

Besides injection molded applications, nylon 6 blends with Novadyn™ DT/DI could be used in specialty film, barrier films and monofilament.

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FOR SAMPLES AND FURTHER INFORMATION

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