

Significantly improve nylon 6,6 performance in humid environments by blending with Novadyn™ DT/DI.



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

- Would you like to specify nylon 6,6 but its poor performance in wet or humid environments is holding you back? Is this driving you to use higher cost polymers instead?
- Could you reduce wall thickness, lower material costs and lightweight your part if nylon 6,6 were stiffer and stronger in humid environments?
- Do you need an effective and low-cost blend additive for GF¹ reinforced nylon 6,6 applications to improve processability for lightweighting initiatives and metal substitution?
- Could your current nylon 6,6 application benefit from a boost in properties while only modestly increasing system costs?
- Are you seeking lower-cost alternatives to High Performance Polyamides (HPPAs) in applications where they are over-engineered?
- Could your margins grow if you could buy a lower-cost alternative to current amorphous polyamides?
- Would nylon 6,6 with lower crystallinity improve processability, enable thinner parts, reduce voids in large parts, improve part surface appearance, and shorten cycle times?

Innovate with Novadyn™ DT/DI additive — because the nylon 6,6 world is not “dry as molded.”²

There are many reasons to use nylon 6,6 in injection molded applications. Nylon 6,6 is a highly versatile engineering thermoplastic used in a variety of applications where its balance of strength, ductility, heat, wear and chemical resistance make it highly suitable for metal replacement. Its ease and wide range of processability also allow it to be used in parts with diverse geometries, including thin walls and thick walls with complex shapes.

However, when a part must perform in wet or humid environments, designers are often compelled to use much higher cost polymers, including HPPAs.

With Novadyn™ DT/DI, retention of conditioned properties is higher — and costs are lower — broadening customer choices and creating new opportunities for nylon 6,6.

¹ Glass fiber. 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.

Performance

Blending with Novadyn™ DT/DI can extend the performance range of nylon 6,6:

- Improved strength and stiffness in humid environments.
- Lower water absorption
- Improved surface appearance: gloss and scratch resistance
- Differentiated performance versus nylon 6I/6T.
- Reduced crystallinity potentially enables use in thin-walled parts, enhances processability (including high GF loadings), improves dimensional stability, reduces warpage, and shortens mold 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, designers, tiers and OEMs to create value-added products without significant impact on nylon 6,6 formulation cost.
- Access to markets and applications that were previously off-limits due to the influence of water on nylon 6,6's mechanical properties.
- Water-moldable blends can replace nylon 6,6 with minimum disruption in processing.

Recycled content

The unique combination of Novadyn™ DT/DI 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 Novadyn™ polyamides at least 43% recycled content.³

Product comparison

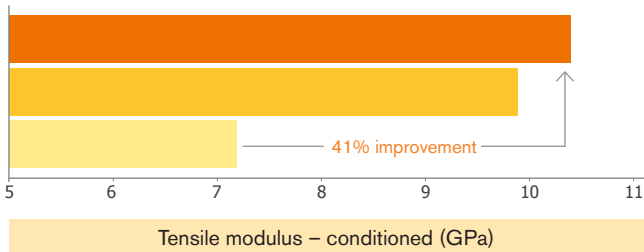
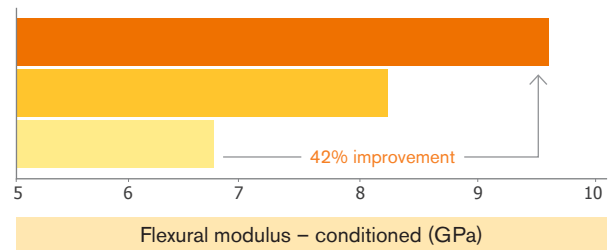
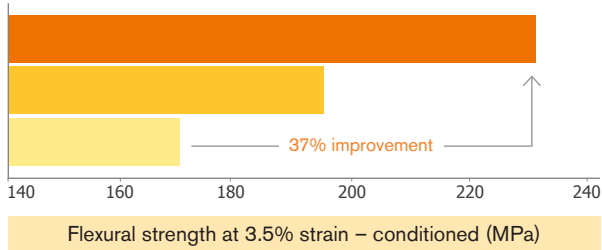
	NYLON 6,6	NOVADYN™ DT/DI + NYLON 6,6 BLEND	NYLON 6I/6T + NYLON 6,6 BLEND
Relative cost	Baseline	\$	\$\$
Glass transition temperature	Baseline	++	+
Conditioned flexural strength	Baseline	++	+
Conditioned flexural modulus	Baseline	++	+
Conditioned tensile strength	Baseline	++	++
Conditioned tensile modulus	Baseline	++	+
Modulus and flexural strength up to 75°C	Baseline	++	++
Crystallinity modification and processability	Baseline	++	++
Surface appearance/gloss (high GF)	Baseline	++	+
Scratch resistance	Baseline	++	+

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

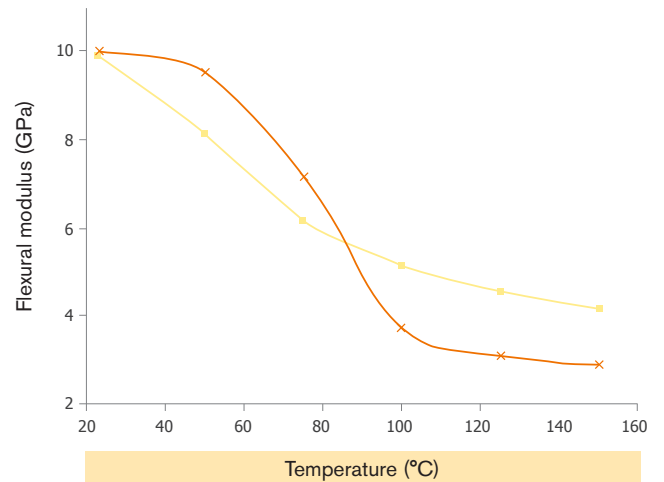
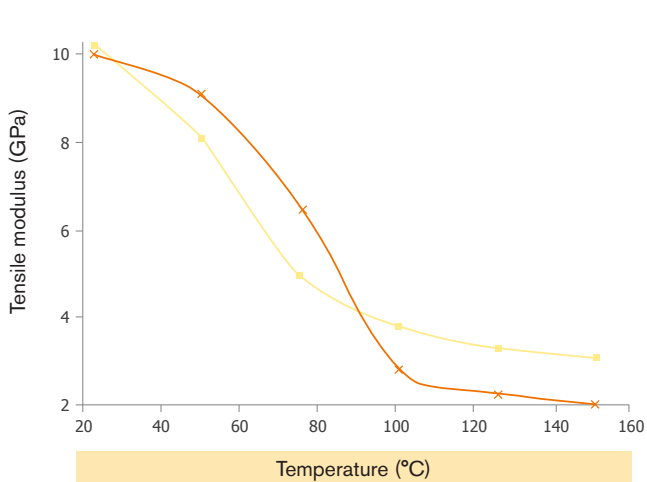
Novadyn™ DT/DI performance advantages

The following charts and data illustrate properties of a 35% glass-fiber (GF) reinforced compound with resin ratio of 75% nylon 6,6⁴ with 25% Novadyn™ DT/DI. This formulation 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 polyamides



- — × Nylon 6,6 + Novadyn™ DT/DI (35% GF)
- — ▲ Nylon 6,6 + nylon 6I/6T (35% GF)
- — ■ Nylon 6,6 (35% GF)



⁴Heat stabilized and lubricated.

Scratch Resistant Nylon Additive



Maximum load with no visible scratch (N)

Technical properties

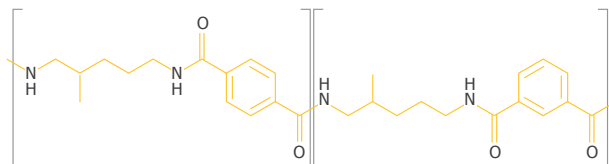
PROPERTY	TEST METHOD	NYLON 6,6 (35% GF)		NYLON 6,6 + NOVADYN™ DT/DI (35% GF)	
		DAM ⁵	COND ⁶	DAM	COND
Tensile strength (MPa)	ISO 527-1,2	174	118	180	135
Tensile modulus (GPa)	ISO 527-1,2	11.1	7.3	10.9	10.2
Elongation @ break (%)	ISO 527-1,2	4.5	6.6	4.1	4.2
Flexural stress @ 3.5% strain (MPa)	ISO 178	270	167	–	228
Flexural modulus (GPa)	ISO 178	10.0	6.7	10.2	9.6
Notched Izod impact strength (kJ/m ²)	ISO 180	9.8	12.5	8.5	8.1
Maximum load with no visible scratch (N)	FLTM BO 162-01	7	3	7	7
Melting temperature (°C)	ASTM D3418-12 (DSC)	265	–	264	–
Glass transition temperature (°C)	ISO 6721-1 (DMA)	87	–	108	–
HDT @ 1.8 MPa (°C)	ISO 75	251	–	224	–
HDT @ 0.45 MPa (°C)	ISO 75	262	–	253	–
Thermal expansion (CLTE): 20 - 100°C (10 ⁻⁵ /k)	ISO 113 89	3.33	–	3.16	–
Density (g/cm ³)	ISO 1183-1	1.41	1.42	1.42	1.43
Moisture absorption (Sat 70°C/62% RH) (%)	ISO 1110	1.95		2.08	
Water absorption (saturation)	ISO 62	3.61	–	2.87	–

⁵ DAM - dry as molded; all mechanical tests performed at 23°C.

⁶ 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

Novadyn™ DT/DI is available as a base resin (i.e., no additives). INVISTA is actively seeking partners to investigate use as a nylon 6,6 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: metal replacement for under the hood (covers, manifolds, fan blades, reservoirs, emission control components), power train and chassis (structural parts, fuel lines, transmission components, pedals), interior parts (instrument panels, housing for steering column and airbags), exterior components (side molding/cladding, door handles), etc.

Electrical and electronics: housing for consumer electronics, connectors, coil forms, solenoids, sensors, switches, switch plates, relays, motors, actuators, etc.

Industrial: pumps, pressure valves, gears, sucker rod guides, etc.

Consumer durables: home appliances (refrigerators, ranges, dishwasher, blenders), power tools, hand tools, lawn & gardening equipment, etc.

Sports and recreation: bike wheels, toys, ski boots, golf club parts, snow mobile housing, etc.

Others: furniture components (castor wheels, braces, brackets), cable ties, toys, 3-D printing, etc.

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

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