

MOISTURE ABSORPTION IN DURETHAN POLYAMIDE PARTS

Nylon resins absorb moisture from the air. The properties of nylon moldings are directly affected by the amount of moisture they contain. Moisture acts as a plasticizer in nylon and therefore reduces strength and stiffness properties but increases elongation and toughness. In general, as moisture content rises, significant increases occur in impact strength and other energy absorbing characteristics of the material.

Characteristics of Moisture Absorption

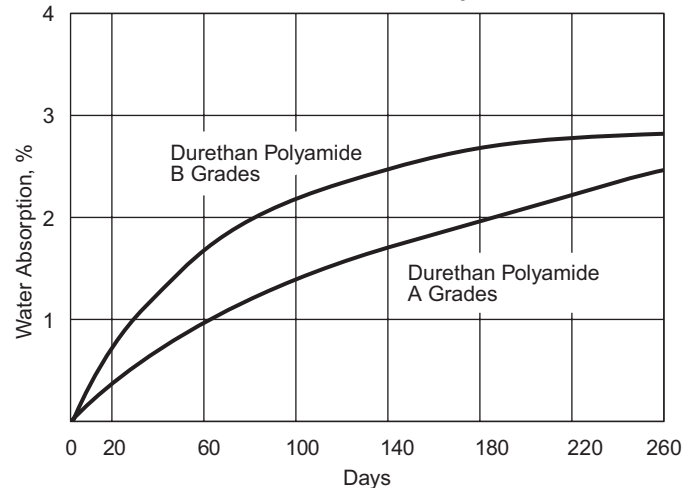
The rate at which nylons absorb moisture from the air is dependent upon air temperature, humidity, part thickness, and part geometry. In general, the rate of moisture absorption is faster at a higher temperature, higher humidity, and thinner part thickness.

The moisture absorption for unreinforced grades of Durethan A (nylon 66) and B (nylon 6) polyamide is shown in Figure 1. Both series of grades exhibit relatively high moisture absorption during the first 50 days as the surface of the molded part becomes saturated with moisture. Once the surface is saturated, the rate of moisture absorption becomes diffusion controlled as the bulk of the material absorbs moisture. Eventually, the molded part reaches equilibrium, and the moisture content remains nearly constant.

The moisture absorption process is reversible, and it depends upon the crystallinity of the resin. In general, moisture absorption decreases with increasing crystallinity.

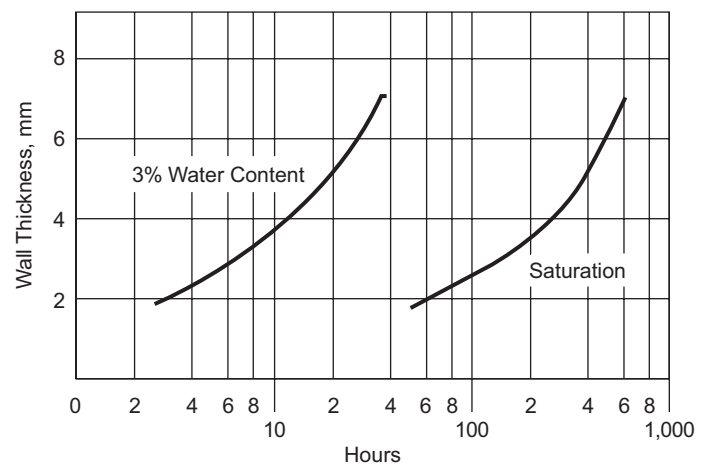
In a standard atmosphere of 73°F/23°C and 50% relative humidity, parts molded from unreinforced grades of Durethan polyamide reach an equilibrium water content of approximately 2.5–3.0%. Reinforced grades of Durethan polyamide absorb less moisture due to the presence of the hydrophobic filler, so that moldings made from materials such as Durethan AKV 30 and BKV 30 polyamide, both of which contain 30% glass fibers, absorb about 1.5% moisture at equilibrium. The effect of water absorption as a function of part thickness and time for unreinforced grades of Durethan polyamide is shown in Figure 2.

Figure 1. Water absorption of unreinforced grades of Durethan A (nylon 66) and B (nylon 6) polyamide as a function of time in an atmosphere of 73°F/23°C and 50% relative humidity*



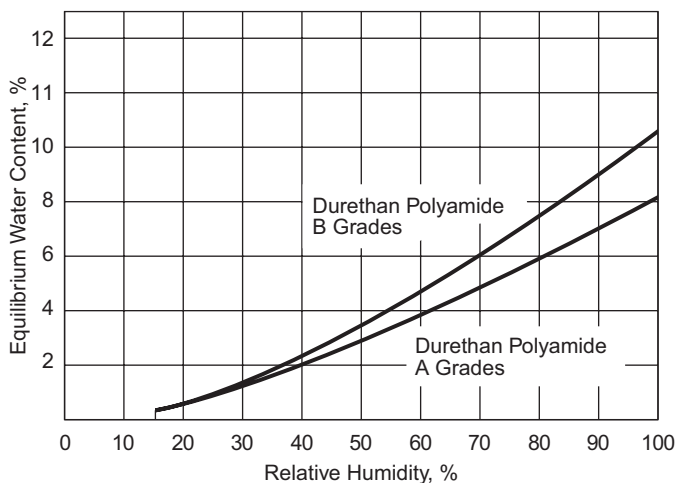
The dependence of moisture absorption on the relative humidity of the ambient air is displayed in Figure 3, which shows the equilibrium moisture content of Durethan A and B polyamide resins as a function of humidity at room temperature.

Figure 2. Water absorption of unreinforced grades of Durethan B (nylon 6) polyamide immersed in water at 140°F/60°C as a function of wall thickness and time*



* The curves are based on the averages of readings obtained from various grades on injection molded test specimens 120 x 10 x 4 mm.

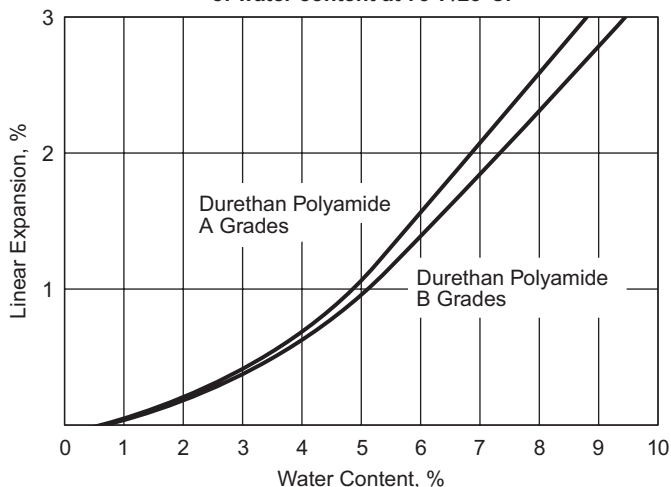
Figure 3. Equilibrium water content of unreinforced Durethan A (nylon 66) and B (nylon 6) polyamide as a function of humidity at room temperature*



Dimensional Changes Due to Moisture Absorption

When nylons absorb moisture, they experience a certain degree of swelling, which results in dimensional changes in molded parts. On specimens in which the post-crystallization has been completed, the swelling behavior is like that shown in Figure 4.

Figure 4. Linear expansion of unreinforced Durethan A (nylon 66) and B (nylon 6) polyamide as a function of water content at 73°F/23°C.



* The curves are based on the averages of readings obtained from various grades on injection molded test specimens 120 x 10 x 4 mm.

Note: The information contained in this publication is current as of May 2005. Please contact LANXESS Corporation to determine whether this publication has been revised.

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However, in many freshly molded parts, crystallization is not yet complete, and the moisture absorption is accompanied by post-crystallization. This leads to a reduction in volume which partly counteracts the swelling so that the dimensional changes for these materials will be below the maximum values shown in Figure 4.

Effect of Moisture Absorption on Physical Properties

Since nylon resins absorb moisture from the air, the physical properties of nylon moldings are affected by the amount of moisture they contain. Moisture acts as a plasticizer in nylon, thereby reducing strength and stiffness and increasing elongation. A beneficial effect of moisture absorption in nylons is that the plasticizing effect increases the impact strength and toughness of the material. However, with impact-modified grades of Durethan resins, good impact strength occurs even in the dry-as-molded state.

Because of these changes in physical properties, it is necessary to properly recognize and account for the effect of moisture on the properties of nylons. Because of our extensive experience with nylon resins, we are able to generally predict the effects of moisture on properties. Therefore, the property changes related to moisture absorption generally should not be of great concern, especially if parts molded from Durethan polyamide are conditioned prior to use. Additional information on conditioning is available in the LANXESS Product Information Bulletin "Conditioning of Parts Made From Durethan Polyamide Resin."

Health and Safety Information

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the LANXESS products mentioned in this publication. For materials mentioned which are not LANXESS products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be followed. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use, and handling. This cannot be overemphasized. Information is available in several forms, e.g., *material safety data sheets and product labels*. Consult your LANXESS Corporation representative or contact the Product Safety and Regulatory Affairs Department at LANXESS.

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