The strength of chemicals.

MOISTURE ABSORPTION

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MOISTURE ABSORPTION IN DOMAMID® AND ECONAMID® GRADES

DOMO Engineering Plastics produces engineering plastics, branded **DOMAMID®** and **ECONAMID®**, based on Nylon 6 and 6.6.

As for all polyamide based compounds, moisture absorption is a key parameter to be considered in polymeric material selection in the design process of final parts. When polyamides are exposed to humidity/water, different effects can occur. First result of the moisture absorption on polyamide is a dimensional change because of swelling processes. This absorption of moisture affects also some mechanical properties of polyamide compounds. In particular, in nylon, the moisture acts as plasticizer. This means that properties like strength, stiffness, elongation and toughness are affected. The extent of these variations is related with the amount of moisture absorbed.

The plasticizing action of moisture can be spotted in an increase of impact strength and toughness of polyamide. At the same time the material experiences a reduction of strength and stiffness and an increase of elongation.

The moisture absorption is a reversible process and it is related with the chemical structure of resins:

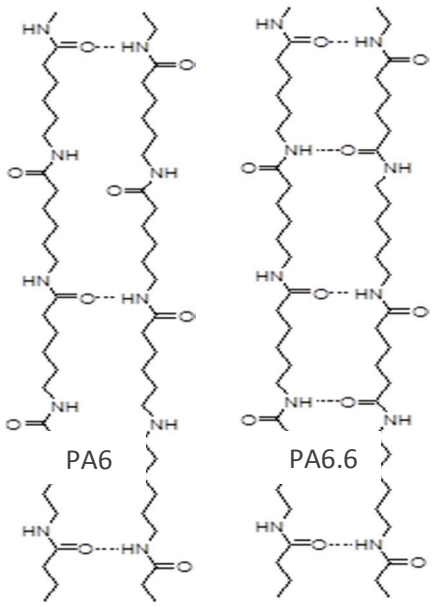

Figure 1. Molecular structure of PA6 and PA6.6

The grade of crystallinity is an important parameter to be considered in the evaluation of absorption capacity of plastics: the extent of moisture absorption is closely related to crystallinity.

Moreover, because of polymeric chains distribution in the resin, nylon 6 is able to absorb more moisture than nylon 6.6: the increased number of H-bonds between the chains of PA6.6 create a closed structure and water molecules have less possibility to interact compared to PA6.

For the same reasons, a filled polyamide will absorb less moisture than the unfilled one and the amount of this variation is proportionally to the content of glass filler.

The international standard for determination of water absorption in plastics is ISO 62. This standard describes the procedure for determining the amount of water absorbed by plastic specimens when immersed in water or subjected to humid air under controlled conditions.

The standard proposes three different ways to evaluate the plastic capacity to absorb water and each one of these gives information about resin behaviour in different conditions:

- Immersion in distilled water @23°C
- Immersion in distilled boiling water
- Exposure to 50% relative humidity @23°C

The immersion tests provide information about the content of water at saturation; the exposure to humidity provides the equilibrium moisture content: these data have a different meaning and value. Sometimes Technical Data Sheets (TDS) report values of water or humidity absorption after exposure for 24 hours (due to long term analysis needed to obtain data at saturation or equilibrium).

ISO 1110 is another method to have accelerated conditioning for polyamides, exposing test specimens to 62% RH @ 70 °C.

As moisture absorption is strictly correlated, not only to the material, but also to the test method,

conditions (temperature, relative humidity, etc.) and specimens (thickness, type, etc.), only data from the same test conditions, procedure and specimens are comparable.

The data in the following graphs show the results obtained on different **DOMAMID®** and **ECONAMID®** grades (PA6 and PA6.6 based, unfilled and glass reinforced) using ISO 62 standard.

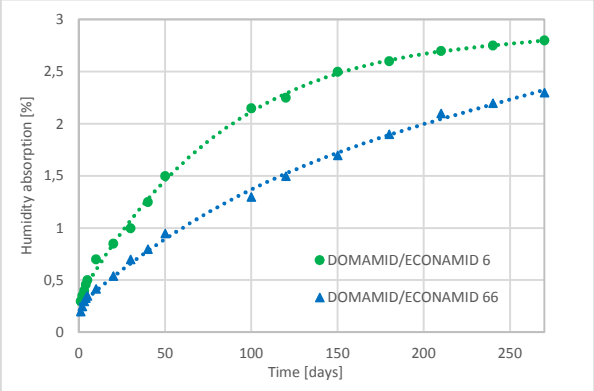

*Figure 2. Humidity absorption of **DOMAMID®** and **ECONAMID®** grades as function of time during exposure in a standard atmosphere with 50% relative humidity @ 23°C [1].*

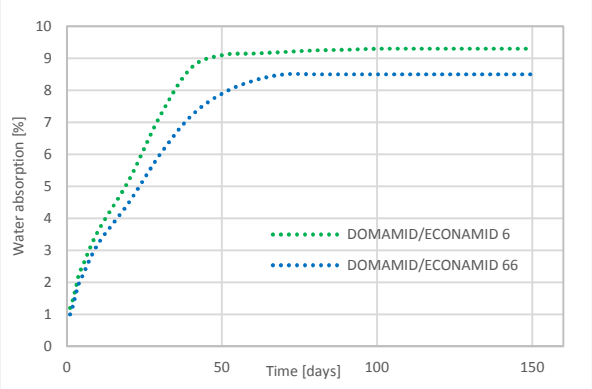

*Figure 3. Water absorption of **DOMAMID®** and **ECONAMID®** grades as function of time after immersion in distilled water @23°C [1].*

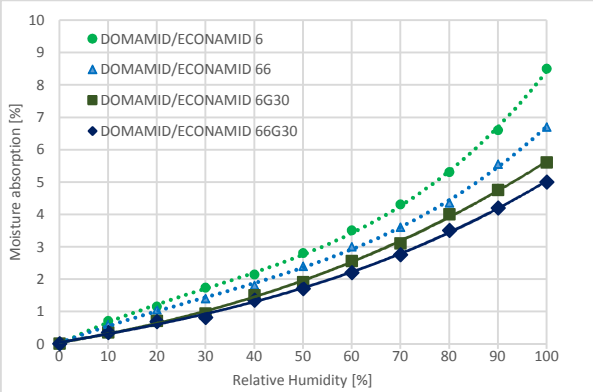

*Figure 4. Equilibrium moisture content of **DOMAMID®** and **ECONAMID®** grades as function of relative humidity during exposure in air @23 °C [1]*

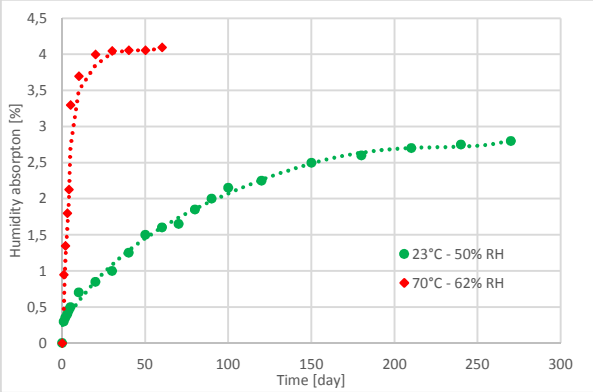

*Figure 5. Humidity absorption of **DOMAMID® 6** and **ECONAMID® 6** grades as function of time during exposure in a standard conditioning (50% RH @ 23°C – ISO 62) compared with accelerated conditioning (62% RH @70°C - ISO 1110) [1]*

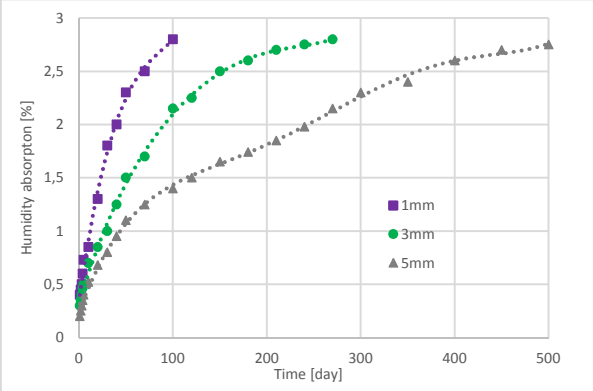

*Figure 6. Humidity absorption of **DOMAMID® 6** and standard conditioning (50% RU @ 23°C) for different thicknesses.*

[1] The data are obtained on the average values measured on test specimens 60x60x3 mm.

Our

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