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UNITIKA LTD.

TERRAMAC® Achieved World's Fastest Level of Molding Speed as Biomass-based Plastic

UNITIKA Ltd. has established a new technology that considerably improves molding speed of polylactic acid (PLA): one of the commercially available biomass-based plastics. TERRAMAC® resin, Unitika's biomass-based plastic resin, will be applied to wide range of area by this innovative technology that brings higher productivity and lower production cost.

This new technology makes the production speed up to 1.7 times higher than the process in which our conventional high-production-speed grade resin is applied so that the efficiency of production process for injection molded products is improved. Furthermore, production cost is expected to be lower because this new technology permits the lower processing temperature during injection molding and saves cost for energy. This new technology will contribute to less environmental effect by the efficiency of the production process and the lower processing temperature in injection molding process.

Now, TERRAMAC has been armed with world's fastest level molding speed and shortest level molding cycle as PLA resin. The potential applications of the PLA molded products has significantly expanded with these new properties and the other properties achieved by our earlier technology for TERRAMAC, such as heat resistance, durability, and impact resistance.

1. Background

Incineration of conventional oil-based plastics causes the increasing greenhouse gasses, such as carbon dioxide (CO_2), in the atmosphere. This means that using oil-based plastics is considered to cause global warming.

On the other hand, using PLA is considered to be less effective for global warming because it is carbon neutral material. The reason why PLA is carbon neutral is that the CO_2 emitted after wasting PLA is absorbed one during the growing corn, which is the ingredient of PLA, and carbon is just circulating in earth's natural systems.

Furthermore, the ingredient of PLA is annually-harvested corn and renewable

resource, unlike oil-based plastics. Therefore, PLA is expected to be an alternative to some oil-based plastics.

However, PLA had problems as follows:

(1) Relatively expensive than conventional polymers
(2) Insufficiently resistant against heat for common usages
(3) Less productive because of the slow molding speed

The history of TERRAMAC has been the history of combating these problems and finding new applications. In October, 2002, we had developed and commercialized PLA sheets for heat resistant applications ahead of the times by getting over the problems that PLA has low grass transition temperature and is less heat resistant and less molding processability than conventional polymers. In terms of PLA resins for foaming and injection molding, we has also eliminated the problems, such as less heat resistance, less flame resistance, and less impact resistance. Applying nano technology, adding plant-based reinforcing agents, and/or adding inorganic fillers has contributed to the elimination of the problems. See appendix.

2. Summary of Developed Technology

TERRAMAC has achieved the world's highest level molding speed as a biomass-based plastic by refining our advantageous techniques for promoting crystallization of PLA and controlling the conformation of the molecular chains during the crystallization of PLA.

The following two points for molding PLA resin are mainly improved by our new technology.

A. Innovative low mold surface temperature: 80 degree Celsius

Our new technology makes the design of die more flexible and decreases consuming energy in molding since this new technology has established the molding process with setting the mold surface temperature at 80 degree Celsius. Previously, designing die was highly restricted because the mold surface temperature should be over 100 degree Celsius in order to get heat resistant PLA molding products and such high temperature of the mold surface causes deformation of the products in ejecting them from the die or appearance of burr

around the products.

B. Remarkable short molding cycle time: 30 seconds

Our new technology makes the molding speed 1.7 times faster than our previous methods. For the molding an ISO dumbbell specimen, the previous methods required about 50 seconds for molding cycle time at 100 degree Celsius for the mold surface temperature. On the other hand, our new technology requires only 30 seconds for molding cycle time at 80 degree Celsius for the mold surface temperature. In terms of molding cycle time, it is theoretically considered that our new technology has established 1.7 times better productivity of injection molding process for PLA resin than previous methods.

As described above, we have achieved both more flexible design of die and better productivity of injection molding for PLA resin. These achievements will reduce the production cost significantly.

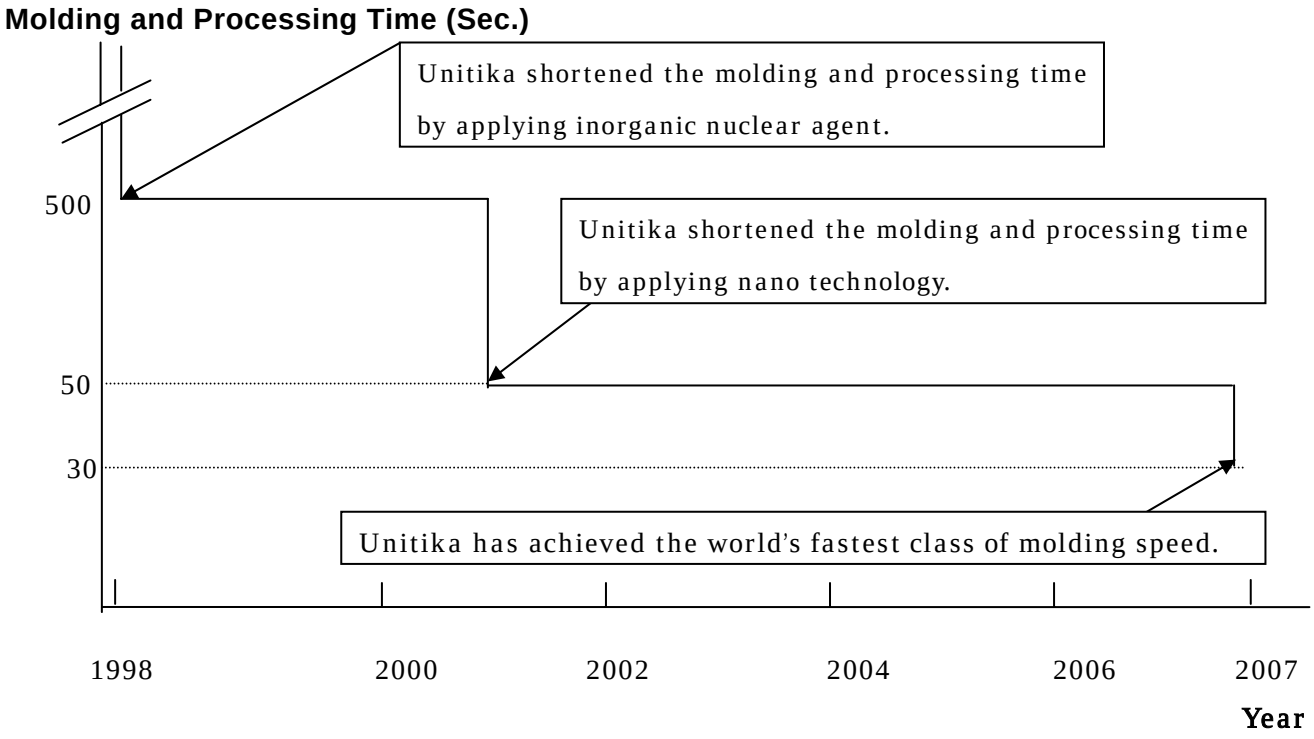
3. Expecting Effects and Applications

TERRAMAC is expected to be used in the wide range of applications, such as office automation equipments, IT devices, electronics parts, automobile interior parts, and products in the field that was considered to be impossible for PLA to be applied in terms of cost.

4. Future View

We are engaged in biomass-based and environmental friendly products mainly composed of PLA as “TERRAMAC” in various shapes such as films, sheets, fibers, and spunbonds. The new TERRAMAC resins obtained by the technology we established this time are expected to become the most important products for TERRAMAC business in the future.

Advancement of Unitika's Technology for Heat Resistant PLA



The molding cycle of the new heat resistant PLA is shown diagrammatically as follows: