Guidelines for drying Eastman Trēva™ engineering bioplastic

Drying Eastman Trēva™ engineering bioplastic pellets before injection molding is important to ensure the most stable processing and the best molded part aesthetics. Depending on storage conditions, initial moisture in Trēva pellets may be in the range of 0.25% to 1.00% (2,500 to 10,000 ppm). Pellet moisture will not significantly affect physical properties of molded parts, but drying is helpful to minimize moisture-related surface defects and to ensure stable injection processing. Undried Trēva pellets will likely produce splay and/or bubbles in molded parts. Additionally, variation in pellet moisture from batch to batch—depending on the storage history—may cause inconsistency in plastication and screw recovery, injection pressure, and fill time.

Suggested drying conditions for Trēva pellets are 80°–90°C for 2–4 hours. Target moisture content after drying is less than 0.2% (2,000 ppm). If a desiccant dryer is used, the drying is most effective; that is, drying is faster and achieves lower pellet moisture than a non-desiccant dryer. A properly maintained desiccant dryer at –40°C dew point can easily dry Trēva in 2–3 hours (Figure 1).

The suggested maximum moisture of 2,000 ppm in dried pellets is the level at which there is typically no splay in molded parts. Drying Trēva pellets to significantly less than 2,000 ppm is acceptable but provides no benefit to the molded part or the molding process. Comparing parts molded at 200 ppm vs. 2,000 ppm, there is no difference in spiral flow length, molecular weight, mechanical properties, or color.

Note that Trēva does not contain plasticizer as other cellulosic plastics do. Therefore, there is no risk of inadvertently contaminating a desiccant bed with plasticizer.

It is also possible to achieve adequate drying of Trēva with non-desiccant dryers, since it is not as moisture sensitive as other plastics. Such dryers may be in the form of ovens, trays, or small hoppers with forced air. In non-desiccant drying, it has been shown that recirculating air in a closed loop is less effective than exhausting the air to the room (open loop). See Figure 1. This is due to the closed-loop air equilibrating to a higher moisture content than in an open system.

For non-desiccant drying, hopper dryers are somewhat preferred over tray or oven dryers. Because of their design, oven and tray dryers do not move air as uniformly through the pellet beds, which decreases the effectiveness of moisture removal. The air movement and the variability of moisture load as pellet batches are moved in and out can also cause larger variation in drying air temperature.

Figure 1 compares different drying scenarios for Trēva pellets. Scenario A is for desiccant drying with initial pellet moisture of 2,500 ppm. In 3 hours, the pellet moisture has dropped to less than 200 ppm.

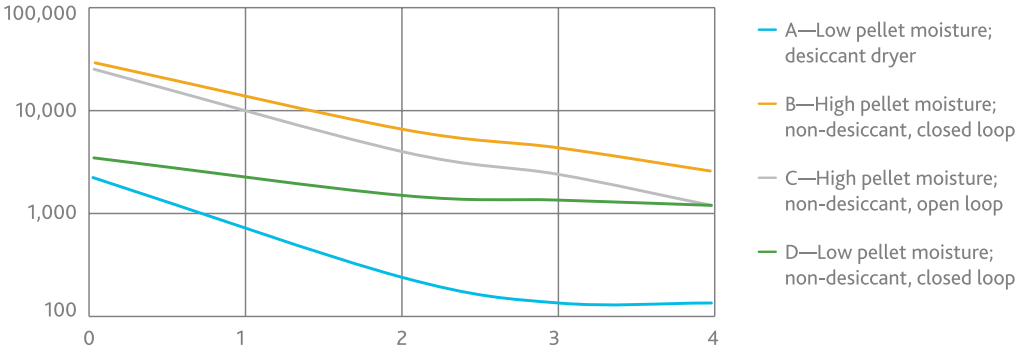
Scenarios B and C compare non-desiccant drying in a closed-loop vs. open-loop system. For these two scenarios, pellets were dosed to an unusually high level of moisture of 28,000 ppm (2.8%). In 3 hours, the pellet moisture in the closed-loop system was 4,200 ppm (0.42%) vs. the open-loop system pellets at 2,400 ppm (0.24%). At 4 hours, the moisture levels were 2,500 ppm (0.25%) and 1,200 ppm (0.12%), respectively, for the closed-loop and open-loop systems. Noting that target moisture content is greater than 2,000 ppm (0.20%), the closed-loop system in this scenario might have difficulty producing parts that are free of splay.

In a non-desiccant, closed-loop system starting with pellets at a lower moisture content, it may be possible to produce parts that are free of splay. Scenario D shows a closed-loop system with initial pellet moisture of only 3,500 ppm (0.35%). After 2 hours drying, the pellet moisture has dropped to 1,500 ppm (0.15%), and after 4 hours, it has dropped to 1,200 ppm (0.12%). In this scenario, the pellet moisture is well below the minimum to make parts free of splay.

Once pellets are dried, it is important to prevent reexposure to ambient, humid conditions when the material is transferred from the dryer to the injection molding machine. In a few minutes, even well-dried pellets can quickly absorb enough moisture from ambient air to create splay in molded parts. For this reason, it may be preferable to use a dryer that is situated directly above the feed throat of the injection molding machine rather than conveying pellets a long distance.

In the event of substantial reexposure of pellets to moisture after drying, there are no adverse effects from redrying Trēva. For redrying, simply use the same drying conditions as are used for first-time drying.

Fig 1. Drying scenarios



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Eastman Corporate Headquarters
P.O. Box 431
Kingsport, TN 37662-5280 U.S.A.

U.S.A. and Canada, 800-EASTMAN (800-327-8626)
Other Locations, +(1) 423-229-2000

www.eastman.com/locations