PREFORM special

An alternative to one-stage bottle production

Injecting customised preforms

Historically one-stage SBM machines were associated with speciality container production and the possibility of manufacturing a wide range of bottle necks and volumes on a single machine. However, the market need for higher production capacity and lower tool cost impelled two-stage machine producers to look for alternative solutions. One of the pioneers in the field, FlexBlow supplies both the versatile stretch blow moulding systems and dedicated PET preforms for hot-fill, light-weight bottle and custom bottle production.

As raw PET absorbs moisture from the atmosphere, humidity has to be removed by drying before processing. There are four main factors relevant for the PET drying process: drying temperature, dew point, drying time and airflow. Dryer temperature should be set at between 177-182°C, and dried for approximately 4h. PET resin is supplied into the hopper dryer by the use of an autoloader that works on the principle of vacuum. Drying PET inside the machine throat minimises the possibility of contamination and moisture re-absorption. Before injecting the PET into the preform mould, the resin moisture level should be dried down to 0.05% or less in order to achieve fine non-crystalline and transparent preforms.

Once the PET pellets have dried, they are forwarded for compressing and melting by rotating screw. The PET resin starts melting after it has reached the temperature of 254-256°C. A number of factors during preform injection process are in play including screw speed, injection speed and pressure, tube and nozzle temperature, switch mode speed as well as cooling and cycle time. Every single parameter mentioned above will influence the product quality, thus controlling them is fundamental.

Recommended injection speed for preforms with a wall thickness up to 4mm should be 8-12g/sec/cavity, and it can be improved to 19g/sec/cavity if the thicker wall preforms are injected. The injection machine's nozzle and front zone temperature should be close to 280°C, whilst the middle and rear zones should be around 282°C and 275°C.

As preforms shrink from a melt density of 1.15g/cm^3 to 1.33g/cm^3 solid density, depending on the wall thickness, the hold time to cool the preforms should be adjusted: the thicker walled preforms should be held longer compared to the thin walled ones that cool down almost immediately after injection. The cooling time should not be less than 1.5s, and could be as long as 20s. In addition to the cooling liquid's temperature which is normally 8-10 degrees inside the injection moulds, high-volume water flow is equally as important, and should be close to 5bar within the system, for optimal flow.

Robotic take out is recommended for preform unloading from the mould as opposed to free-drop as this allows enough time for cooling and helps to prevent the preform surface from scratches, thus ensuring a smooth finish of the preform and blown bottle at the end of the process.

PET preforms can be made both crystallisable and non-crystallisable by controlling the temperature and cooling time. The majority of PET resins are called copolymers due to the fact that a certain percentage of modifier has been incorporated in the polymer chain. Such blends improve crystallinity properties and the injection process in the mould is improved.

Thus, manufacturing custom PET preforms in relatively small quantities for containers with non-standard necks, or for ultra-light and hot-fill bottles requires knowledge and precision in controlling the process. Hitherto, the traditional approach to preform supply used to be either cooperation with large preform manufacturers on the one hand, or one-stage machine producers on the other. Terekas now sees an alternative solution midway between these two traditional approaches.

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