UTEC – Compression Molding

OBJECTIVE

The extremely high molecular weight of the Ultra High Molecular Weight Polyethylene (UHMWPE) – UTEC® leads to a very high viscosity in the molten state which results in a very low, approximately zero, melt flow index 190°C/21,6kg. Therefore, it is not possible to use conventional processing methods as injection, blow molding or extrusion, to process this material. In this case, semi-finished sheets or profiles are obtained by compression molding for consequent finishing by machining processes.

This bulletin brings some information on the most used molding process for UHMW-PE – compression molding – and the material use conditions.

This bulletin should be used as a previous recommendation for production only. The ideal process conditions will be obtained by practical tests, due to parameters that will only be defined during the production.

NECESSARY EQUIPMENT

Press: The machine should be a hydraulic press with a minimum 70 kgf/cm^2 pressure capacity over the projected part area.
The maximum temperature should be 220ºC approximately; therefore, the press should be designed for that.

Mold: The mold should be designed to support 70 kgf/cm^2, with a good safety factor. The mold shall have heating and cooling channels.

For sheets with thickness over 20mm, the mold should have a temperature control of the superior and inferior parts. This is necessary to avoid a premature cooling, which would create a thin solid film in the part's surface.
A gap of 3 to 5mm between the male and female mold parts is enough, since UTEC do not flow in the molten state.

The mold surface finishing depends on the part's needs. In case a polished mold is used, it is recommended to use a release agent, for example a stearate powder.

In order to calculate the powder quantity, it must be taken into consideration the density difference between the powder (~ 0.45 g/cm^3) and the molten material (~ 0.95 g/cm^3). To calculate the mold height a factor of ~ 2.5 is generally used. As an example, for the production of a 20mm-thick sheet we must have in the mold a height of 50mm.

Auxiliary Equipments:

Scale: to weight the material.

Mixer: to add pigments or additives.

Ruler: to level the powder surface into the mold.

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PROCEDURE

1. Weight the necessary powder quantity.

2. Add the additives and pigments (if necessary) and put the powder into the mold.

3. Level the powder thickness with the auxiliary of a ruler. This is a necessary operation, because as the material does not flow, the powder thickness irregularities could cause unfilled areas in the final sheet.

4. Degassing (powder air removal): gradually apply pressure till 50kgf/cm^2 and maintain this pressure for 2 minutes, from the moment that the piston remains still. After 2 minutes, reduce the pressure to zero.

5. Repeat the previous operation elevating the pressure until 70kgf/cm^2 and reducing it until 30kgf/cm^2 after 2 minutes.

6. Start heating the mold until a temperature of 220°C approximately, keeping a pressure of 30kgf/cm^2.

7. Let the mold in this temperature until the powder in the middle of the mold reaches 160°C. The necessary time for that depends on the sheet thickness. The table below shows some examples:

Time (min)	2.0	2.5	9.0	20.0	35.0
Thickness (mm)	2.0	5.0	10.0	15.0	20.0

8. Start the cooling cycle.

9. When the temperature reaches 150°C, you must gradually increase the pressure until 70kgf/cm^2 and hold this until the end of cooling. This high pressure avoids the formation of sink marks due to the material contraction.

10. In sheets with thicknesses over 25mm, you must guarantee that the temperature on the sheet edges is kept at 150 °C, while the middle of the sheet is still not cooled.

The presence of opaque and/or white areas on a heated transparent sheet may indicate:
- inadequate plastification due to inefficient heating;
- inadequate pressure distribution due to the mold format or to the poor powder distribution;
- trapped air due to problems on the degassing phase.

Note: The information contained herewith is merely informative. It is presented in good faith and expresses the truth based on the current acquired knowledge. They do not imply in any guarantee of result or performance.