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Equivalency of Foaming Temperature and Time about Cell Density of Foamed Polystyrene

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In this paper, the equivalency between the foaming temperature and foaming time of the cell density, the number of cell per unit volume remaining in the foamed polystyrene (PS) resin, will be discussed. The foaming was carried out by the following method. The blowing agent was soaked into the solid resin at high pressure under temperature lower than the glass transition temperature of the resin. After the blowing agent reached its saturation state, cell nucleation and cell growth were induced by heating various foaming temperatures higher than the glass transition temperature and various foaming times after decompression. Finally, cell growth was halted by cooling. Concretely, using a device that can accurately control temperature and the decompression rate, PS resins were foamed under various the foaming temperatures and the foaming times by the above-mentioned method. The following results were obtained. (1) Cell size of foamed polystyrene (PS) plastics shows time and temperature dependence as the cell sizes become small when foaming temperature is low and foaming time is short. (2) Cell density of foamed PS plastics show time and temperature dependence as the cell densities become large when foaming temperature is low and foaming time is short. (3) Equivalency is maintained between the foaming time and foaming temperature dependence of the cell density of foamed PS, and it can be expressed with one master curve. That is, the time-temperature equivalent law is held about cell density. (4) The time-temperature shift factor when a master curve is made becomes two Arrhenius' types of one with different activation energy, which it looks like the one of the viscoelastic behaviour of the materials. (5) Based on this equivalency, it is possible to predict the required foaming conditions of plastics having arbitrary cell densities.