Polymer Services Group
Innovation, Application, Evaluation

PVC Pipe Extrusion

Extrusion has been around since the Chinese have made pasta and the Europeans have made sausage. Extruders are very similar to today's meat grinder/sausage stuffers. They basically consist of a motor at one end attached to a screw conveyor inside a metal housing, or barrel. Material is fed into the hopper, compressed by the forward motion of the screw, and forced through the die orifice into some particular shape.

PVC pipe extrusion begins with the powder blending operation. The PVC resin arrives in a granular form, like sugar. It is added to a large intensive mixer, similar to a home blender. The intensive mixing action creates heat by friction of the resin particles rubbing against each other. As the resin heats the liquid ingredients are added to the formulation, which are absorbed into the porous resin particles. Next the low-melting ingredients and waxes are added, followed by the higher-melting waxes and polymeric additives which get dispersed and adsorbed onto the surfaces of the PVC resin particles. Finally the solid additives are added and dispersed into the dry blend. The hot mixture is then transferred to a less intensive blender where the formulation is cooled and transferred to a silo or large holding container.

Ultimately the PVC dryblend is transferred to the hopper of the extruder. The powder falls into the channels of the screw and is conveyed through the heated cylinder of the extruder. Most extruders use a single screw, however, PVC extruders generally use twin-screw extruders for better mixing and heat control. The screws compress the powder creating heat through friction and shearing, or mixing action, as well as forcing the powder against the heated metal chamber or barrel. Most of the heat used to melt the resin is derived from the mechanical shearing action of the screws and not from heat transfer from the barrel. In fact, during steady-state operation, many PVC extruders utilize screw- and barrel-cooling to control the temperature of the process.

The screw fits tightly in the barrel, such that with each revolution of the screw, the top of the screw flight actually wipes away molten PVC from the barrel surface and collects the melt within the screw flight. By the time the PVC has been transferred about half-way through the extruder, the PVC mixture has become more of a cheesy, dough-like mixture. At this point, the screws are designed to decompress the resin and permit air and volatile materials to escape through a vacuum vent in the barrel. Next, the screws recompress the PVC to complete the

melting or fusion process, and pumps the viscous material into the die where the pipe begins to be formed.

The viscous melt exits the ring-shaped orifice of the die in the general cylindrical form of a pipe. Because the melt has been under considerable pressure within the die, the material expands as it exits the die. The outside diameter of the extrudate gets larger than the orifice diameter, and the thickness of the wall becomes thicker than the die gap opening. In the short gap between the exit of the die and the cooling station, the extrudate is pulled by the downstream take-off unit to size the wall thickness, while the outside surface of the extrudate is sucked against the chilled vacuum-sizing rings which calibrate the pipe's final outside diameter. As the pipe exits the cooling station, the pipe is cooled enough to retain its shape. The product is marked, cut into lengths, and stacked, ready for shipment.

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