PWPipe

# TECHNICAL BULLETIN

**SPECIFICATIONS** **TB-S3**

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## Polyvinyl Chloride (PVC) Pipe Compound

Polyvinyl Chloride (PVC) Pipe compound is produced by adding a variety of ingredients to PVC resin. By adjusting the type and quantity of these ingredients, all of the different water, sewer, irrigation, plumbing, and electrical products can be produced. The following list describes common ingredients and provides a brief discussion of their functions.

| | |
|---|---|
| **Polyvinyl Chloride (PVC) Pipe Compound** | PVC pipe compound consists mainly of bulk PVC thermoplastic resin. The resin is a basic polymer, which is produced as a fine, white powder. Between 70 and 90 percent of PVC pipe by weight is composed of PVC resin. The remaining percentage of the pipe compound is comprised of additives that chemically react and/or combine with PVC resin to optimize processing and generate desirable physical characteristics in the finished product. |
| **Polyvinyl Chloride (PVC) Pipe Resin** | The bulk polymer associated with PVC pipe compound is known as PVC homopolymer and is produced from vinyl chloride monomer (VCM), a colorless and odorless gas. VCM is produced from common salt and ethylene. |
| **Stabilizer Additive** | The stabilizer protects PVC pipe compound and compound polymer chains from thermally degrading during the extrusion process. Stabilizers also exhibit some external lubrication characteristics that promote a certain amount of slippage of the compound melt through the extruder and die metal surfaces. |
| **Calcium Stearate Additive** | As an “internal lubricant,” calcium stearate promotes flow and slippage of polymer chains within the compound melt. It increases melt strength while lowering melt viscosity of the compound. At higher usage levels, it promotes compound fusion (the process of going from a powder form to a fused or melt form). It possesses some external lubrication characteristics at certain process temperatures and usage levels, and also works with the stabilizer to protect against thermal degradation of PVC compound. |
| **Paraffin Wax Additive** | Paraffin wax is a true “external lubricant.” It promotes proper slippage and eliminates possible sticking of the compound melt to the associated hot, internal metal surfaces of the extruder and extruder die. This wax also delays fusion. |

**Polyethylene Wax Additive**

Polyethylene wax is primarily an external lubricant, which performs effectively at higher temperatures. It also has some of the same properties as that of an internal lubricant. This wax is utilized in the PVC pipe compound at a very low usage level.

**Pigmentation Additive**

The variety of colors in PVC pipe is achieved by introducing different pigments during compounding or extrusion. These additives are considered non-reactive and are utilized only to achieve the proper color. Titanium dioxide is the primary pigment and gives pipe a white or beige color with the desired brightness and opacity. Prior to field installation, it also retards pipe discoloration due to ultraviolet light. Carbon black is used in conjunction with titanium dioxide to produce gray or black color in the pipe. This additive is used primarily in the electrical conduit and duct pipe compounds at very low usage levels. Other colors can be used to produce a pipe for a specific end use, such as the purple color for reclaimed water pipe.

**Calcium Carbonate Additive**

Calcium carbonate is also considered a non-reactive ingredient, although some grades improve the melt flow. It comes in different grades, which can be combined with other ingredients to optimize finished product characteristics. Some calcium carbonates can cost more than PVC resin on a cost-per-unit volume basis. Choice of grade and use level is made to design specific high modulus, high tensile, and high impact compounds. (See Table below.)

**Acrylic Process Aid/Impact Modifier Additive**

The acrylic process aid acts much like an internal lubricant, which promotes fusion, reduces melt viscosity, and increases melt strength of the compound during the extrusion process. It also has the ability to reduce uneven compound melt flow as the melt is extruded from the die. When combined with the impact modifier, the ingredient adds toughness and impact resistance to the finished product.

Formulations can be produced with a variety of characteristics by varying the quantities of the additives. The following table shows how a typical formulation can be changed to produce a high tensile, high modulus, or high impact product.

**Typical Formulations**
**(Pounds per Hundred Pounds Resin)**

| Ingredient | High Tensile | High Modulus | High Impact |
|---|---|---|---|
| Stabilizer | 0.30 – 1.00 | 0.30 – 1.00 | 0.30 – 1.00 |
| Calcium Stearate | 0.40 – 1.50 | 0.40 – 1.50 | 0.40 – 1.50 |
| Paraffin Wax | 0.60 – 1.50 | 0.60 – 1.50 | 0.60 – 1.50 |
| Polyethylene Wax | 0.00 – 0.30 | 0.20 – 0.40 | 0.10 – 0.20 |
| Titanium Dioxide | 1.00 – 3.00 | 1.00 – 3.00 | 1.00 – 3.00 |
| Calcium Carbonate | 0.00 – 5.00 | 0.00 – 40.00 | 0.00 – 15.00 |
| Acrylic Process Aid/Impact Modifier | 0.00 – 2.00 | 0.00 – 2.00 | 2.00 – 5.00 |