Table 7.41

Properties of Common Thermoplastics

Polyvinyl Chloride (PVC)

Advantages:
- Can be compounded with plasticizers, filters, stabilizers, lubricants and impact modifiers to produce a wide range of physical properties
- Can be pigmented to almost any color
- Rigid PVC has good corrosion and stain resistance, thermal & electrical insulation, and weatherability

Disadvantages:
- Base resin can be attacked by aromatic solvents, ketones, aldehydes, naphthalenes, and some chloride, acetate, and acrylate esters
- Should not be used above 140°

Applications:
- Conduit and conduit boxes
- Housings
- Pipe
- Wire and cable insulation
- Relative permittivity 3.20 down to 2.84 with rising frequency and 100% pure (plumbing PVC is not pure, but has additives for various purposes)

Polystyrene

Advantages:
- Low cost
- Moderate strength
- Electrical properties only slightly affected by temperature and humidity
- Sparkling clarity
- Impact strength is increased by blending with rubbers, such as polybutadiene

Disadvantages:
- Brittle
- Low heat resistance

Applications:
- Capacitors
- Light shields
- Knobs
- Relative permittivity 2.55, stable over frequency

Polyphenylene Sulfide (PPS)

Advantages:
- Excellent dimensional stability
- Strong
- High-temperature stability
- Chemical resistant
- Inherently completely flame retardant
- Completely transparent to microwave radiation

Applications:
- R3-R5 have various glass-fiber levels that are suitable for applications demanding high mechanical and impact strength as well as good dielectric properties
- R8 and R10 are suitable for high arc-resistance applications
- R9-901 is suitable for encapsulation of electronic devices
- Relative permittivity 3.0

Polypropylene

Advantages:
- Low density
- Good balance of thermal, chemical, and electrical properties
- Moderate strength (increases significantly with glass-fiber reinforcement)

Disadvantages:
- Electrical properties affected to varying degrees by temperature (as temperature goes up, dielectric strength increases and volume resistivity decreases)
- Inherently unstable in presence of oxidative and UV radiation

Applications:
- Automotive battery cases
- Blower housing and fan blades
- Insulators
- Lamp housings
- Support for current-carrying electrical components
- Relative permittivity 2.25 - 2.56, but not rated at UHF

Polyethylene (PE)

Advantages: Low Density PE
- Good toughness
- Excellent chemical resistance
- Excellent coefficient of friction
- Near zero moisture absorption
- Easy to process
- Relatively low heat resistance

Disadvantages:
- Susceptible to environmental and some chemical stress cracking
- Wetting agents (such as detergents) accelerate stress cracking

Advantages: High Density PE
- Same as above, plus increased rigidity and tensile strength

Advantages: Ultra-High Molecular Weight PE
- Outstanding abrasion resistance
- Low coefficient of friction
- High impact strength
- Excellent chemical resistance
- Material does not break in impact strength tests using standard notched specimens

Applications:
- Bearings
- Components requiring maximum abrasion resistance, impact strength, and low coefficient of friction
- Relative permittivity 2.26, stable over frequency

Phenolic

Advantages:
- Low cost
- Superior heat resistance
- High heat-deflection temperatures
- Good electrical properties
- Good flame resistance
- Excellent moldability
- Excellent dimensional stability
- Good water and chemical resistance

Applications:
- Commutators and housings for small motors
- Heavy duty electrical components
- Rotary-switch wafers
- Insulating spacers
- Relative permittivity 5.25 down to 3.57 with rising frequency and depending on formulation

Nylon

Advantages:
- Excellent fatigue resistance
- Low coefficient of friction
- Toughness as a function of degree of crystalinity
- Resists many fuels and chemicals
- Good creep- and cold-flow resistance as compared to less rigid thermoplastics
- Resists repeated impacts

Disadvantages:
- All nylons absorb moisture
- Nylons that have not been compounded with a UV stabilizer are sensitive to UV light, and thus not suitable for extended outdoor use

Applications:
- Bearings
- Housings and tubing
- Rope
- Wire coatings
- Wire connectors
- Wear plates
- Relative permittivity 3.2 - 5, numerous formulations