Overview of individual plastic piping materials

There are three main types of "plastics": thermoplastics, thermosets and elastomers.
Thermosets and elastomers can only be cured once, and when they have been hardened they cannot be changed in shape by heating. They cannot be fused or melted. Thermoplastics, however, can be repeatedly heated to a liquid state and then rehardened by cooling with no measurable change in the properties of the material. They can also be fused.
Thermoplastics are ideal for use as materials for piping systems. Several materials are in common use for this application, each offering unique properties and features that distinguish it from other materials. In this way it is possible to closely match the choice of material to the application, particularly with respect to the duty and the cost effectiveness.
The following is an overview of the materials in common use for rigid thermoplastic piping systems.

PVC-U (Unplasticised Polyvinyl Chloride)

Exceptionally economical in cost, PVC-U is by far the most commonly used thermoplastic piping system. Unplasticised Polyvinylchloride (PVC-U) is one of the oldest and most widely used plastics for piping systems worldwide. It is a highly versatile material that is used for both pressure and drainage piping systems for above and below ground applications. It is an amorphous thermoplastic material with good tensile, flexural and mechanical strength, low moisture absorption, good flammability characteristics, and exceptional dimensional stability.
PVC-U has excellent chemical resistance across its operating temperature range of 0°C to 60°C, with a broad band of operating pressures. In addition, because of its long term strength characteristics, high stiffness and cost effectiveness, PVC-U systems typically account for a large proportion of thermoplastic piping installations.
PVC-U is resistant to most solutions of acids, alkalis, salts and organic compounds miscible with water. It is not resistant to solvents, aromatics and some chlorinated hydrocarbons.

PVC-C (Post-chlorinated Polyvinyl Chloride)

Post-chlorinated Polyvinylchloride (PVC-C) is a highly versatile material that has been used for both pressure and drainage piping systems for above and below ground applications for more than forty years. It is an amorphous thermoplastic material with good tensile, flexural and mechanical strength, low moisture absorption, good flammability characteristics, exceptional dimensional stability and good tenacity.
PVC-C also has excellent chemical resistance across its operating temperature range of 0°C to 90°C, with a broad band of operating pressures. In addition, because of its long-term strength characteristics, high stiffness and cost effectiveness, PVC-C systems are suitable for a wide diversity of thermoplastic piping installations.
PVC-C is resistant to many acids, bases, salts, paraffinic hydrocarbons, halogens and alcohols. It is not resistant to solvents, aromatics and some chlorinated hydrocarbons.

ABS (Acrylonitrile Butadiene Styrene)

Acrylonitrile Butadiene Styrene (ABS) has been manufactured as a pressure piping system for more than 30 years, and it is a widely used versatile material that can also be found in car parts, household goods, DIY tools as well as thermoplastic piping. ABS is copolymer of Styrene and Acrylonitrile grafted to Polybutadiene. The chemical resistance of Acrylonitrile, added to the impact strength of Butadiene, combined with the processing properties of Styrene, produce and homogenous material with chemical resistance, ductility and tensile strength. The Butadiene content of ABS provides exceptional resistance to impact damage at temperatures as low as -40°C and up to 80°C.
ABS offers good abrasion resistance to aggressive slurries, and its smooth bore allows high flow velocities whilst inhibiting the formation of scale.
ABS is mostly resistant to solutions of salts, inorganic acids, food acids and alkalines. It is not resistant to solvents, aromatics and some chlorinated hydrocarbons.

Overview of individual plastic piping materials

PP (Polypropylene)

Polypropylene (PP) is a partially-crystalline thermoplastic from the polyolef in group of materials, and it is characterized by its low density when compared to other thermoplastics. A unique combination of properties including mechanical strength, chemical resistance and thermal stability all combine to make polypropylene one of the most popular piping systems materials.
Because of its non-polar nature, polypropylene generally exhibits a good resistance against a variety of chemicals, such as salts, acids, and alkalis. Good chemical resistance is also achieved against contact with solvents, such as alcohols, esters and ketones. Consequently, solvent cement welding of polypropylene pipes and fittings is not possible.
Polypropylene is suitable for applications within the temperature range -10°C to 100°C. The material has a very good resistance to chemicals and solvents. Good with aqueous, salts, acids or alkaline solutions. It can be attacked by halogens, some acids and oxidizing agents, and by aromatic and chlorinated hydro-carbons at high temperatures.

PE (Polyethylene)

Polyethylene (PE) is a partially-crystalline thermoplastic from the polyolefin group of materials, and it is characterized by its low density when compared to other thermoplastics. A unique combination of properties including mechanical strength, chemical resistance and thermal stability all combine to make polyethylene one of the most popular piping systems materials. It is suitable for use within the temperature range from -40°C and up to 65°C Polyethylene is non-polar and exhibits a good resistance against a variety of chemicals, however strong oxidizing acids attack the material. Good chemical resistance is achieved against contact with solvents, such as alcohols, esters and ketones. Consequently, solvent cement welding of PE pipes and fittings is not possible. When compared to other thermoplastics, PE shows excellent diffusion resistance, and because of this property, polyethylene has been successfully applied for the safe transportation of gases for many years.
Polyethylene has good resistance to acids and caustic substances. Resistant to organic and inorganic solvents at a wide range of temperatures. It is not resistant to strong oxidizing acids.

PVDF (Polyvinylidene fluoride)

PVDF is a thermoplastic that is distinguished from other fluorinated polymers by its ease of processing, good welding characteristics, and good heat formability. PVDF also has high mechanical strength, excellent chemical resistance, and high operating temperature capabilities. It has the widest range of applications of any of the thermoplastics used for rigid piping systems, and has outstanding characteristics within the temperature range from -20°C to 140°C.
The excellent chemical resistance of PVDF means that it is extensively used in the chemical industry as a piping system for aggressive liquids, and in the field of tank construction and lining. PVDF is a hornopolymer without additives such as stabilizers and processing agents. It also displays excellent flame retardant properties. Consequently, PVDF is listed with many worldwide agencies as suitable for use with foodstuffs, dairy products, in semi-conductor and pharmaceutical manufacturing, and for other applications in the food and drug sector.
PVDF is resistant to most acids, alkalis, salts, halogens, alcohols and chlorinated hydro-carbons. Strong polarized solvents, such as ketones and esters, can cause the material to swell.

ECTFE (Ethylene-chlortrifluorethylene)

ECTFE is an extremely pure polymer that contains no stabilizers, plasticizers, lubricants or flame retardant additives. ECTFE offers many advantages with its superior chemical resistance and high temperature capabilities, making it ideally suited for highly demanding applications.
ECTFE has an extremely smooth surface finish, and the pipes, fittings and semi-finished products are used in a wide diversity of applications from high purity liquid applications in the semi-conductor industry, to process piping systems and tank linings in the chemical industry.
ECTFE is resistant to most acids, alkalis, salts, halogens, alcohols and chlorinated hydrocarbons, and is especially good with caustics and chlorine solutions.