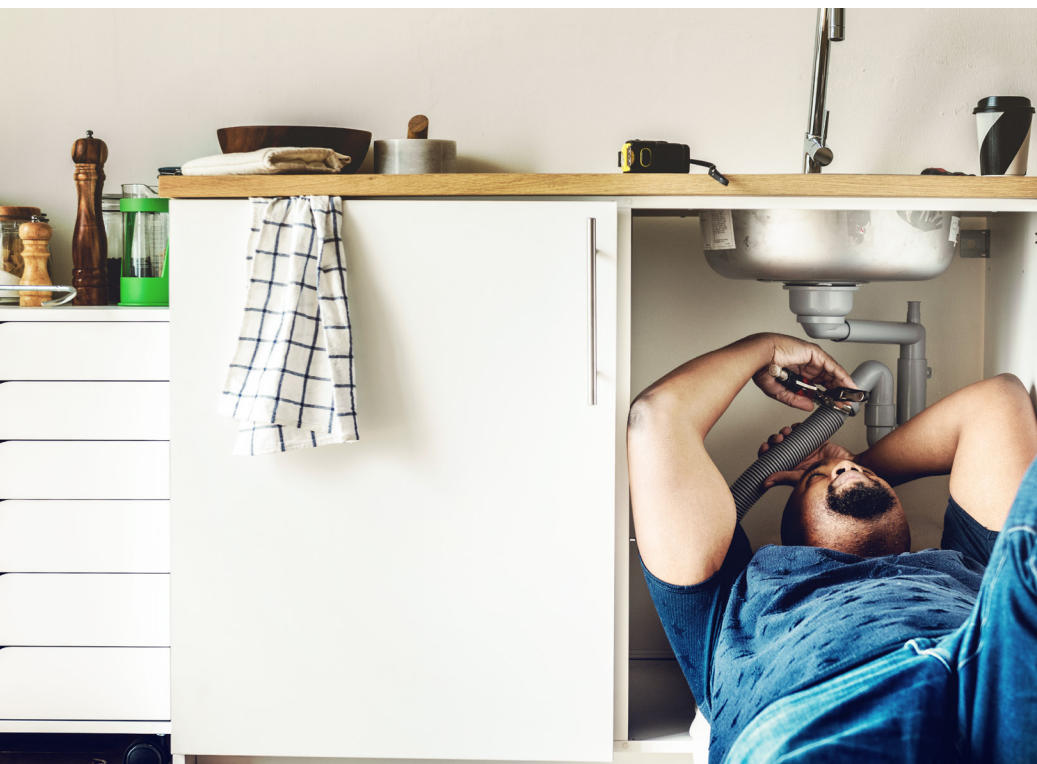


HOMEOWNER'S GUIDE TO CPVC



WHY CPVC IS THE
BEST CHOICE FOR
EVERY HOME

FLOWGUARD[®] PLUS
CPVC PLUMBING SYSTEMS[™]





INTRODUCTION

Traditional houses and villas count for more than half of all households in India. For homeowners who rely on their plumbing systems to consistently deliver clean, safe drinking water with little-to-no maintenance or repair work required, material selection is critical.

Whether you're installing a new system or replacing an existing one, single family homeowners have a major say in what material is used for their pipes and fittings. Plumbing mishaps can have devastating effects. Homeowners must be sure they are making informed decisions about plumbing products and selecting the appropriate materials.

MATERIAL OPTIONS

FlowGuard® Plus CPVC pipe and fittings are backed by 60 years of proven performance in various applications, with distinct advantages over many of the common materials used in residential plumbing systems.

CPVC

CPVC (chlorinated polyvinyl chloride) is a strong, durable thermoplastic that has been successfully used in plumbing applications around the world.

Key advantages users recognize with FlowGuard® Plus CPVC include:

- Superior water quality
- Excellent chlorine and biofilm resistance.
- Fire resistance.
- Easy, cost-effective and safe installation.

Furthermore, CPVC's chemical resistance, reliability and ability to stand up to high heat and pressure make it ideal for residential piping systems.

PEX

Crosslinked polyethylene (PEX) is a plastic plumbing pipe used to replace copper tubing during the late 1960s. However, over the last 20 years, PEX systems have been reinvented multiple times due to product liability concerns.

In the USA, there have been at least 22 plumbing failure class action lawsuits in the last 17 years and since 2008, at least 10 lawsuits have involved PEX plumbing systems, stemming from failures due to contact with drinking water. PEX piping is:

- A permeable material, meaning that contaminants coming in contact with the outside of the pipe may be transmitted through the pipe wall, leading to water contamination.

- Prone to failure as a result of ultraviolet (UV) light.
- Time-consuming and expensive to install, compared to CPVC.
- Affected by chlorine in hot water systems and only tested to resist chlorine at levels up to 4.3 ppm. The use of chlorine-based disinfectants reduces the temperature rating of PEX by 22°C (from 82°C to 60°C).



Limiting Oxygen Index (LOI) is the percentage of oxygen needed in the atmosphere to support combustion. The higher the value, the greater resistance to burning.

CPVC has an LOI of 60 and does not support combustion.

PPR has an LOI of 17, making it a more combustible material.

GREEN PIPE (PPR)

Polypropylene (PPR), or green pipe, is a thermoplastic like CPVC. But since its emergence, PPR system failures are reported in diverse climates and regions due to poor installation and damaged pipes—often caused by the chlorine and chlorine dioxide disinfectants used in potable water. PPR claims to have a lifespan of around 50 years, but has no installations dating back far enough to prove that in real-world applications.

Homeowners should be wary of using PPR because the material is:

- Less durable and susceptible to oxidative stress and cracking caused by hot chlorinated water.
- More dangerous and expensive to install. With less tensile and exural strength compared to FlowGuard® Plus CPVC, PPR requires more hangers and support. Additionally, the heat fusion joining method exposes installers to burn risks
- More susceptible to bacterial growth and biofilm formation than CPVC*.
- More combustibile, which can increase fire damage when aiming drips fall from the pipe.

COPPER

Copper is one of the more traditional plumbing pipe materials. However, many professionals have moved to alternatives due to common problems like pitting, scaling and corrosion. Additionally, copper pipes are:

- Soldered together, which requires a skilled expert.
- Prone to condensation, which can drip and cause water damage.

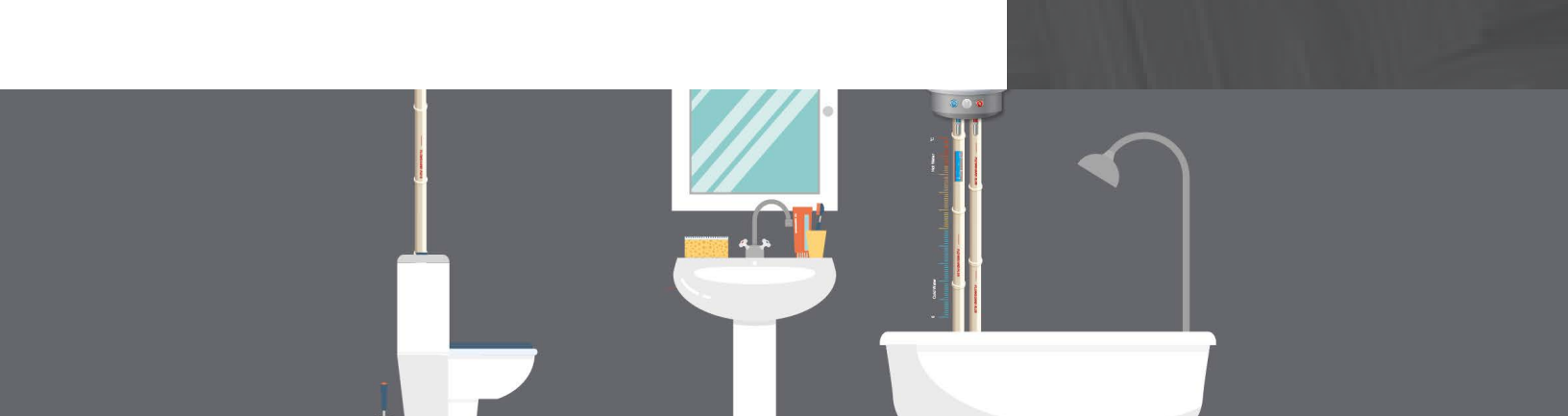
- Extremely taxing on the environment as a result of mineral extraction, smelting and soldering, production, installation and even recycling.
- Susceptible to leaching harmful pipe material into drinking water under aggressive water conditions.
- Signi cantly more expensive than other piping materials, including CPVC.

POLYBUTYLENE

Polybutylene used to be the standard for plumbing systems. But due to growing research and poor eld performance, it is no longer permitted in many places, including new constructions in North America.

The product was found to react with low levels of chlorine in drinking water, leading to reduced tensile strength and premature failure. For countless homes around the world, FlowGuard® Plus CPVC plumbing systems have served as a replacement for polybutylene.

*©Kiwa Water Research, 2007, Assessment of the microbial growth potential of materials in contact with treated water intended for human consumption, KWR O7.068



HOW TO COMPARE PLUMBING PIPE MATERIALS

As the pioneer in CPVC technology, FlowGuard® Plus CPVC Pipe and Fittings is trusted by homeowners around the world. We offer the most well-established piping material across all markets, which continually delivers greater results than other piping materials in key performance areas.

WATER QUALITY

FlowGuard® Plus CPVC has been tested for performance capabilities and international water standards at the following reputable organizations:

NSF International: the Public Health and Safety Company™, a non-profit, non-governmental organization, is the world leader in standards development, product certification, education, and risk-management for public health and safety. While focusing on food, water, indoor air, and the environment, NSF develops national standards and provides third-party conformity assessment services.

Water Regulation Advisory Scheme (WRAS) (UK): The purpose of WRAS is to contribute to the protection of public health by preventing contamination of public water supplies and encouraging the efficient use of water by promoting and facilitating compliance with the Water Supply (Water Fittings) Regulations and Byelaws in Scotland.

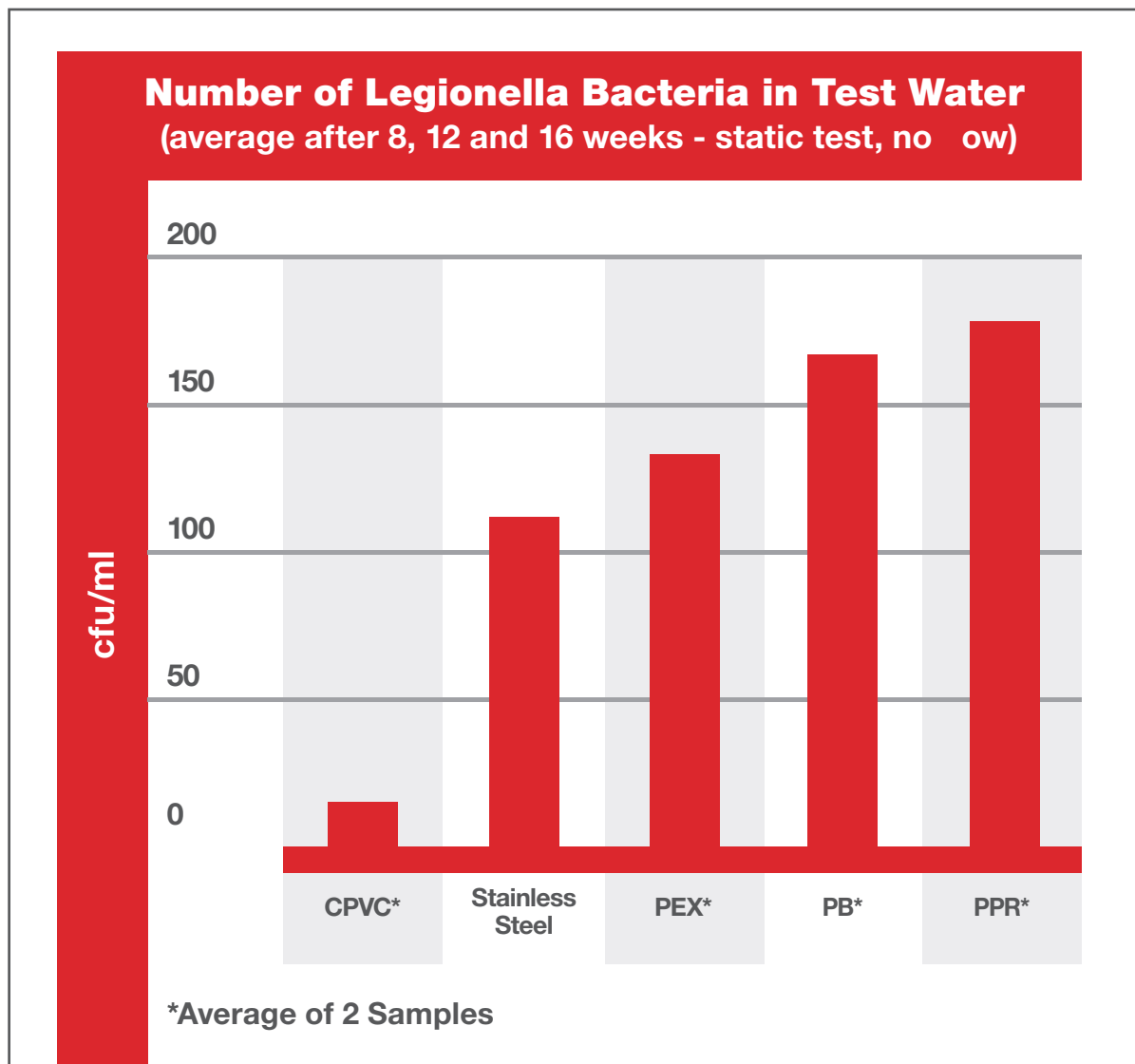
Fédération Île-de-France de Recherche sur l'Environnement (Fire ex- CRECEP) (FRANCE): The Federation Ile-de-France for Research on the Environnement, aims to promote interdisciplinary researches in environmental sciences. It mainly focuses on researches relating to surfaces connecting with human activities (catchment areas and large watersheds, living area, hydrographic network, farm plot and forest, small agricultural region, urban and rural landscapes).

BACTERIA RESISTANCE

The key to CPVC's resistance to bacteria is its very low potential for biofilm formation.

biofilm forms when biomass such as bacteria, fungi, algae and mold adhere to surfaces in wet environments. Results from the Kiwa Water Assessment confirms PPR has the greatest potential for biofilm formation compared to other piping materials. **See Figure 1.**

FIGURE 1



Study: Biofilm Formation Potential of Pipe Materials in internal installations by H.R. Veenendaal /D.

Van de Kooij – KIWA - 1999

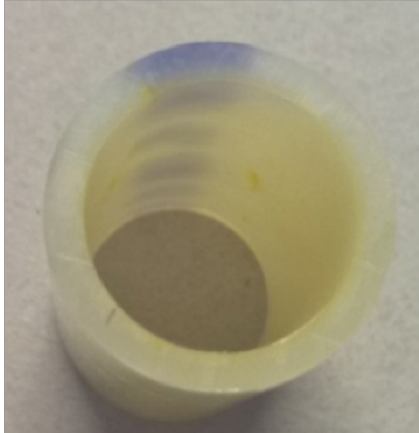
(KIWA is the approvals agency for potable water piping systems in The Netherlands)

Compared to other piping materials, it's harder for bacteria to form within CPVC because of several qualities, including:

- The chemical makeup and smoothness of the interior pipe surface, which makes it difficult for bacteria to latch onto the material.
- The absence of plasticizers, which act as a nutrient source for fungi.
- CPVC's resistance to scaling and corrosion.
- CPVC resists biofilm formation. Chlorine and chlorine dioxide don't deteriorate CPVC, which would create small gouges along the pipe's surface where biofilm can easily grow.

CHEMICAL RESISTANCE

Chemical permeation occurs when a substance or material comes in contact with the outside of a pipe and transmits contaminants through the pipe wall into your water.



The ink from the print line on this PEX pipe has permeated almost completely through the pipe after less than 10 years.

CPVC is not subject to chemical permeation. Thanks to its chlorine content, additives and chemical makeup, CPVC is resistant to permeation of many common chemicals that can pollute water.

COST

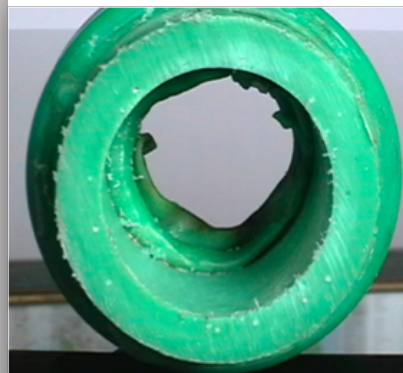
Installation and labor costs make up a considerable portion of the total plumbing system cost. With FlowGuard® Plus CPVC, it is easy and safe to quickly assemble a strong, leak-free plumbing system. This speed and reliability allow for cost savings, improved safety and long-term joint strength.

INSTALLATION COSTS AND SAFETY

Installation costs can make up half of the total plumbing system cost. However, CPVC piping systems are very cost-effective compared to other materials. In fact, FlowGuard® Plus CPVC can be installed quicker than any other piping system, and many contractors reported saving on labor compared to PPR.

Homeowners will experience further cost-savings with CPVC compared to other piping materials because:

- CPVC is more rigid than many other plastics, meaning it sags less and requires fewer hangers, resulting in quicker installation.
- CPVC is installed with simple, inexpensive hand tools. These tools are easy to obtain and typically don't require a great deal of space on a job site—nor special permits.
- CPVC installation tools are very safe. No torches or welding machines are needed. This significantly reduces the potential for injuries, particularly burns, which can limit liability costs.
- PPR requires heat fusion to install. This leads to the likelihood of bead formation inside the pipe, which reduces flow rate and increases mineral deposits and bacterial growth.



UTILITY EXPENSES

Thermal conductivity of a copper system is 2,500 times that of a FlowGuard® Plus CPVC system, and FlowGuard® Plus CPVC thermal conductivity is about 30% better than other plastic pipes.

The improved insulating characteristics associated with FlowGuard® Plus CPVC may generate substantial long-term savings for an energy-conscious homeowner. FlowGuard® Plus CPVC will keep hot water hotter and cold water cooler compared to copper and may reduce energy loss.

SERVICE LIFE

With a history of successful, long-lasting installations, FlowGuard® Plus CPVC continues to be the ideal choice for residential plumbing applications because of several advantages.

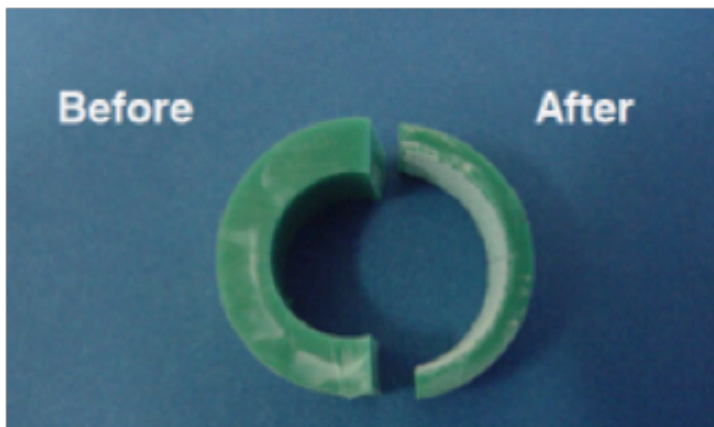
CHLORINE RESISTANCE

Chlorination is the most common method used for disinfecting drinking water. According to the World Health Organization “the use of chlorine to protect drinking water is one of the greatest public health advances in history.”

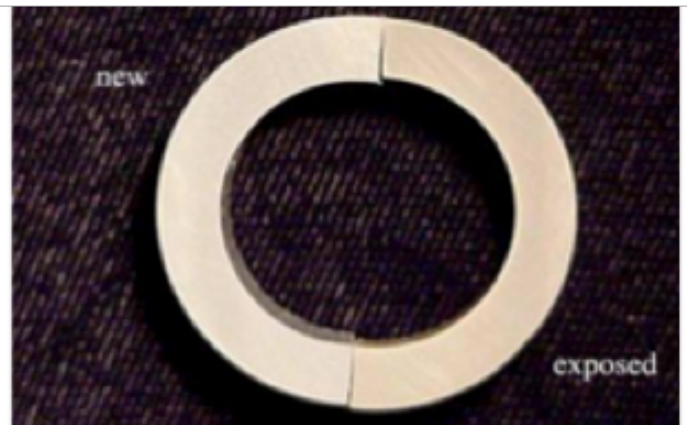
When chlorine and water mix, they can form hypochlorous acid, which is known to break down materials like PPR, metal and PEX.

CPVC is unaffected by the hypochlorous acid present in the potable water supply. This results in a stronger plumbing system with a longer service life.

Other materials, like PPR, don't have the same defense mechanisms when exposed to hypochlorous acid. This results in oxidation stress cracking inside the pipes and erosion of the pipe wall, leaving a thinner, weaker material.



PPR Erosion
After 10 months (at 5ppm Chlorine)



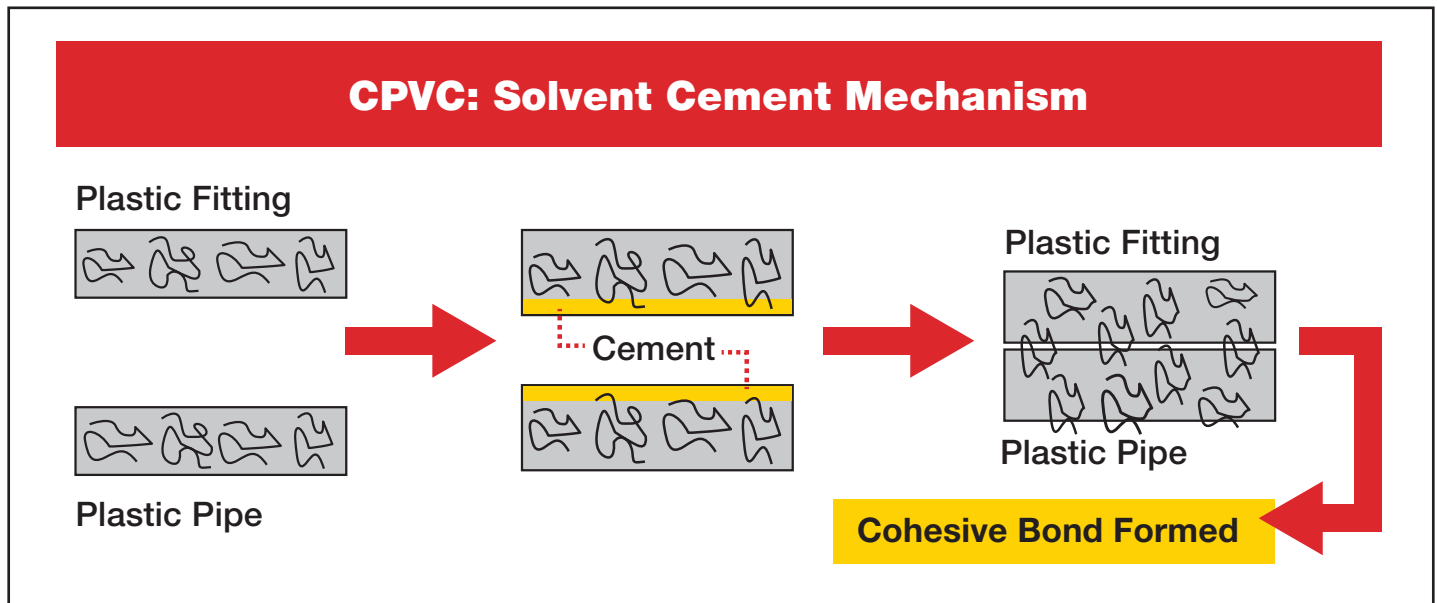
CPVC: Real Life testing after 24 years

INSTALLATION ADVANTAGES

Joints are typically the main cause of failures in most piping systems. This is true for piping systems, like PPR, that use heat fusion for joining. Heat actually breaks down the surface of the pipe, resulting in a weak seam.

FlowGuard® Plus CPVC pipes are not joined with heat. Instead, CPVC is joined with solvent cement.

Solvent cement is not glue. Instead, it chemically fuses the material at the molecular level and creates a long-lasting seam that becomes the strongest part of the system.



TEMPERATURE RESISTANCE

All plastic piping have a maximum allowable operating pressure rating at which the piping system may be operated for 50 years, and it is related to the water temperature. As the temperature increases, the maximum allowable pressure rating decreases to a point where the pipe can not handle the water temperature anymore, and this temperature is called maximum allowable operating temperature.

PPR's maximum allowable operating temperature is 70°C for 50 years, which is around the same temperature that hot water reaches in most homes. When PPR is subjected to water above 70° C, the service life of the pipe drops significantly as the temperature increases.

FlowGuard® Plus CPVC, on the other hand, has a higher allowable operating temperature of 93° C. This means that FlowGuard® Plus CPVC will keep its strength and appearance and last longer well beyond the temperature most pipes are exposed to in residential homes.



CPVC



Other Plastics



Other Plastics

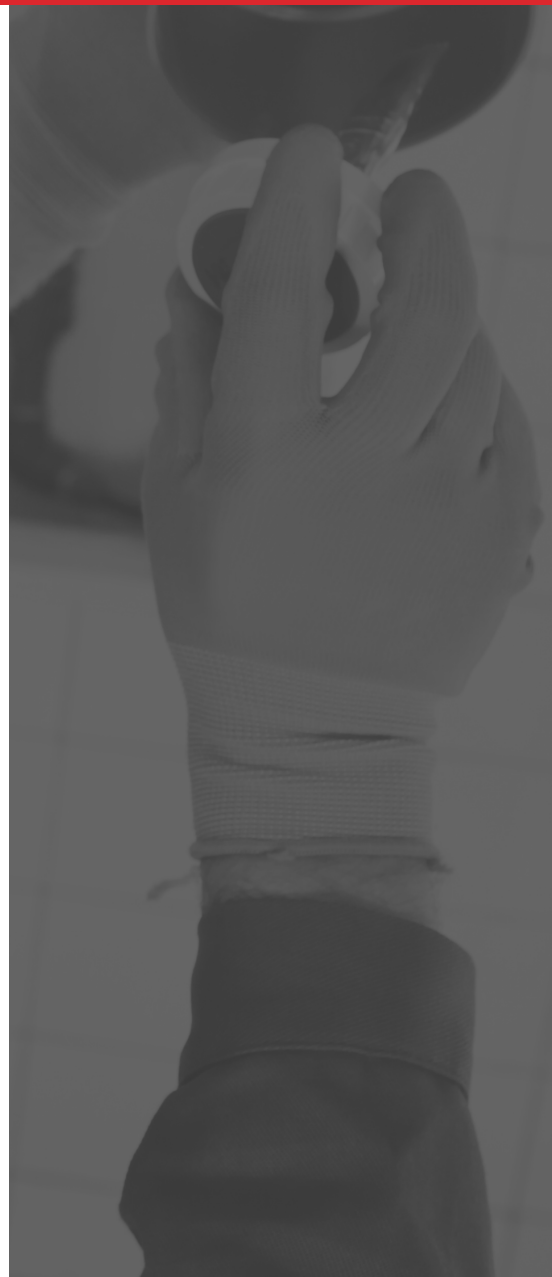
FlowGuard® Plus CPVC has a flash ignition temperature of 482°C, whereas PPR has a flash ignition temperature of 340°C. For reference, many other ordinary materials, like wood, ignite at 260°C or less.

FIRE RESISTANCE

As a homeowner, your plumbing system probably doesn't come to mind when you think about fire hazards.

While some Plastic (olefin/non vinyl), like PPR, can't withstand heat or fire, FlowGuard® Plus CPVC:

- Is self extinguishing and will not support combustion—meaning it won't spread a fire after exposed to a flame. FlowGuard® Plus CPVC has been tested in accordance with EN 13501-1:2002 (a test of how well a material will react to fire) and earned a Bs1d0 rating—the best fire resistance rating a non-metal material can receive.
- Limits the amount of smoke produced. The low smoke development of CPVC piping won't significantly add to the damage from a fire or increase exposure to toxic smoke and gases. In fact, when burning, CPVC is no more toxic than wood.



UV RESISTANCE

Ultraviolet (UV) rays can have damaging effects on piping materials—especially in regions where UV resistance is very high.

UV light generates free radicals within thermoplastics. For thermoplastics like PPR, which are particularly susceptible to UV, free radicals can chemically break down the material. This leads to early deterioration of the pipe and shortens service life.

With CPVC, the high levels of chlorine make it naturally more resistant to free radical degradation than PPR. Our material is specially engineered with additives that protect pipes and fittings from UV rays. These consist of carbon black and titanium dioxide, which are widely recognized as excellent UV blocking agents.

The only effect of direct UV exposure on CPVC is surface discoloration. Therefore, it's suitable to cover piping with a non transparent tarp or store it in a shaded area before and during construction.

QUALITY ASSURANCE

A single material brand is often made by a number of manufacturers. You should have confidence that pipes and fittings will deliver the same performance and reliability regardless of by whom, when and where it is produced.

The Lubrizol Corporation produces FlowGuard® Plus CPVC compounds for licensed manufacturers, who must each participate in the quality assurance program and receive on-site technical assistance. This program assures FlowGuard products continually meet the highest international standards.

ENVIRONMENTAL FRIENDLINESS

All piping materials and products have an effect

on the environment. To limit these effects, homeowners must carefully consider the products that make up their plumbing system.

All FlowGuard® Plus CPVC approved solvent cements, primers and cleaners meet the requirements for Low VOC (volatile organic compound) emission limits established by the California South Coast Air Quality Management District (SCAQMD—one of the USA's strictest air quality regulatory bodies.

Low VOC emissions support cleaner air and help reduce fumes and odor for the comfort and wellbeing of homeowners.

FlowGuard® Plus CPVC is also recyclable. In many applications, PPR requires fiberglass reinforcement to meet the strength and performance requirements for its intended use. But, because of the fiberglass layer, PPR is unrecyclable.

CPVC can be recycled into polyvinyl chloride (PVC) piping or window profiles.

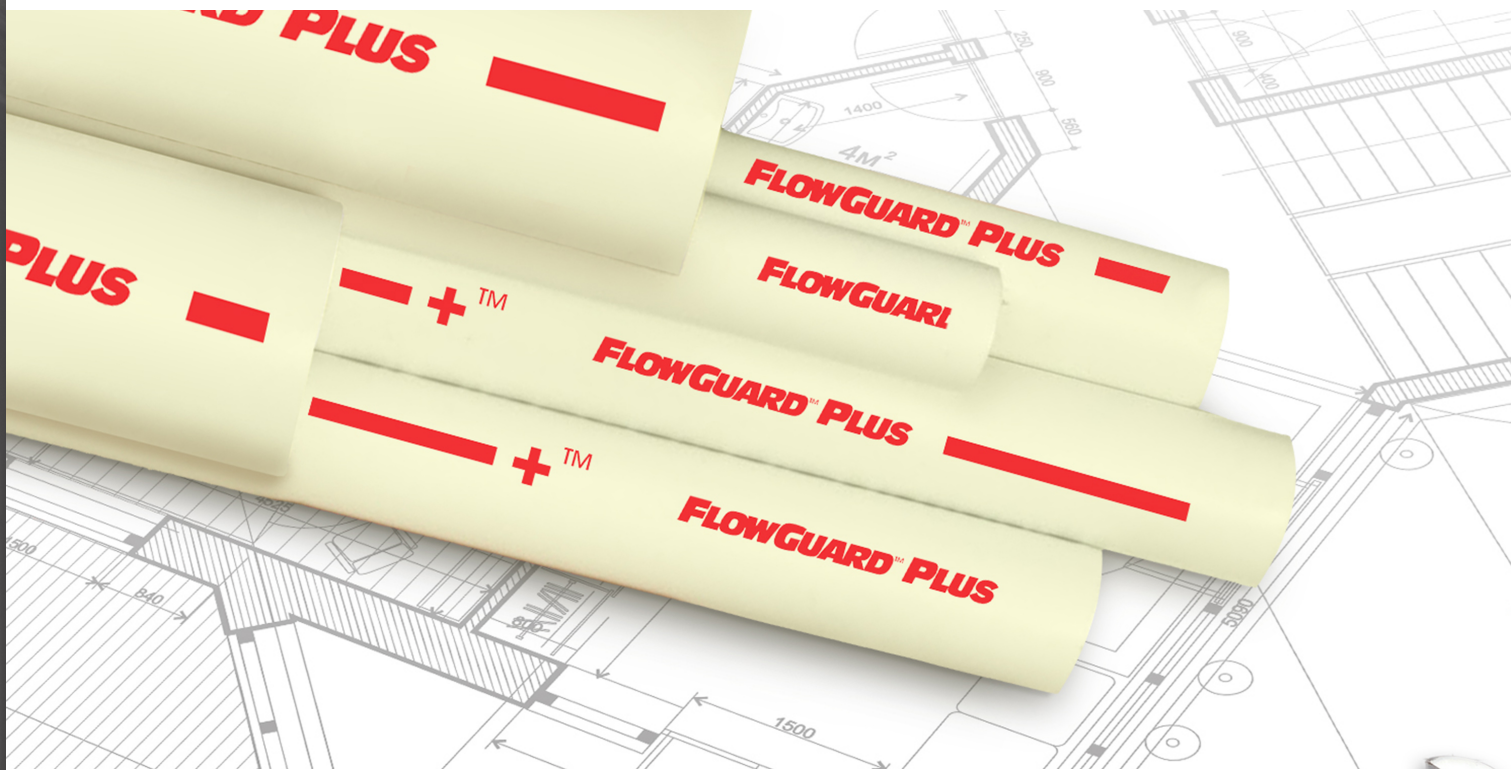
CPVC piping material can also be collected on the jobsite by a specialized recycling firm and ground into pellets and granules. The pellets can be recycled and reused for different applications, including:

- Floor fillings.
- Floor coating.
- Cable trays.
- Speed bumps.
- Car mats.

FLOWGUARD® PLUS PIPE AND FITTINGS RESOURCES

FlowGuard Pipe and Fittings are the most established and top-performing polymer piping products on the market. For technical support or on-site training, contact our team of piping specialists.

RELIABILITY. FOR LIFE



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