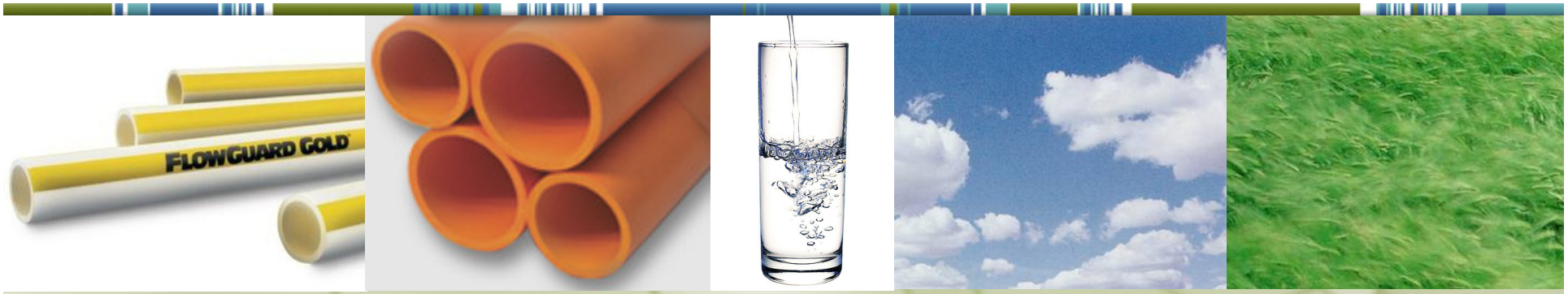
FBC™ Building Solutions CPVC:
The Responsible Choice for Water Distribution and Fire Sprinkler Systems



Agenda

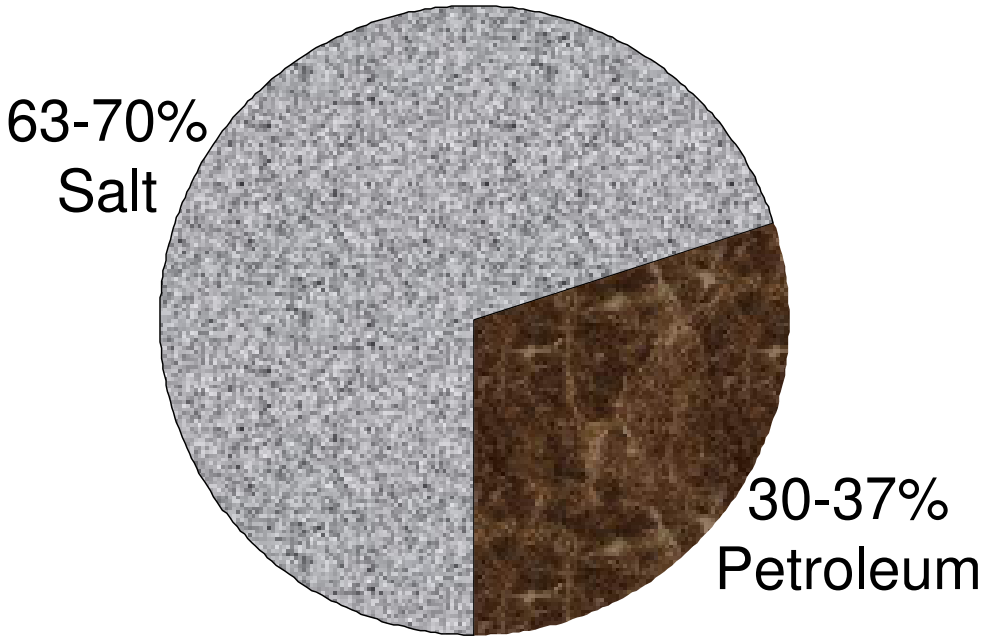
- What is CPVC?
- Energy Requirements
- Recycling
- Combustion
- Toxicity
- Biofilm Formation
- Green Building
- Conclusions

What is CPVC?

- Chlorinated Polyvinyl Chloride (CPVC): A thermoplastic produced by chlorination of polyvinyl chloride (PVC) resin

- Thermoplastic: Polymer material that turns to liquid when heated and becomes solid when cooled

What is CPVC?



2/3 of CPVC resin by weight comes from salt, of which there is an almost limitless supply. Only 1/3 comes from petroleum resources.

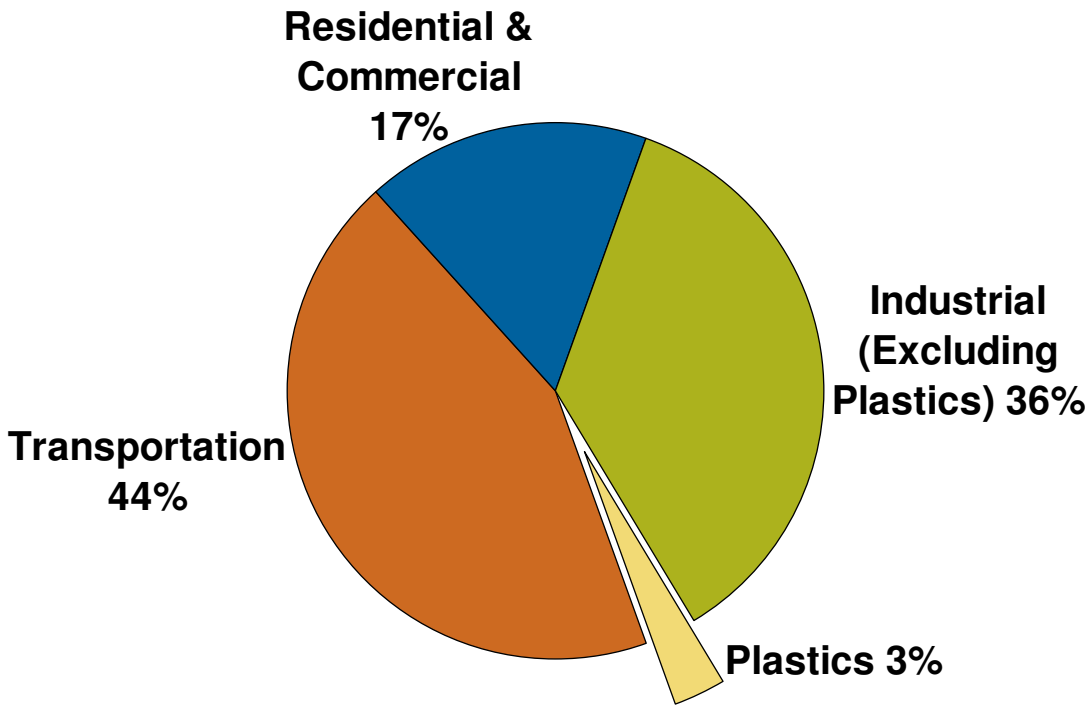
The CPVC Production Process

EDC = Ethylene Dichloride

VCM = Vinyl Chloride Monomer

Energy Requirements

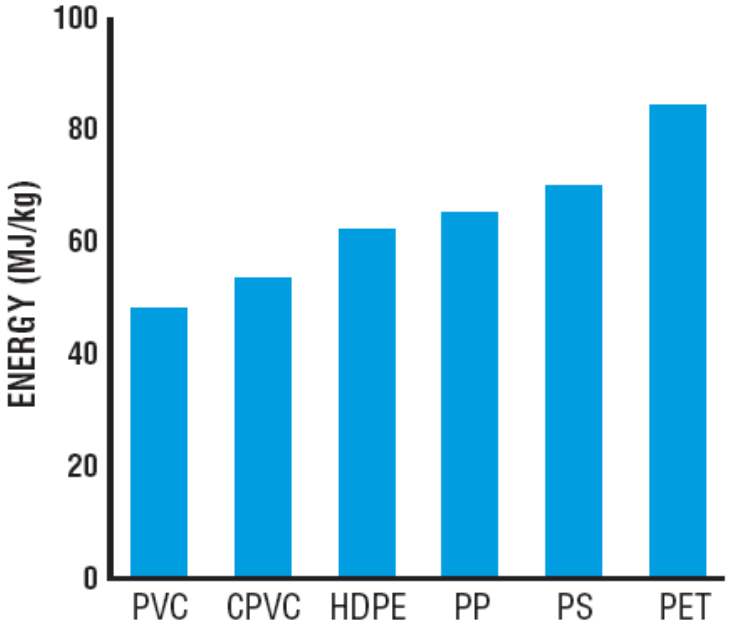
- Plastics account for just 3% of fossil fuel usage (e.g., petroleum, coal, natural gas)



Source: PVC Issues & Answers, The Vinyl Institute, 2008

Energy Requirements – CPVC v. Other Plastics

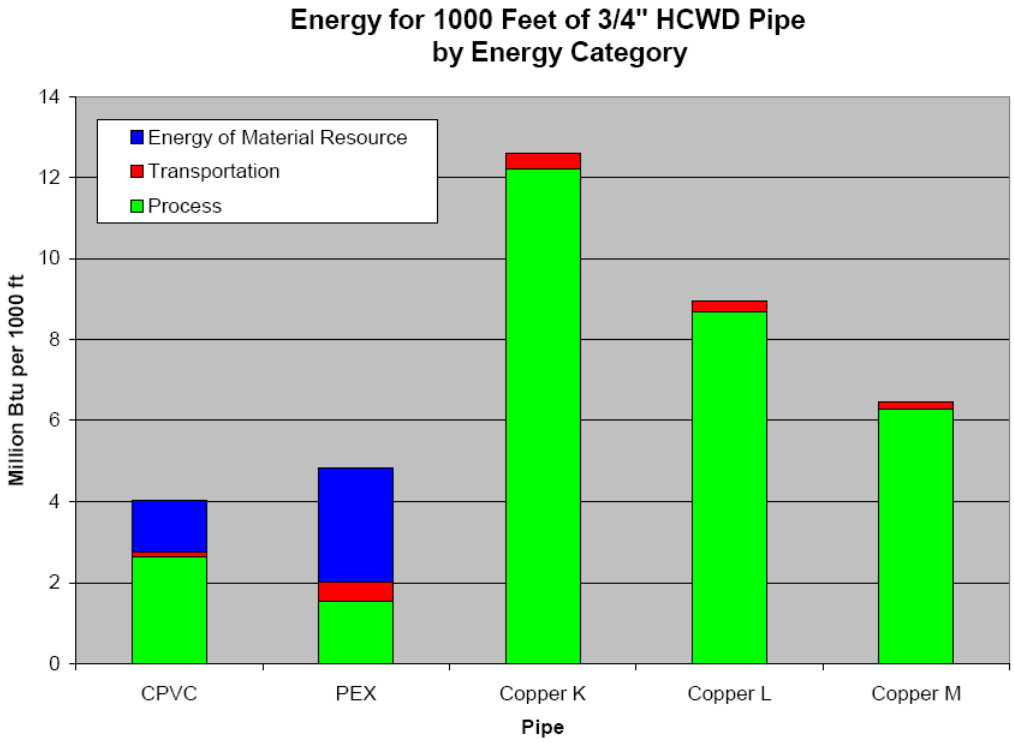
- Total energy requirements for CPVC production are lower than other plastic materials, due primarily to the low petroleum content



CPVC = Chlorinated polyvinyl chloride
PVC = Polyvinyl chloride
HDPE = High-density polyethylene
PP = Polypropylene
PS = Polystyrene
PET = Polyethylene terephthalate

Source: H. Sambele, Kapitel Nachchlorierte Polyvinylchloride Rohre, Technical University Berlin, 1993

Energy Requirements



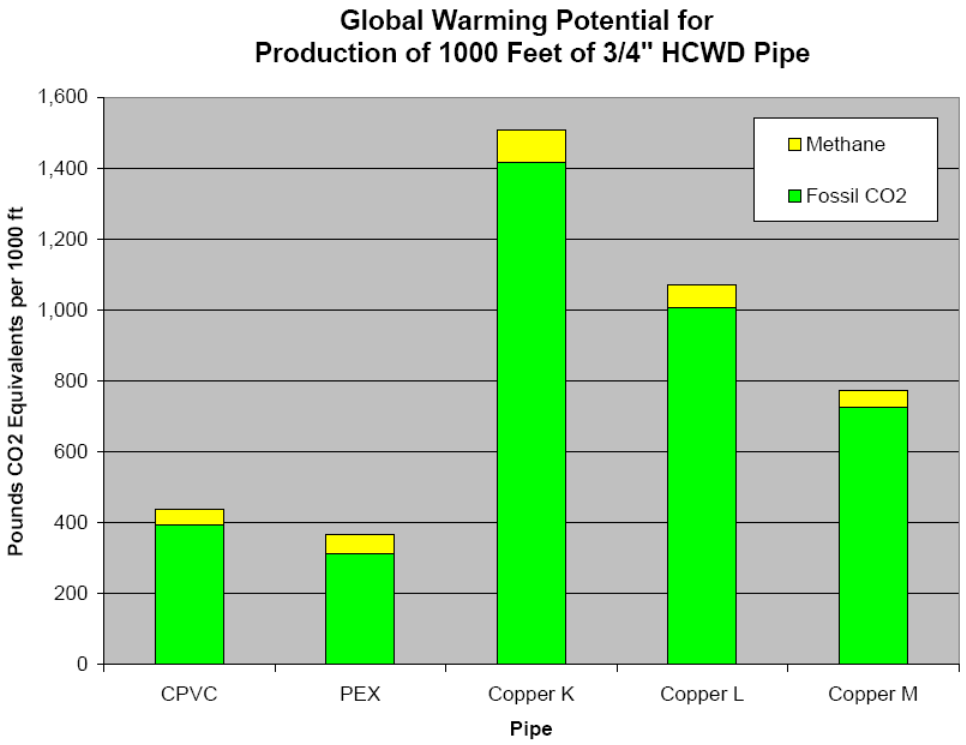
Energy of Material Resource:
Not an expended energy but the energy value of fuel resources withdrawn from the planet's finite fossil reserves and used as material inputs for materials such as plastic resins

Transportation energy:
Energy to move material during its journey from raw material to product

Process energy:
Energy for all processes required to produce the pipes, from acquisition of raw materials through pipe manufacturing

Source: Life Cycle Inventory of the Production of Plastic and Metal Pipes for Use in Three Piping Applications, Prepared for The Plastic Pipe and Fittings Association by Franklin Associates, US, June 2008

Energy Requirements



CPVC has a much lower Global Warming Potential than Copper pipe, which requires combustion of large amounts of fossil fuels for ***process energy***

Source: Life Cycle Inventory of the Production of Plastic and Metal Pipes for Use in Three Piping Applications, Prepared for The Plastic Pipe and Fittings Association by Franklin Associates, US, June 2008

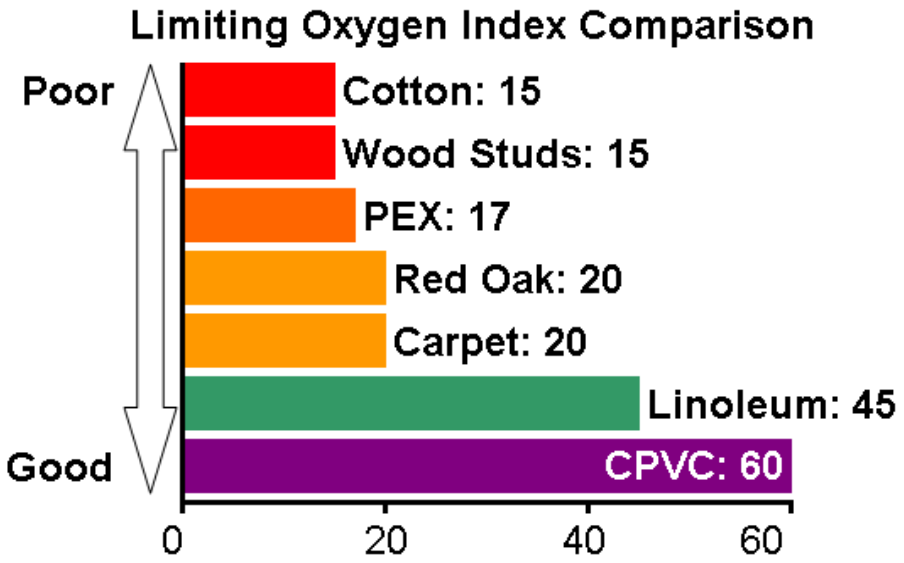
Recycling CPVC

- CPVC piping can easily be recycled as PVC piping or window profiles
- Piping material can be collected from the jobsite by a specialized recycling firm (country specific)
- Regrind piping material into pellets and granules
- Mix regrind into applications such as:
  - Floor fillings
  - Floor coatings
  - Cable trays
  - Speed bumps
  - Car mats

CPVC and Combustion

- Limiting Oxygen Index (LOI) – the percentage of oxygen needed in the atmosphere to support the combustion of a material
- The oxygen level in the atmosphere is not more than 21%
- CPVC requires more oxygen to sustain a flame than what is available in the atmosphere

Therefore, CPVC does not sustain a flame.



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CPVC and Combustion

EN 13501-1:2007 – Fire classification of construction products and building elements

CPVC Rating:
B s1 d0

=

The best possible rating a non-metal material can receive

Fire behavior	B → Low flammability, no contribution to flashover
Smoke development	s1 → Low smoke development
Flaming droplets	d0 → No burning drops

CPVC and Combustion

Air Plenums: Flame/Smoke Spread Development Rating

- CPVC can be used in return air plenums
- An independent lab tested and verified the following pipe sizes are in general accordance with ASTM E84/UL723 and meet the 25/50 flame/smoke requirement
  - ½" through 2" FlowGuard Gold® CPVC pipe and fittings
  - ½" through 6" Corzan® CPVC pipe and fittings

CPVC and Toxicity

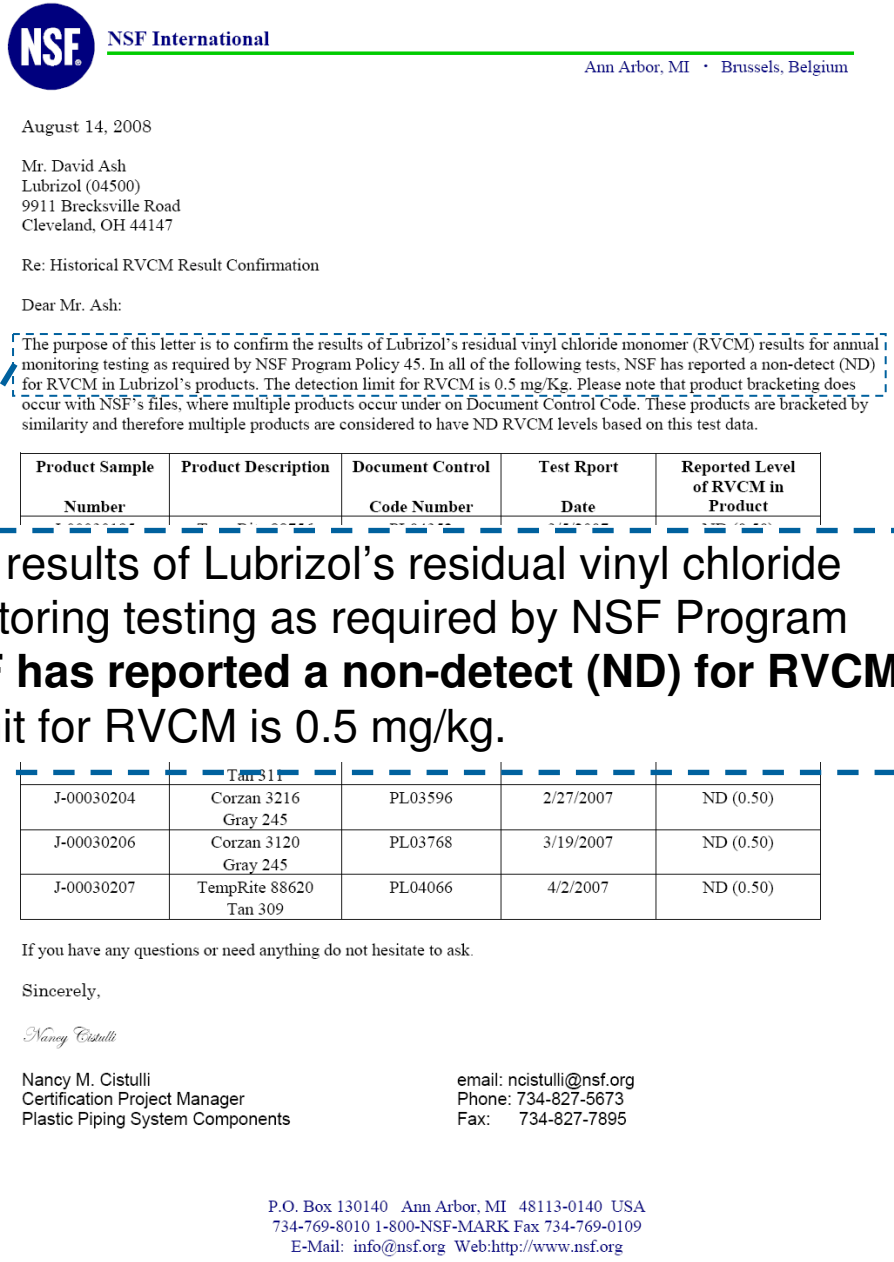
- Vinyl Chloride Monomer (VCM): Raw material used to produce PVC

- Residual Vinyl Chloride Monomer (RVCM): VCM that does not react in the irreversible polymerization process used to transform VCM into PVC

CPVC and Toxicity

- VCM is transformed into PVC by an irreversible polymerization process, so PVC contains only trace amounts of RVCM
- The post chlorination of PVC into CPVC reduces RVCM levels by a factor of 300
- Testing shows that CPVC does not release VCM when heated to 225°C, far higher than any HCWD system
- When CPVC does burn, the combustion products are no more toxic than traditional building materials, such as Douglas Fir (*United States Testing Company, Inc., 1989*)
- Maximum permissible level of RVCM in CPVC for potable water applications is 2 ppm (mg/kg)

CPVC and Toxicity



NSF International

Ann Arbor, MI · Brussels, Belgium

August 14, 2008

Mr. David Ash
Lubrizol (04500)
9911 Brecksville Road
Cleveland, OH 44147

Re: Historical RVCM Result Confirmation

Dear Mr. Ash:

The purpose of this letter is to confirm the results of Lubrizol's residual vinyl chloride monomer (RVCM) results for annual monitoring testing as required by NSF Program Policy 45. In all of the following tests, NSF has reported a non-detect (ND) for RVCM in Lubrizol's products. The detection limit for RVCM is 0.5 mg/Kg. Please note that product bracketing does occur with NSF's files, where multiple products occur under on Document Control Code. These products are bracketed by similarity and therefore multiple products are considered to have ND RVCM levels based on this test data.

Product Sample Number	Product Description	Document Control Code Number	Test Rport Date	Reported Level of RVCM in Product
	Tan 311			
J-00030204	Corzan 3216 Gray 245	PL03596	2/27/2007	ND (0.50)
J-00030206	Corzan 3120 Gray 245	PL03768	3/19/2007	ND (0.50)
J-00030207	TempRite 88620 Tan 309	PL04066	4/2/2007	ND (0.50)

If you have any questions or need anything do not hesitate to ask.

Sincerely,

Nancy Cistulli

Nancy M. Cistulli
Certification Project Manager
Plastic Piping System Components

email: ncistulli@nsf.org
Phone: 734-827-5673
Fax: 734-827-7895

P.O. Box 130140 Ann Arbor, MI 48113-0140 USA
734-769-8010 1-800-NSF-MARK Fax 734-769-0109
E-Mail: info@nsf.org Web:http://www.nsf.org

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CPVC and Toxicity

- All building materials impact the environment, in one way or another – Human toxicity loading is one of several environmental impact categories
- Emissions from the manufacturing, use, and disposal of building materials all contribute to human toxicity
- Dioxins are one of many emission categories contributing to human toxicity, and most studies agree that they are only a minor contributor to total human toxicity loading*
- Addressing the total human toxicity impact of a building material will yield greater environmental benefits than fixating solely on dioxins

* Source: Life Cycle Assessment of PVC and of principal competing materials, Commissioned by the European Commission, July 2004

CPVC and Toxicity

- Studies have shown that vinyl content has no effect on dioxin content of gases from incinerators
  - The presence or absence of vinyl has no effect on the amount of dioxin produced during the incineration process (*New York Energy Research and Development Authority, 1987*)
  - An analysis of over 1,900 test results from 169 large-scale, commercial incinerator facilities throughout the world found no relationship between the chlorine content of waste and dioxin emissions from combustion processes under real-life conditions (*American Society of Mechanical Engineers, 1995*)
  - "Reducing the quantity of PVC in waste does not reduce the quantity of dioxin in the waste gases" (*Swedish Environmental Protection Agency, 1996*)
- Operating conditions, not vinyl, govern dioxin formation in incinerators

CPVC and Biofilm Formation

- Biofilm: Forms when bacteria adhere to surfaces in aqueous environments and begin to excrete a slimy, glue-like substance that can anchor to all kinds of materials
- Biofilm Formation Potential (BFP): Potential growth of bacteria on a material surface that is in contact with water (e.g., pipes, flushing containers, storage containers)

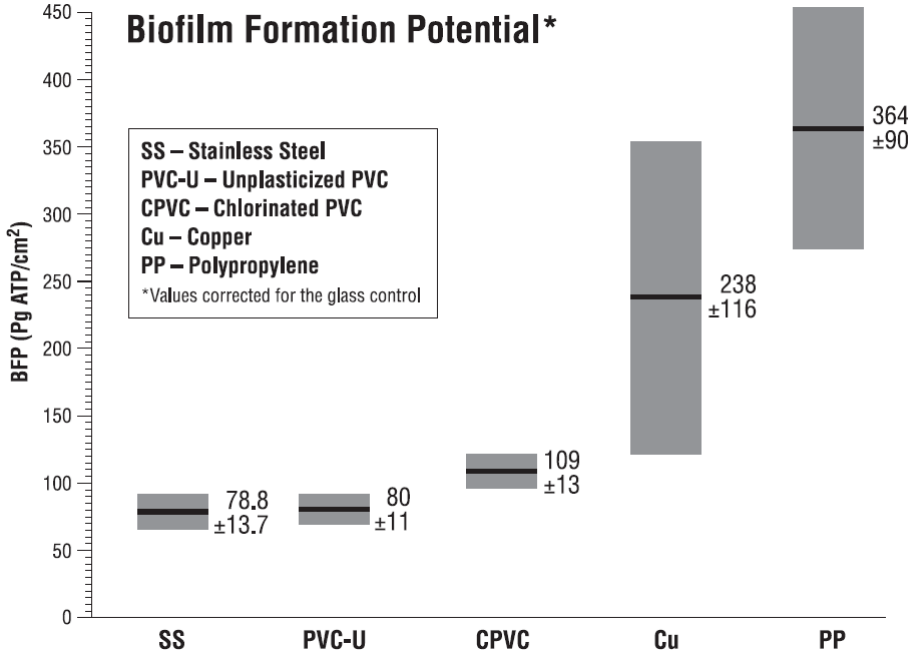
CPVC and Biofilm Formation

- **Superior Antimicrobial Performance** - There is no statistical difference between the antimicrobial performance of CPVC and copper. Both have proven to offer the best protection against biofilm formation.

Source: Dr. Paul Sturman, research professor and industrial coordinator for The Center for Biofilm Engineering at Montana State University based on his evaluation of Dutch Research and Knowledge Institute for Drinking Water (KIWA) 1999 study Biofilm Formation Potential of Pipe Materials in Plumbing Systems, 2006 study Standardizing the Biomass Production Potential Method for Determining the Enhancement of Microbial Growth by Construction Products in Contact With Drinking Water, and 2007 study Assessment of the Microbial Growth Potential of Materials in Contact with Treated Water Intended for Human Consumption

CPVC and Biofilm Formation

- Dr. Paul Sturman concludes **CPVC consistently outperforms most other non-metallic piping materials with regard to its ability to resist the formation of biofilms.**



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Source: Assessment of the Microbial Growth Potential of Materials in Contact with Treated Water Intended for Human Consumption, KIWA, 2007

Green Building

- NAHB National Green Building Standard (NGBS): Criteria for rating the environmental impact of design and construction practices to achieve conformance with specified performance levels for green *residential* buildings.

- LEED 2009 for New Construction and Major Renovations: Set of performance standards for certifying the design and construction of *commercial* buildings to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

NAHB National Green Building Standard

FBC™ products contribute to points:

- Water use reduction systems
  - Structured-type plumbing with demand-controlled hot water loops
    - FlowGuard Gold® pipe and fittings – 67% by weight chlorine and unaffected by chlorine in the water supply
  - Engineered parallel piping system (manifold system)
    - FlowGuard® MultiPort facilitates installation of a manifold system
  - Central core plumbing system
    - FlowGuard Gold® pipe and fittings facilitate installation of this system
- Gray water systems
- FlowGuard Gold® and Corzan® pipe and fittings are joined with low-VOC solvent cements

LEED 2009 for New Construction and Major Renovations

FBC™ products contribute to points:

- Water use reduction systems – featuring the FlowGuard® Hybrid System
- Water efficient landscaping systems
- Gray water systems
- Optimize energy performance
  - FBC water distribution systems do not lose heat the way metal systems can. There is less waste since occupants do not have to wait for the running water to "get hot".
  - Demand hot water heaters
    - FlowGuard Gold® pipe and fittings – 67% by weight chlorine and unaffected by chlorine in the water supply
- Recycle construction waste
- FlowGuard Gold® and Corzan® pipe and fittings are joined with low-VOC solvent cements

Conclusions

- Total energy requirements for CPVC are low
- CPVC can easily be recycled
- CPVC does not sustain a flame
- RVCM is not an issue for CPVC
- CPVC has no effect on dioxin levels
- CPVC pipe is ideal for delivering safe, pure drinking water
- CPVC facilitates construction of green residential and commercial buildings

FBC™ Building Solutions –
The Responsible Choice in Piping Systems!

FBC™ Building Solutions CPVC: The Responsible Choice for Safe, Pure Water

- Low energy manufacturing
- Recyclable
- Safe and reliable
- Corrosion resistant
- Less biofilm formation
- Third-Party certified
- Contributes to LEED and NGBS points
- Durable