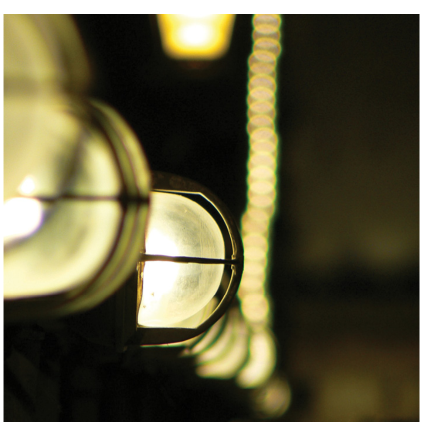
University of Saskatchewan

Smart Purchases Big Impact

Sustainable Purchasing Guide

Piping Products

Sustainability... your university, your world



Piping Products

UNIVERSITY OF SASKATCHEWAN

Introduction

This section provides information on currently available options for ***water and waste water piping*** that can help to move the University of Saskatchewan toward its sustainability goals. Living within the boundaries of our sustainability goals requires us to apply two main strategies:

Dematerialization requires that we reduce the amount of materials as much as possible; and that we continually move toward the use of 100% recycled content.

Substitution requires that we find less harmful materials to replace those that currently damage and are not recyclable.

Sustainable purchasing is about including social, environmental, financial and performance factors in a systematic way. It involves thinking about the reasons for using the product (the service) and assessing how these services could be best met. If a product is needed, sustainable purchasing involves considering how products are made, what they are made of, where they come from and how they will be used and disposed.

Finally, remember that this is an evolving document – it will change with new information as our understanding of sustainability impacts and potential solutions improves.

Purchasing Services

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Smart Purchases Big Impact

Wherever possible **CHOOSE** products that employ a combination of characteristics listed in the left hand column, and **AVOID** products that demonstrate characteristic in the right-hand column.

CHOOSE	AVOID
• Recycled PVC material	• Excessive piping

Option: Reduce the Need for Piping

Strategy: Dematerialization (SO 1, 2, 3, 4)

Piping is required to move water and wastewater. Although there are no preferable alternatives for the delivery of potable water in municipalities, there are some alternatives to the management of wastewater. On-site technologies such as composting toilets can manage or treat grey water and backwater on-site. Total piping requirements can also be substantially reduced through design; locating treatment of the water within urban containment boundaries or other areas already serviced.

Option: Use Recycled PVC Piping

Strategy: Dematerialization – less waste (SO 1, 2, 3, 4)

Poly Vinyl Chloride (PVC) piping with recycled content moves us toward all of our sustainability objectives. These are multi-layer pipes with a thin outside layer of new PVC (and sometimes a similar layer inside, where there is contact with sewer fluids) and a thick layer of recycled (and sometimes also foamed) PVC.

Option: Use High Density Polyethylene (HDPE) Piping

Strategy: Substitution – elimination of chlorine compounds (SO 2)

High-density polyethylene (HDPE) is another plastic used for piping. Like other plastics, it is derived primarily from non-renewable hydrocarbon feedstock (e.g. gas or petroleum). However, HDPE does not contain chlorine compounds and is considered by many to be environmentally preferable to Poly Vinyl Chloride (PVC). HDPE is also inexpensive, lightweight, non-corrosive and flexible. The main problem often cited with HDPE is its high expansion coefficient, three times higher than PVC, potentially making it technically less suitable for some water and liquid waste uses.

Option: Use Ductile Iron Piping

Strategy: Substitution (SO 2, 3)

Ductile iron piping is sometimes suggested as a substitute for PVC. From a sustainability perspective, its advantages lie primarily in that it does not contain chlorine compounds and contains fewer synthetic substances and additives. It is, however, made up primarily of substances from the earth's crust, containing iron, carbon, silicon, phosphorous, sulphur, manganese and magnesium. While ductile iron is durable, it is heavy and thus expensive to install and requires more energy to transport than other more lightweight materials. It also requires more energy to manufacture if that energy is generated from fossil fuels. Ductile iron can corrode and is therefore often encased in polyethylene (a non-renewable hydrocarbon source) as a corrosion inhibitor. Overall, this option is less preferred than either of the two listed above.

Arriving
at the currently preferred options

1. Identify the service

Pipes are used to transport fluids, primarily water and sewage.

2. Assess the need

Meeting the needs of the University of Saskatchewan involves services such as the delivery of water and removal of wastewater and sewage.

3. Identify the contents

Pipes can be constructed from a variety of materials. Three commonly used materials for municipal water and sewage systems are polyvinyl chloride (PVC), high-density polyethylene (HDPE), and ductile iron.

PVC is a versatile plastic, with many applications because of its combination of properties: it forms an excellent barrier to water and gases, has mechanical strength combined with light weight, is resistant to chemicals, is non-combustible, and has electrical insulation properties.

PVC is manufactured from two naturally occurring raw materials: oil and salt. However, to convert it into a versatile material, PVC has to be combined with a wide range of additives including stabilizers, plasticizers, colouring agents, flame retardants, and fillers.

HDPE is a resilient thermoplastic which can withstand high temperatures and greater stress than other plastics. The primary elemental components of HDPE are carbon and hydrogen, although, as with PVC, numerous additives are also included.

Ductile iron piping is composed of a spheroidized graphite cast iron. The inside of the pipe is lined with a cement mortar to prevent corrosion. New varieties of ductile iron piping are very thin which can lead to a shorter useful lifetime before the piping must be repaired or replaced. Ductile iron is strong and fracture resistant but is susceptible to corrosion and can be brittle compared to available alternatives.

4. Identify sustainability impacts

i. ....systematically increasing concentrations of substances from the earth's crust?

- Raw plastic is thermally unstable so a wide range of stabilizers is used as an input in finished PVC. These contain metallic compounds, many of which incorporate heavy metals. Although the heavy metals are physically bonded into the PVC and cannot be easily removed, they tend to disperse into nature during production, product life and at end-of-life.
- Energy is used in the extraction, processing and transport phases of piping. PVC manufacturing and processing plants use oil, natural gas, and electricity. Ships, vehicles and trains are used for the transport of feedstock, products and waste materials, primarily powered by fossil fuels. The principal impact of this fossil fuel based energy consumption is the direct or indirect generation of greenhouse gases (causing climate change).
- Hydrocarbon feedstock comprises approximately half of the weight of PVC. Currently, at the end of the piping's useful life, most of the PVC content ends up as waste material and is deposited in landfills or incinerated. Particularly when incinerated, carbon derived from fossil fuels is released into nature.

ii. ...systematically increasing concentrations of substances produced by society?

- Both the manufacturing and potential end-of-life incineration of PVC produce dioxins (one of the most toxic and persistent group of substances known) as well as furans. Although flows of these substances from production of PVC may be minor, their persistence in nature is problematic.
- Refrigerant and fire-fighting chemicals used to make PVC can be problematic as many of these are ozone depleting or can accumulate in nature with unpredictable consequences.
- A range of metallic substances is used in PVC products as stabilizers. In addition to the potential for build-up of metals in nature, these substances also have the long-term potential to end up in landfills and elsewhere.

iii. ...systematically degrading nature by physical means?

- Mining directly destroys habitat and natural systems, although these impacts can be mitigated through proper management and comprehensive reclamation. Although the relative quantities of minerals used by the PVC industry are not large, they nevertheless contribute to the loss of habitat.
- Substantial quantities of water are used in the manufacturing and processing of PVC. Depending on where that water comes from, these processes may contribute to ongoing physical degradation of nature.
- Many waste PVC products are deposited in landfill sites or incinerated, and this will likely continue in the foreseeable future. Landfills and associated infrastructure require large areas of land, and continued expansion of these contributes to the loss of land area and quality.

continued on page 3 . . .

4. Identify sustainability impacts (con't)

iv. . . . systematically undermining people's ability to meet their basic human needs?

- Many of the environmental problems mentioned above are also harmful to human health, and thus violate people's ability to meet basic human needs. For example, employees that work with potentially carcinogenic materials may suffer severe health consequences.

5. Envision sustainable piping products

In principle, sustainable piping would be made entirely from materials that can be assimilated by the natural environment (either mined or synthetic), or materials that can be 100% recaptured in tight technical cycles for re-use. The production, use and disposal of the piping would not physically degrade nature in the long-term and/or have any negative impacts on human health. To fit this definition, many changes would be required for the way in which PVC is produced and managed.

Many of the sustainability challenges associated with PVC result from the way in we dispose of it. Closing the loop on PVC by recycling it rather than sending it to landfill at the end of life would address many, although not all, of the sustainability impacts described above. Ultimately, PVC piping will be sustainable when the industry:

- Uses sustainable energy that is renewable and non-polluting,
- Manages PVC waste as a close-loop system, both at the end of the products' useful life and during the manufacturing process,
- Ensures that releases of persistent organic compounds from the whole life cycle do not result in long-term increases in concentration in nature, and
- Phase out and find substitutes for substances that can accumulate in nature over time, or where there is doubt regarding toxic effects.

6. Identify and prioritize alternatives

Step 6 helps identify the product or service that offers the best pathway toward meeting all four of our Sustainability Objectives by using the following three criteria for assessment:

a) Does the product or service move us in the right direction with regards to our four Sustainability Objectives?

b) Does the product or service create a flexible platform for the next step toward sustainability?

c) Is the decision financially viable?

Resources
and Additional Information

1. PVC and Sustainability, the Natural Step
   http://www.naturalstep.org/en/pvc-and-sustainability

WHISTLER

This guide was made possible through the generosity of the Whistler 2012 project, which shared its template and much of its research.