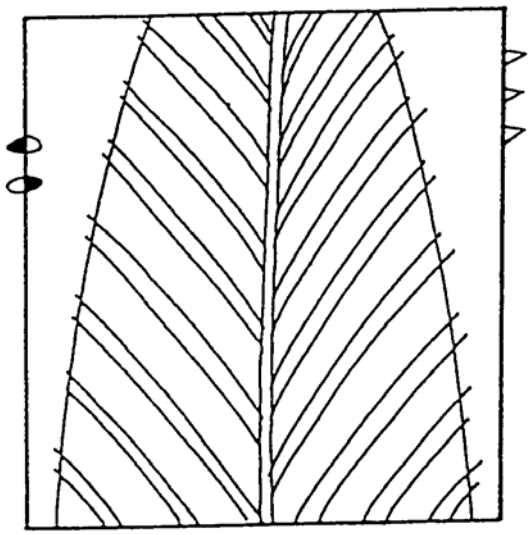
PLASTICS



Waitakere City Council
Te Taiao o Waitakere

Contents

This chapter is part of the Waitakere City Council's Sustainable Home Guidelines. The complete set can be obtained through most libraries or from the Waitakere City Council, Private Bag 93109, Henderson, Waitakere City 0650, New Zealand, phone (09) 839 0400, email: info@waitakere.govt.nz.

The guidelines are also available on the council's web site: http://www.waitakere.govt.nz

Plastics – what are they?

Because plastics are durable, inexpensive and lightweight, they have become a popular building material. They are the standard for most piping and electrical cabling; heavily used for flooring, furniture and furnishings; and they compete strongly in areas like rain gutter, external cladding and window joinery.

There has been much debate over the environmental cost of plastics in recent years. However, much of this is associated with the packaging industry, and the issues for buildings are quite different from those of packaging. Plastic building materials are not generally throw-away products. They last a long time, so the energy and environmental implications of using plastic in a building can be quite different from its use in packaging.

Plastics can be made from renewable resources such as casein (a milk product) or cellulose. However, with current technology the performance of these alternative materials is inadequate for building products. Hence plastics are generally made from mineral oil – a finite and non-renewable resource – because it is cost-effective and results in a durable product. One in ten litres of all refined oil is used in the plastics industry.

The basis of all plastics is a high-molecular-weight polymer, which is inert and non-hazardous. However, by itself this is unsuitable for building products, so additives such as thermal stabilisers, antioxidants, ultraviolet light stabilisers, plasticiser compounds and fillers may be added. It is these additives that might raise concerns about toxicity.

Plastics are generally very durable and will not break down naturally, although biodegradable plastics are available. Most thermoplastics can be readily recycled. This requires some additional energy input, but considerably less than in using virgin material. Composite products (made from more than one material) cannot generally be recycled.

Plastics for building

Different plastics have different environmental impacts. Plastics are often made from many different compounds, with additives to achieve the desired properties. Generally the more simple plastics – those with only one polymer and few or no additives – can be recycled more easily. The main plastics used in construction in New Zealand are PVC, polybutylene, polyethylene and polypropylene.

PVC

PVC, or polyvinyl chloride, was introduced in 1913. By the 1960s it had become the most important mass-produced synthetic material used. In 2006, 40,000 tonnes was used in New Zealand. All PVC resin used in New Zealand is imported.

The monomer used to produce PVC is vinyl chloride, a toxic gas and recognised human carcinogen. At manufacture the levels of free vinyl chloride are very low (less than 1 part per million), and it is volatile, so that by the time the resin is incorporated into finished goods, levels are reduced to a few parts per billion.

Whilst the risk from a carcinogen cannot be assumed zero at any concentration, unplasticised PVC pipe is approved for use in water supply by the World Health Organisation and other independent bodies. All PVC drinking-water products in New Zealand have to meet stringent international standards and testing at independent laboratories.

Like other plastics, PVC is combined with various additives to change its properties. PVC by itself is thermally unstable at its processing temperature, so it needs thermal stabilisers to make it usable. Another commonly used group of additives are plasticisers, such as pthalates, for applications where it needs to be flexible. Concerns have been raised over the possible long-term health effects of some of these additives, although scientific evidence seems inconclusive.

In buildings, the most common plasticised PVC products are vinyl flooring and cable insulation. Items such as pipes, gutter, claddings, and window frames are made with unplasticised (rigid) PVC and so do not contain any plasticisers.

Beside the effects of the product in use, we have to consider the beginning and end of PVC's life cycle. Concerns have been voiced over the environmental effects of the production process, with risks of toxic waste generation, water and air pollution. Rock salt and ethylene (a petroleum product) are the main raw materials. They are combined to make ethylene dichloride, then vinyl chloride monomer, which is polymerised to make PVC resin. This is combined with various additives, heated and extruded to make a range of products. While the intermediates produced during the production of PVC are hazardous, modern closed-system manufacturing plants release very little of these compounds, and similar concerns could be raised about the production of many other building materials.

When PVC burns, as in a house fire or during waste incineration, dioxins and furans can be released into the air. These are some of the most toxic substances known. In Europe concerns have been raised about the smoke generated when PVC burns, and particularly its effect on rescue services, such as firefighters. Again however, dioxins and furans are also generated by the burning of many other building materials including timber.

Compared with other plastics and other combustible materials, PVC may have a beneficial role in reducing injuries in structural fires, as it may reduce the chances of a fire igniting or spreading due to its relatively high ignition temperature. PVC also has a low rate of heat release and is self-extinguishing once the heat source is removed. US

research has shown the overall impact of PVC emissions from house fires to be minuscule. The countrywide emissions to air in New Zealand are considerably lower than in other developed countries [NZ Inventory of Dioxin Emissions, Ministry for the Environment, Wellington, New Zealand].

Because of these concerns, some individuals and organisations avoid the use of PVC in buildings. However various independent scientific reports do not support this position. In 2007, the US Green Building Council published the findings of a Life Cycle Assessment (see the *Materials* chapter) of PVC compared to other materials in claddings, pipe, sheet flooring, and window frames. It concluded that "no single material shows up as the best across all the human health and environmental impact categories, nor as the worst." Other materials, when investigated to the same rigorous extent as PVC, had drawbacks from the points of view of human health and environmental impact. So avoiding PVC could steer decision makers toward using materials that may be worse in some environmental and health respects.

Just as important as the choice of material is how it is looked after during its life and disposed of at the end of it. The report did suggest that for resilient flooring other choices might be preferable for the human health impact. It also acknowledged that there are gaps in the data, particularly for end-of-life impacts.

Alternative plastics are often suggested as environmentally friendlier alternatives to PVC. This is because their production does not involve the use of chlorine as a base material. However, rigorous life cycle assessment appears not to support this view.

Polybutylene, Polyethylene and Polypropylene

Polyethylene, polypropylene and polybutylene are used in significant quantities in construction in New Zealand and can be substituted for some PVC-based building products. Polyethylene, polypropylene and polybutylene do not include chlorine as a base material, so these plastics are often suggested as environmentally friendlier than PVC. However, they potentially consume much more fossil fuel in their production. This is because rock salt forms about half the raw materials in PVC, so its embodied energy is much lower than the alternatives. Any material choice decision is best based upon up-to-date life cycle assessment of the candidate materials.

Further information

Advice at the Waitakere City Council:

Phone the call centre (09) 839 0400
Ask for: Eco Design Advisor
Cleaner Production

In print

Your Home Technical Manual, Australian Government. Comprehensive printed resource, much of it relevant to New Zealand.

On the web

For the executive summary of the US Green Building Council report on PVC, see www.usgbc.org/ShowFile.aspx?DocumentID=2379

www.smarterhomes.org.nz is a mine of up-to-date and independent information. Designed for the general public, it's easy to use, has case studies, and includes features such as Homesmarts, a calculator you can use to find information relevant to your needs or simply to run a home-health check.

If there are questions you can't find answers to on Smarterhomes, www.level.org.nz goes into more depth and is aimed at the design and building industries, with drawings and links to Building Code compliance documents.

Eco-building Products and Services Directory, Building Biology and Ecology Institute, phone Auckland (09) 376 6767, Wellington 0800 223 272. This is updated regularly and can be obtained from the website www.ecoprojects.co.nz.

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