PVC Based Construction Materials

and the Environmental Issues Affecting their Use Pre and Post Sydney 2000 Olympics

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INTRODUCTION

If someone today invented a product that was cost effective, labour efficient, durable, easily available and environmentally responsible, it would probably be among the first items specified in construction contracts.

Instead, however, the reverse is occurring. A product that meets all the above criteria is the subject of an intensive, misinformed campaign resulting in restrictions of this product's use.

The product? PVC. And the outcome of the restrictions? Construction Project Managers may be denied use of a material that, compared with alternatives, helps them meet budgetary and time criteria and deliver a quality result with low environmental impact.

The performance benefits of PVC are well known. It has been in widespread use for 60 years and its use is standard practice across a broad range of industries and applications.

In recent times, however, a concerted but ill–informed campaign seeking the elimination of all chlorine production around the world has sought to undermine PVC's viability as a commercial product.

WHAT ARE THE ISSUES?

- First and foremost, PVC contains chlorine
- The carcinogenicity of vinyl chloride monomer
- PVC combustion can produce dioxins
- Are PVC products a toxic hazard in building fires?
- What issues are associated with the major additives – especially lead based stabilisers and phthalate plasticisers?
- What problems, if any, are associated with the disposal of PVC products at the end of their useful lives?

WHERE DOES CHLORINE FIT?

- Chlorine is the most widely used of all industrial chemicals, being used in 50–60% of all industrial chemistry.
- It is used in the manufacture of 85% of pharmaceuticals and 96% of crop protection chemicals. It is used throughout the world in water disinfection systems.
- Chlorine is abundant in nature as well as society. It comprises 2% of the mass of the oceans and 0.15% of the mass of the human body.
- The manufacture of PVC consumes 35% of the world's industrial chlorine. This is a major lobbyist group's grievance against PVC!

COST EFFECTIVE AND LABOUR EFFICIENT

The National Institute of Economic and Industry Research (NIEIR)[4] has found that the best available alternative to PVC for plumbing adds 3% to the cost of building an average Australian home.

NIEIR have also estimated that a phased in ban on PVC in Australia would add $920 million per year to costs in the economy and would reduce long term GDP by 0.25%.

PVC products are extremely cost effective. For example, a study by BIS Shrapnel[5] shows that substituting PVC in the Sydney Olympic Games facilities will increase costs by $12 million compared with the next best alternatives.

Characteristics such as light weight, long section lengths, solvent weld capability and low gradient pipe requirements give PVC products a high labour efficiency. For plumbing and drainage applications the installed cost of alternative products is typically twice as much as for PVC.[6]

DURABILITY AND PERFORMANCE

The strength, corrosion resistance and good weathering properties of PVC products add to their cost effectiveness and labour efficiency as they require less frequent replacement.

PVC products are typically strong, durable and naturally fire resistant.

Applications range from sewer pipe, electric cable insulation and floor tiles, to garden hose and cosmetics bottles. Approximately 80% of usage is in long–life products.

A Canadian study shows that ductile iron water mains pipes break 13 times more often than the PVC alternative, while cement pipes break around 8 times as often. The lower breakage rates mean less water loss and lower maintenance costs.

It is used throughout the world in blood transfusion bags and is a widely preferred product for supermarket fresh food wrap.

PVC products are highly cost effective and labour efficient. They are used in virtually all low rise residential drainage, plumbing and electric cable insulation.

PVC products are widely recycled at end of life. Shredded cable insulation is converted into hose–core and mud–flaps. PVC bottles are converted into pipe fittings and floor tiles. In Europe, excavated pipe is remade into new pipe.

EASILY AVAILABLE

PVC products are well known for their easy availability.

Project Managers in the construction industry know that PVC can be readily delivered to sites around the nation, with the added benefit that transport costs are extremely competitive thanks to the material's light weight.

ENVIRONMENTALLY RESPONSIBLE

The principal grievances raised against PVC are:–

- PVC is "arguably the largest source of dioxin in our environment";
- PVC is dangerous in building fires; and
- Phthalate plasticisers used in flexible PVC products "are known to be hormone disrupters" and "can cause .. malformed reproductive organs in males and low sperm counts".

DIOXINS

Over the past 20 years, the level of dioxin in the environment has decreased by 30%, whilst the manufacture of PVC has increased by nearly 300%!

4"A study into the impacts of PVC on the Australian economy", NIEIR, January 1993

5"Olympic Village Report, The Impact of replacing PVC with Alternative Construction Materials", BIS Shrapnel, August 1994

6Industry estimates

This apparent paradox is easily explained: PVC is a relatively minor source of dioxins. In the USA, PVC throughout its full life cycle is estimated to add less than two–tenths of one percent of all man–made dioxins in the environment.

The annual dioxin emissions from the manufacture of PVC in the USA are estimated to be at most 5 grams TEQ[7] per year out of a total of 9350 grams from all industrial sources.

In comparison, the US EPA estimates that metals smelting contributes 230 grams, cement kilns 350 grams, and diesel motor vehicles 85 grams[8]. These estimates are from a draft report, but remain the best data available at the present time in this context.

The above estimate for PVC manufacture is consistent with Scandinavian data.[9]

BUILDING FIRES

PVC has a low flammability. PVC is naturally fire resistant. PVC products will typically self extinguish once the external flame source is removed. However, all combustible building products release toxic gases of some kind during combustion.

The most important asphyxiant gas in building fires is carbon monoxide, which is released by all burning materials.

Danish EPA – "Dioxin formation (from the combustion of PVC) at real fires is expected to play a minor role in the total dioxin formation and emission to the environment (from all sources)".[10]

The US Centre for Fire Research has found that the combustion toxicity of PVC is similar to other common products, and its low flammability is a significant benefit.

All combustible building products emit toxic gases of some kind during combustion. The CSIRO identifies two principal asphyxiant gases in fires – carbon monoxide and hydrogen cyanide.

Carbon monoxide is by far the more important of the two, and arises from the combustion of any organic material, such as wood, fibre and plastics. Hydrogen cyanide is released from nitrogen–containing products such as acrylics, polyurethanes and wool.[11]

Because of the importance of heat and carbon monoxide in building fire lethality, the principal factors which will determine a product's contribution to this will be flammability and rate of heat release.

An additional factor of significance is the incapacitation effect of smoke. The combustion of PVC, in common with many materials, gives off a heavy smoke.

HORMONE DISRUPTION

At the present time, hormone disruption through chemicals in the environment remains a scientific hypothesis on which much research is required.

In the meantime, premature claims have been made that phthalate plasticisers used in PVC are contributing to the problem. These claims are not supported by evidence.

7F Krause, Deputation before the Toronto City Services Committee, 25 March 1996, PVC estimate prepared in cooperation with EPA. For total figure of EPA estimate, see below.

TEQ = The sum of dioxin and furan quantities multiplied by their respective toxicity factors compared with the most toxic dioxin, 2,3,7,8 TCDD. There are 210 different dioxins and furans, of which only 17 are considered to have significant toxicity.

8"Estimating Exposure to Dioxin–Like Compounds (Review Draft)", Executive Summary, US EPA, Jun 1994

9"PVC on the Environment 1996". North Hydro, December 1995

10Danish EPA, "Environmental Aspects of PVC", 1995

11C Ramsay, "Toxic Products from Fires", in Building Innovation, CSIRO, June 1995

Further research is needed on the entire phenomenon; the occurrence of reproductive disruptions, the possible connection with chemicals in the environment, and, if these factors are confirmed, the role of particular groups of chemicals.

Norwegian National Institute of Public Health –

”In the case of those chemicals in the environment that we know most about, such as phthalates, the exposure appears to be so low, and the hormone–resembling factor so weak, that such effects cannot be expected to be triggered.”[12]

Discussing the impact of PVC on male reproductive organs, the Chief Physician for National Health in Norway has said –

”We have absolutely no factual evidence to support claims that there exists a connection between the additives in PVC and serious health injuries such as complications of the male genitalia (and) a reduction in the quality of sperm in men”.[13]

A SAFE PRODUCT

More recently, in 1996 a ”state of the art” LCA of pipe for gas distribution systems in the Netherlands has found PVC to be overwhelmingly environmentally superior to each of the alternatives – iron and polyethylene.

That PVC products are no more harmful to the environment than alternatives has been confirmed by independent, ”cradle to grave” Life Cycle Assessments (LCA’s). A 1995 review for the European Commission found –

”.. LCA reviews show that products made with PVC do not produce a structurally better or worse environmental performance than alternative products.”[14]

AUSTRALIAN SCIENTISTS SUPPORT PVC

CSIRO Chiefs of Chemicals, Polymers & Forestry Products –

”Contrary to recent Greenpeace claims, PVC .... is a safe and thoroughly tested product.”

Dr T H Spurling & Dr W Hewertson, Chemistry in Australia

Royal Australian Chemical Institute, November 1995

Writing in January 1996, the Professor of Chemistry at the University of NSW, Michael Gallagher, wrote –

”The only way you could harm anyone with PVC would be to hit them over the head with a large piece... Criticism of PVC as a building material is ill informed.”[15]

PACIA and the PVC industry believes opposition to the use of PVC goes against both scientific evidence and good building practice.

I repeat, PVC has been used safety for more than 60 years in a variety of applications, ranging from building construction to life–saving medical equipment, with much benefit and, in many cases, clear cost advantages.

Industries under pressure to consider avoiding the use of PVC products should, therefore, ask three questions –

What is the factual evidence on PVC?

12 Press release, October 1995

13 Reported in Varden, 27 October 95

14 Bundesdag Enquete Kommission, July 1994, English translation

15 Michael J Gallagher, Letter to the Editor, The Australian, 25th Jan 95

What is the cost and practicality of introducing alternatives?

Is there evidence to show that alternatives are environmentally superior?

Objective answers to these questions will help contractors ensure that their clients receive the best ”all round” solutions to their construction needs.

It is likely that PVC will emerge in a good light from such considerations.

THE SYDNEY OLYMPICS ENVIRONMENTAL GUIDELINES

The Environmental Guidelines for the Sydney Olympics contain a broad spectrum of valuable environmental principles. However, they also include the following statement –

”Olympic host cities should commit themselves to ... minimising and ideally avoiding the use of chlorine–based products (organochlorins) such as PCB’s, PVC’s and chlorine bleached paper.”

Oddly enough, the manufacture of PCB’s was phased out around the world years ago, and elemental chlorine bleaching of paper was already being phased out in Australia in 1993. The above clause, therefore, in effect, appears to have been targeted at just one product – ”PVC”.

The guidelines were developed with strong editorial input from Greenpeace Australia, without expert scientific input of any kind on this issue, and without consultation with the PVC or chlorine industries.

Understandably concerned at this surprising outcome of the host city bidding process, the industry sought clarification from Government.

In August 1995, the Director General of the Olympic CoOrdination Authority (OCA), David Richmond wrote –

”The Environmental Guidelines represent a performance–based approach and are not a prescriptive set of rules ....”

”It is not the intent to prejudicially single out for exclusion any particular product or material.”

At about the same time, the Chairman of the Olympic Environment Committee, Dr Colin Grant wrote –

”.. all components for new projects will be uniformly subject to life–cycle costing and consideration of environmental implications ... OCA does not wish proponents to discount the inclusion of any materials.”

There is no legislative requirements that the Guidelines be followed, especially in an instance where they are clearly in error. In approving construction designs, OCA is required to ”consider ... the consistency” of design with the guidelines.

CONCLUSION

In closing, PVC is an outstanding building material in terms of design, installation, performance, maintenance and cost efficiency.

On environmental grounds it compares well with alternatives.

Demand for the product is growing worldwide at an annual rate of 5%.

Opposition to its use in the Sydney Olympic Games is defiance of scientific evidence, economics and good building practice.

PVC is the product of choice in many applications.

PVC has no greater impact on the environment than alternatives.

Industry is working to ensure PVC is specified on its merits.