PVC-U Windows Recycling in Action
Some Case Studies
British Plastics Federation: PVC-U Windows Recycling in Action

Contents

1 About This Document

2 PVC Overview

3 Case studies

3.1 Beyond Windows - Recycled PVC-U used for Fencing

3.2 Epwin Group in UK’s First Closed-loop Recycling of PVC-U Windows: Northwards Housing

3.3 Eurocell:
    3.3.1 Code Level 6 zero-carbon development
    3.3.2 Nottingham City Homes scores an ‘A’ for recycling

3.4 VEKA signs UKs first major recycled window contract

3.5 MK Electric - Manufacturing with Recycled PVC
1 About This Document

This document describes what happens with PVC-U once it has been used.

2 PVC Overview

2.1 PVC Overview

Polyvinyl Chloride (PVC) is a major plastics material which finds widespread use in building, transport, packaging, electrical/electronic and healthcare applications.

![PVC molecular structure]

PVC has been in commercial production since 1933 (year the BPF was founded). It now accounts for about 20% of all plastic manufactured world-wide, second only to polyethylene. The UK produces approx. 500,000 tonnes of PVC per annum.

PVC is a very durable and long lasting construction material, which can be used in a variety of applications, either rigid or flexible, white or black and a wide range of colours in between.

The essential raw materials for PVC are derived from salt and oil. The electrolysis of salt water produces chlorine, which is combined with ethylene, obtained from oil, to form vinyl chloride monomer (VCM). Molecules of VCM are polymerised to form PVC resin, to which appropriate additives are incorporated to make a customised PVC compound.

2.2 Applications

PVC is used in a wide variety of applications, including windows and doors, cladding and fascia boards, pipes, packaging (cling film, for instance), healthcare (blood bags, hospital flooring), automotive (various), flooring applications and an everyday product, which is often taken for granted – the credit card.

Around 45 million tons of PVC were produced worldwide in 2010 and production is expected to rise to 55 million tons by 2016.

2.3 Sustainable example: PVC-U Windows

PVC-U has been used for fabricating window frames since the 1950s, first in Germany and then more recently in the UK. Over the past 30 years the use of PVC-U windows has grown dramatically and now over 80% of new and replacement window projects use PVC-U, usually to replace timber framed windows. There are many reasons for this success, but the main one is the quality of the product. PVC is strong, lightweight, durable and has versatile characteristics. It is naturally flame retardant and has excellent insulating properties.
Window Maintenance

PVC-U can be successfully maintained by following the guidance provided by the British Plastics Federation's Windows Group. It is important to remember that timber window frames are also subject to weathering, and they will require cleaning just the same as PVC-U. PVC-U windows, however, do not rot, warp, peel or chip.

We recommend regular cleaning with appropriate detergents and warm water, and the checking of certain hardware components such as gaskets and hinges, which may need lubrication from time to time. This would hold true for all materials, however, and is not unique to PVC-U.

Cost Comparison

Faced with austerity measures public authorities need materials that offer high performance at a low cost. Many studies have shown that PVC products have a more favourable cost/performance ratio than alternatives.

A new study funded by the European Council of Vinyl Manufacturers (ECVM) and conducted by Prof. Marangoni at Althesys has examined the „Total Cost of Ownership“ (TCO) for PVC products and the most popular functional alternatives in some key applications (windows, pipes and flooring).

Highly detailed cost data was obtained from public authorities and product suppliers in Germany and Italy, although the methodology can be applied to other national costs and conditions.

The results are robust and highly favourable for PVC products and in particular PVC-U windows. For good thermal performance windows the payback period for PVC-U windows are significantly shorter than for equivalent performance timber or aluminium windows.

However, the marked success that PVC-U windows have enjoyed in the UK market clearly demonstrates their cost-effectiveness in relation to competing materials.

1 Downloadable at http://www.pvcconstruct.org
Aesthetics

PVC-U now accounts for some 80% of the replacement window market in the UK. The use of PVC-U windows in modern dwellings is subject to few if any planning regulations. Windows obviously play an important part in the expression of period, image and regional building traditions and a range of styles is available suitable for heritage buildings.

2.4 Recycling of PVC-U Windows

The PVC industry has invested millions of pounds to develop a sophisticated recycling service, bringing thousands of tonnes of used material back into use in a new generation of advanced energy efficient and sustainable products. Because of its structure and composition, PVC can be easily, mechanically recycled in order to obtain good quality recycling material. Careful and proper sorting is of crucial importance for the optimal recycling of PVC materials.

Importantly, this includes a capacity to recycle not just production off-cuts but also old PVC products, for example doors and PVC-U windows that have reached the natural end of their life cycle – closing the loop on the recycling process.

Old windows are far more complex to recycle than factory off-cuts because they inevitably contain building debris, for example steel, concrete and sealants which need to be removed before re-processing.

The primary aim of recycling is to elicit a net environmental benefit through reducing the use of primary resources and/or diverting resources from landfill. Since the late 90s, the European PVC Industry has been working hard to embrace its responsibility to the challenge of sustainable development. This was particularly evident in the achievements of Vinyl 2010, the EU PVC Industry’s ten-year Voluntary Commitment to Sustainable Development, which made great progress in waste management, recycling and the responsible use of additives.

Ambitious, new targets for sustainable development were launched on 22 June 2011 as part of the VinylPlus programme which will build on the success of Vinyl 2010. For more information visit www.vinylplus.eu
The European PVC industry has most definitely achieved real successes in this regard, using the Recovinyl scheme to co-ordinate the collection and recycling of post consumer PVC building products. It has long been common practice to recover and recycle factory wastes and/or off-cuts after the window has been fabricated. These materials are then incorporated with virgin polymer to produce further long life products including window profiles.

Consistently, since inception of the scheme the UK has led the way in the increasing volume of PVC collected and recycled in Europe.

Regardless of the materials involved, a potential barrier to cost-effective recycling of post use products is the ability to retrieve, economically meaningful quantities of used products to supply a recycling scheme with its feedstock. In Germany, PVC-U windows were commercially introduced some twenty years before they were in the UK. Hence, German companies developed technologies to recycle post-use PVC products, which may arise as demolition wastes, for example. Tonnages are seeing significant growth, not only in the UK, but right across Europe.

As tonnages of post consumer PVC products inevitably increase, the European industry is seeing the development of the technology and infrastructure to recycle them in commercially viable and environmentally beneficial schemes.

In 2006, the UK saw over 16,800 tonnes of post-consumer PVC product recycled. The UK leads the field under Recovinyl, in Europe. The indications are that the UK will continue the upward trend in post-consumer PVC recycling.

The Vinyl 2010 Commitment made possible that 200,000 tonnes of PVC were recycled across Europe in 2010 and 49,343 tonnes of PVC recycled were in the UK only.

From the total of PVC recycled in the UK, almost 25,000 tonnes were from PVC windows and profiles, setting PVC-U as a good example of sustainable material.
3 Case studies

3.1 Beyond Windows – Recycled PVC-U used for Fencing

PVC-U’s environmental credentials are impressive with research suggesting that it can actually be recycled up to 7 times without losing performance. Given the reference service life of 35-year of plastic windows and doors, this means at the end of their useful lives they can potentially be turned into many new and diverse products over several centuries.

Whether it’s windows, roofline products or even garden furniture, giving this fully recyclable material a new lease of life offers many environmentally-friendly, economic and low-maintenance benefits for consumers.

These were among the reasons why Recovinyl recycler PVC Recycling Ltd and PAL Group, a Midlands-based manufacturer of construction and glazing products teamed up to produce an innovative equestrian fencing product, Fensys – made entirely from old plastic windows.

End-of-life frames diverted from landfill are processed at PVC Recycling’s Stalybridge site into chip or melt-filtrated pellets to a quality that can be used to make new products. The company’s state-of-the-art processing plant can recover up to 400 tonnes of even the most contaminated post-use PVC-U window and door frames per month.

PAL Group extrudes the 100% recycled material to make a white fencing product for paddocks and equestrian centres, complementing its existing Fensys range of decking and fencing systems. PVC-U is ideal for this application as the maintenance-free, 1.2 metre high fencing will not rot or splinter, offering a cost/effective, long-life and environmentally-friendly alternative to wood. Plus, there’s no costly and time-consuming maintenance to worry about, such as painting and repairs.

An extra advantage of using recycled window grade rigid PVC-U is the higher impact resistance it gives to the fencing. Special additives used to strengthen PVC for window use are retained in the recycled product, which meets all current equestrian regulations.

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2 The BRE (British Research Establishment) estimates that PVC-U can be recycled up to 7 times over a 200-year lifespan. In its 2008 Green Guide to Specification, the BRE has awarded PVC-U windows and cladding systems an A rating for domestic and an A+ rating for commercial properties.

3 ISO 15686 Building and constructed assets – Service life planning: Part 8, Reference service life
Peter Lowe, PAL Group Chairman, says: “Every 160 metres of recycled plastic three-rail fencing saves one tonne of waste PVC from landfill. It makes sound environmental and economic sense to re-use such a versatile material in new concepts from fencing to furniture. Being maintenance free, PVC is perfect for leisure industry applications. It’s a green solution for green fields!”

Ian Murray, MD PVC Recycling Ltd, adds: “One tonne of waste PVC equates to around 140 old plastic windows, so recycling them makes a significant contribution to reducing environmental impact and conserving precious resources. Consumers are far more willing to buy recycled products where possible. Paddock fencing is one example of where recycled plastic offers a genuinely practical, sustainable and time-saving solution.”

### 3.2 Epwin Group in UK’s First Closed-loop Recycling of PVC-U Windows: Northwards Housing

The Epwin Group boasts many UK window and construction industries firsts. This includes the manufacture of a window frame made solely from recycled PVC-U in 2004 and the first commercial application of a window profile manufactured solely from recycled material in 2009.

Managing and maintaining almost 13,000 properties in North Manchester, three-star ALMO Northwards Housing became the first social housing provider in the UK to specify and complete a PVC-U window replacement program installing windows manufactured solely from recycled material.

Delivered by preferred partner and principal contractor Manchester Working, Wrekin Windows (Manchester Working supply chain partner) and New Charter, the project drew on technical innovation in PVC-U building technology from the Epwin Group to recover and recycle old „waste“ material.

The pioneering programme followed Wrekin’s earlier appointment by Manchester Working and Northwards Housing to replace almost 600 PVC-U windows and curtain walling in
the eight storey Liverton Court tower block in 2008. As part of the contract brief the window specialist had to meet the specific requirement to reprocess and recycle all recoverable “waste” material from the refurbishment programme.

Reprocessed using sophisticated technologies by Dekura and then re-used in new component products by social housing specialist window systems company, Profile 22, tonnes of waste material that would have previously been destined for landfill were recovered.

Building on this success and following conversations between Northwards Housing Manchester Working and Wrekin Windows, Northwards in consultation with its board and residents, specified the installation of a fully-recycled window for use in the refurbishment of 18 properties in Corris Avenue, a small cul-de-sac of cottage flats and semi-detached properties in the Higher Blackley Area.

Manufactured by Wrekin Windows using material recovered by Dekura and re-extruded by Profile 22 from the tower block site, the fully recycled windows were fitted in March 2009 – the first time window frames manufactured from solely from recycled PVC-U framing material have been installed in social housing in the UK.

The culmination of the project resulted in the award of Best Recycled Product at the National Recycling Awards 2009.
3.3 Eurocell case studies

3.3.1 Code Level 6 zero-carbon development

Gentoo Homes required a cavity closer and window solution that would help it meet Code Level 6 requirements on two properties in Durham. Weighing up to 60kg each, the challenge posed was to devise a structural cavity closer that would allow the 0.8W/m²K U-value triple-glazed windows to sit over the 300mm cavity.

The walls had an overall thickness of 502mm with 300mm EPS bead filled cavity, which achieved a U-value of 0.10W/m²K. The windows also had to achieve Secured by Design standard.

Eurocell’s cavity closer arm, Cavalok and its approved fabricator Securiframe worked with Gentoo to develop a structural cavity closer based on the BigBlok system. This utilised new structural thermal materials, enabling the zero-carbon windows to be seated and fixed directly onto the main body of the closer, which eliminated the need for strapping back over large spans to the inner structure.

Initially developed as a bespoke solution for this project, the BigBlok structural cavity closer which, like all Cavalok products is the UK’s only BBA-approved 100 per cent post-consumer recycled PVC-U cavity closers, has now been introduced as part of the range.

In what represents a completely zero-carbon solution from Eurocell, Eurologik windows, which achieved a U-value of just 0.8 W/m²K, were specified alongside the cavity closer. Eurologik continues to make use of post-consumer recycled PVC-U to create more sustainable energy rated windows.

The architects at Gentoo also orientated the windows to maximise use of solar energy transmittance, in line with Passivhaus principles. The 70% light transmittance of the glazing enabled credits under the Code for Sustainable Homes to be gained for daylighting.
Eurocell and partner Nationwide Windows secured a £13 million contract with Nottingham City Homes to supply “A”-rated windows to 15,300 properties, using advanced PVC-U profiles from Eurocell. A cost-effective “A”-rated windows solution was developed for the project, which exceeded the client brief requirements and gave residents all the thermal efficiency benefits of the highest possible Window Energy Rating.

To deliver maximum sustainability for this contract, the 100,000 old window frames were recycled at Eurocell’s dedicated UK recycling plant. The material was then reground to make PVC-U Thermal Inserts for the new “A”-rated windows, fitted to the same properties. More than 90% of all waste material from site was recycled.

Fitting the new windows and doors will reduce current carbon emissions across the City of Nottingham by around three million kg each year and help residents save an average of £80-100 per household on annual fuel bills.

Mark Johnson, Director of Property Services, Nottingham City Homes, commented: “Our Secure Warm Modern project is helping us to improve thousands of council homes across the city. The innovative use of “A” rated windows means that our residents are receiving the best low carbon technologies available.”

Eurocell opened a state-of-art PVC-U recycling plant in Derbyshire in 2011. The processing plant has the capacity to process up to 12,000 old PVC-U window frames a week, which equals around 20,000 tonnes of recycled windows a year. Patrick Batemen, Eurocell’s chief executive, said “We want to stop “end-of-life” PVC from going to landfill and this material can be re-used up to 8 times. Stack that up against timber and the argument for using PVC is very strong”
3.4 VEKA signs UKs first major recycled window contract

VEKA unveiled in 2010 plans for the UK’s first major installation of windows made with recycled PVC-U. The ground-breaking contract is with the Places for People Group and involved tens of thousands of windows, each with nearly 80% recycled polymer from VEKA’s unique processing facility in Germany. VEKA Managing Director Dave Jones said: “This is a housing body with a real will to provide a sustainable environmental solution – and the vision and commitment to make it happen.”

Trevor Ranns, VEKA’s Commercial Sales Manager added: “We have had the technology in place for some years; we were simply waiting for the leap of faith in UK public opinion to recognise PVC-U recycling as a positive contributor to the environment”.

“Places for People has shown the courage to lead the way and we believe many more will now follow that example.”

The VEKA profile for the contract would be extruded as a separate product and all existing profile would continue to be made of 100% virgin polymer. The recycled product will comply with BS EN 12608 ensuring equal technical performance and appearance to virgin profile.

The VEKA Recycling plant at Behringen in Germany, is the first purpose built PVC-U recycling plant in the world, and is now supported by a primary processing unit in Kent and northern collection hub in Burnley to minimise fuel use in transportation of post-consumer windows for processing.

Launched 16 years ago, the Behringen plant, has the capacity to process annually 50,000 tonnes of post consumer windows, 12,000 tonnes of which comes from VEKA Recycling in the UK.
3.5 MK Electric - Manufacturing with Recycled PVC

MK Electric, a leading supplier of cable management products, is using PVC recyclate in the manufacture of its products. The company uses 100% recycled extruded lengths of PVC in the production process, enabling it to claim it can supply the ‘greenest’ products on the market. Overall, over 90% of MK Electric’s Cable Management range is made from recycled material.

Supplied by a Recovinyl recycler, the PVC recyclate used in MK Electric’s manufacturing process is sourced largely from the PVC window frames and doors industry. The waste PVC is sorted into dedicated containers by window companies across the UK and Ireland, ready for collection by PVC Group. The PVC is processed to remove all contaminants and ground into a high quality blended powder for re-use.

Using PVC recyclate supports the MK Electric’s own sustainability policy by diverting over 12,000 tonnes of PVC per year from landfill and by saving natural resources and reducing the energy costs involved in the production of new material.

MK Electric has developed products from recycled material to the same exacting quality standards as those produced from virgin polymers, manufactured to ISO 9001 certification and guaranteed for 10 years. With the commitment from the UK construction industry to improve sustainability across the whole sector, sourcing products like MK Electric’s can make a significant contribution by providing environmentally friendly solutions in the cable management sector.

Managing director, Mike Southgate, says: “We are seeing a marked change in emphasis as far as sustainability goes. Initiatives such as the Code for Sustainable Homes, the 2012 Olympic Construction Commitments and the Government’s Waste and Resources Action Programme (WRAP) have put sustainability to the top of the agenda for the construction sector.”
Suppliers

Windows System Companies

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LB Plastics Ltd
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Zenith Staybrite Ltd.
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