

# Polyvinyl Chloride PVC

## INTRODUCTION

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



This briefing has been prepared by the British Plastics Federation's [Vinyl's Group](#).

PVC is a very durable and long last 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. Due to its very nature, PVC is widely used in many industries and provides very many popular and necessary products.

57% of the molecular weight of PVC is derived from common salt, with the remaining 43% derived from hydrocarbon feedstocks.

- Over 50 quadrillion tonnes of salt exist dissolved in the sea, with over 200 billion tonnes of salt available underground - reserves of this material are clearly abundant.
- Ethylene from oil equates to 0.3% of annual oil usage, but increasingly ethylene from sugar crops is also being used for PVC production.

### The manufacturing process:

The basic manufacturing process can be described as follows:

The PVC production process consists of 5 steps

- The extraction of salt and hydrocarbon resources
- The production of ethylene and chlorine from these resources
- The combination of chlorine and ethylene to make the vinyl chloride monomer (VCM)
- The polymerisation of VCM to make poly-vinyl-chloride (PVC)
- The blending of PVC polymer with other materials to produce different formulations providing a wide range of physical properties.

Products and bi-products of PVC manufacture include Chlorine and Caustic Soda, two of the perhaps most important manufacturing "ingredients" not only for PVC manufacture, but many other applications. Chlorine is used in the manufacture of life-saving medication, indeed 85% of all pharmaceuticals. Caustic Soda too has many key, everyday applications, including the following applications: pulp and paper manufacture, soap and surfactant manufacture, detergents and cleaners, alumina extraction, textiles and the food industry.



PVC is used in a wide variety of applications, including windows and doors, including 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 - credit cards and cling film.

Around 34 million tons of PVC was produced worldwide in 2006, with approx. 6 million tonnes being used within Western Europe, predominantly used within rigid applications such as Windows and Doors and Pipes.

To summarise:

- PVC is a safe material
- PVC is a socially valuable resource
- PVC does not need to be replaced or phased out



## PROPERTIES

PVC's major benefit is its compatibility with many different kinds of additives, making it a highly versatile polymer. PVC can be plasticised to make it flexible for use in flooring and medical products. Rigid PVC, also known as PVC-U (The U stands for "unplasticised") is used extensively in building applications such as window frames and cladding.

Its compatibility with additives allows for the possible addition of flame retardants although PVC is intrinsically fire retardant because of the presence of chlorine in the polymer matrix.

PVC has excellent electrical insulation properties, making it ideal for cabling applications. Its good impact strength and weatherproof attributes make it ideal for construction products.

PVC can be clear or coloured, rigid or flexible, formulation of the compound is the key to PVC's "added value".

## PHYSICAL PROPERTIES

Tensile Strength 2.60 N/mm<sup>2</sup>

Notched Impact Strength 2.0 - 45 Kj/m<sup>2</sup>

Thermal Coefficient of expansion 80 x 10<sup>-6</sup>

Max Cont Use Temp 60 oC

Density 1.38 g/cm<sup>3</sup>

## RESISTANCE TO CHEMICALS

Dilute Acid \*\*\*\*

Dilute Alkalis \*\*\*\*

Oils and Greases \*\*\* variable

Aliphatic Hydrocarbons \*\*\*\*

Aromatic Hydrocarbons \*

Halogenated Hydrocarbons \*\* variable

Alcohols \*\*\* variable

KEY \* poor \*\* moderate \*\*\* good \*\*\*\* very good

## **APPLICATIONS**

Window frames, drainage pipe, water service pipe, medical devices, blood storage bags, cable and wire insulation, resilient flooring, roofing membranes, stationary, automotive interiors and seat coverings, fashion and footwear, packaging, cling film, credit cards, synthetic leather and other coated fabrics.

### **Construction**



PVC has been used extensively in a wide range of construction products for over half a century. PVC's strong, lightweight, durable and versatile characteristics make it ideal for window profiles. PVC's inherent flame retardant and excellent electrical insulation properties make it ideal for cabling applications.

Typical example of PVC construction products include:

Window and door profiles, Pipes and fittings, power, data and telecoms wiring and cables, cable and services ducting, internal and external cladding, conservatories and atria, Roofing and ceiling systems and membranes, rainwater, flooring and wall coverings.

### **Healthcare**



PVC has been used for hundreds of life-saving and healthcare products for almost 50 years being used in surgery, pharmaceuticals, drug delivery and medical packaging.

Typical examples of PVC healthcare products include:

"Artificial skin" in emergency burns treatment, blood and plasma transfusion sets, blood vessels for artificial kidneys, catheters, blood bags, containers for intravenous solution giving sets, container for urine continence and stormy products, endotracheal tubing, feeding and pressure monitoring tubing, inhalation masks, surgical and examination gloves, shatter-proof bottles and jars, mattress and bedding covers and blister and dosage packs for pharmaceuticals and medicines.

The Thackray Museum in Leeds, UK, currently has an exhibition running on the influence plastics and PVC has had in the Medicinal area. This brand new interactive gallery explores the many different ways plastic is used in medicine to save lives today.

From the patient's face mask, the surgeon's scalpel to the flooring of the operating theatre, this exhibition will show you how plastics and PVC have shaped modern medicine.

The Museum is in the centre of Leeds, next to St. James' Hospital. For full details on the exhibition, please visit <http://www.thackraymuseum.org/>

It's thanks to PVC's versatility and life-saving functions that it has become an essential product for the medical profession.

### **Automotive**



PVC brings both high performance qualities and important cost benefits to the automotive industry. Independent research by Mavel Consultants has shown that the typical cost of using alternative materials is in a range 20-100% higher per component. Typical examples of PVC automotive components include:

Instrument panels and associated mouldings, interior door panels and pockets, sun visors, seat coverings, headlining, seals, mud flaps, under body coating, floor coverings, exterior side moulding and protective strips and anti-stone damage protection.

### **CURRENT CASE STUDIES**

#### **Flexible PVC**

Flexible PVC is used to make blood storage bags, and in fact is the only material approved by the European Pharmacopoeia for this purpose. The nature of the material means that blood can be stored for longer and safely.

Vinyl flooring is a key product in many areas of modern life, from hospitals and hotels to everyday usage in the home.

PVC was first used as cable insulation as a replacement for rubber during the Second World War, but has now become the superior material through its flexibility, ease of handling in installation and inherent flame retardation. PVC cables do not harden and crack over time and find use in many applications from telecommunications to electric blankets. Cable insulation is recyclable and is being recycled through the Vinyl 2010 scheme called [Recovinyl](#).

#### **Windows**

PVC in window frames. Unplasticised PVC is one of the stiffest polymers at normal ambient temperature and shows little deterioration after many years in service.

PVC is versatile and can be used for different colours and effects. This example shows it being used as an alternative to traditional wood frames. Full details of PVC-U windows can be found via our Windows Group, [www.bpfwindowsgroup.co.uk](http://www.bpfwindowsgroup.co.uk).

The Building Research Establishment (BRE), the UK's leading authority on sustainable construction, has granted PVC-U windows a life-span of more than 35years. There are many examples of products lasting much longer than this, however.

### **The "Green Guide to Specification"**

The latest Building Research Establishment (BRE) 'Green Guide to Specification', confirms that PVC is one of the best all-round framing materials on the market currently. PVC-U windows, in a domestic setting, score an "A" rating and in the commercial arena, an "A+" rating - the best there is! PVC-U windows are one of the best performing products on the market today.

### **Energy Ratings**

The British Fenestration Ratings Council (BFRC) also grades materials on their energy efficiency, PVC-U frames - compared to the listed Aluminium and Timber options - score many 'A' ratings, marking their superior energy performance. Please see [www.bfrc.org](http://www.bfrc.org) for further details.



Coupled together with the variety of colours available (from a variety of manufacturers), the inherent recyclability of PVC, minimal maintenance (regular cleaning required) and their ease of repair, should anything go wrong, PVC-U Windows offer great advantages over competing materials.

### **Packaging**

PVC is used extensively in sandwich box packaging, with excellent barrier properties, the food is preserved and packed efficiently, protecting the product from damage and reducing wastage.

### **Vinyl Records**

PVC is used to make vinyl records. Whilst the CD format takes the lion share of the home music market, the vinyl record remains popular with DJs and the dance music culture where sampling and mixing music is traditionally achieved using vinyl, as well as enthusiasts of vinyl who prefer the format.

### **Seminars**

The BPF Vinyls Group organises various conferences and seminars to help communicate ideas and

developments throughout the industry and beyond. Full details can be found via the Events Page of [www.bpfevents.co.uk](http://www.bpfevents.co.uk)

### Vinyls Group

The BPF Vinyls Group represents the UK PVC industry to government, customers and media in the UK and Brussels. PVC faces specific issues in the market place and so representatives from forward-thinking PVC producers, converters, additives suppliers and recyclers finance this Group in a focussed programme of activity. The BPF Vinyls Group disseminates relevant communications resources and takes queries from customers, specifiers, decision-makers and opinion formers at exhibitions, including Interplas and EcoBuild.

To find out more about the BPF Vinyls Group, click [here](#).

### IOM3 PVC Conference

The BPF Vinyls Group are actively involved in the [IOM3](#) PVC tri-annual conferences held in Brighton, both as a sponsor, and as active members of the Organising Committee. The 2008 Conference, in Brighton, attracted over 400 delegates from many countries, confirming the conference place as one of the premier PVC conferences.

### Vinyl 2010

The BPF Vinyls Group is the UK platform for the implementation of the Vinyl 2010 Voluntary Commitment of the European PVC Industry in the UK. This forms part of PVC's environmental credentials. Full details of this scheme are available via the BPF Vinyls Group page and also [www.vinyl2010.com](http://www.vinyl2010.com).

### [www.pvcaware.org](http://www.pvcaware.org)

The PVC industry is keen to promote the benefits of such a versatile material - and one which is easily recycled. One such initiative to promote PVC has been developed by the BPF Windows Group, which is called PVC Aware ([www.pvcaware.org](http://www.pvcaware.org)) and is an easy to use tool promoting the benefits of PVC.