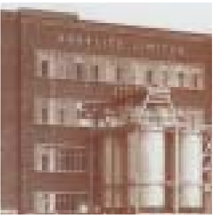
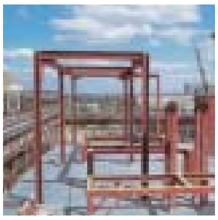
Hydro Polymers







50 Years at Newton Aycliffe

[People & PVC]

Foreword

A History of Progress

In 1997, Hydro Polymers celebrates 50 years of PVC production at Newton Aycliffe and the start-up of our new £35m resin plant. By any standards these are major milestones in the history of the company, and they provide an opportunity both to look back on the route travelled to get to this point, and at the way ahead - hence the publication of this book.

Over 50 years the development of Hydro Polymers and its antecedents, and the development of PVC as a material, have been closely interwoven. During the past few years, Hydro Polymers has reflected in microcosm what has been happening in the best of manufacturing industry in the UK in general, and in the North East in particular. The company has progressively sought to adopt the philosophy and discipline of Total Quality Management; concentrating on satisfying customer needs with consistently high quality products, safely and cost-efficiently produced,marketed by well trained and motivated people, using modern and effective business processes. This strategy has brought benefits to our customers, employees and shareholders as well as gaining us a cupboard-full of quality, training and safety awards.
The PVC market is increasingly global in character and that means more competitive. The progress we have made in quality in all areas of our operations has been a major factor in the investment decision to expand capacities at Aycliffe. With heavy capital expenditure, over £50 million between 1995 and 1998, Norsk Hydro is demonstrating its commitment to the future of PVC, and its support for sustaining the obviously strong competitive position of HPL.

In addition to the new resin plant, which has proprietary Hydro large-reactor technology, Hydro Polymers' compounding capacity is currently being boosted by a £5m investment. Already the largest single site PVC compounding unit in Europe, this represents a further 30% growth for Aycliffe. To support the growing businesses, a new £1.5m fully integrated IT system has been implemented, using state-of-the-art SAP software.

These developments provide the platform for Hydro Polymers' evolution into the 21st Century. Our future is based on clear customer focus, excellent product and process technologies, a strongly competitive position, credible environmental policies and perhaps most

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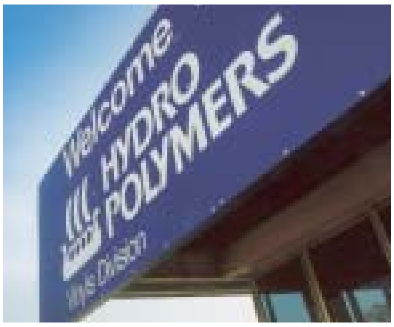
importantly, an educated, empowered and committed group of people.

We have come a long way over the past 50 years. PVC was born into a very different world at Aycliffe after the Second World War, but over those 50 years, advancing technologies and the involvement and contribution of people have been recurrent themes.

Geoff Richards
Managing Director (1992 - 1998)
Hydro Polymers Limited



The Early Years

The six years of World War II were tragic for the civilians and military personnel killed, injured or made homeless. As governments and people made common cause in seeking to survive and to provide for their armies however, very necessary social and technological changes were accelerated far beyond their peacetime pace. "The History of Bakelite Ltd", by T.J. Fielding, published in 1947, makes clear the speed of those technological changes.

Bakelite had been founded in 1926 to produce phenol-formaldehyde thermosetting plastics and lacquers. Until 1939 the only plastics most of the public really knew about were Bakelite and its competitors, though the thermoplastics PVC, polyethylene, nylon and polystyrene, were already being produced in small commercial quantities in Germany and the USA. Rubber was by then almost a 'traditional' material and it had become very important in military and civilian life for waterproofing materials, vehicle tyres and for the insulation of the cables used in electric and electronic equipment.

As the war at sea grew more and more intense, it became increasingly difficult to obtain supplies of raw rubber from South East Asia and from South America. A locally produced alternative to rubber cable insulation became essential and flexible or plasticised PVC was one of the alternatives available. Given the pressures upon oil supplies in such a time of war it was fortunate that vinyl chloride was not then derived from oil but from coal. Lime and coke were roasted together in an electric furnace to produce calcium carbide. When mixed with water the carbide gave acetylene which could then be reacted with hydrogen chloride, derived from salt, to give vinyl chloride, the raw material for PVC. The plasticisers used to make PVC flexible could also be made from coal-based chemicals. Much of the early commercial development of PVC was done in the USA and one of the major shareholders in Bakelite Ltd was Union Carbide, a company founded to take advantage of the production of acetylene from calcium carbide. Bakelite files from the early 1940s report visits to Union Carbide in the USA by the Research Director, Mr S.E. Chubb, to obtain supplies of PVC polymer under the terms of the Lend-Lease programme.

The Government needed manufacturers to make the alternatives to rubber and existing plastics manufacturers were the obvious choice. The mixers and mills used to prepare Bakelite resins were also suitable for thermoplastics and Bakelite first mixed or compounded PVC at their Tyseley works. Later in the war a dedicated plant was built in a paper mill at Feniscowles in Lancashire. The applications for PVC developed in wartime promised plenty of new business in peacetime, as is explained in the chapter on the origins of PVC. As Bakelite Ltd re-organised itself for peace, the manufacture of PVC became one of its four key activities.

The 1940s

The 1940s was a decade of extraordinary upheaval. War meant shortages and the world had become necessarily austere and drab. When the War was over the world was ready for something new.

Post-war governments, faced with re-building Britain, felt free to direct industry to wherever it was needed. The people of the North East had suffered very badly in the 1930s Depression because their employment was so dependent on heavy industry and the pits where, in County Durham at least, the coal was becoming more difficult and less economic to extract. The Government had experimented successfully with the Trading Estate concept in 1936 when it set up the Team Valley estate near Gateshead.

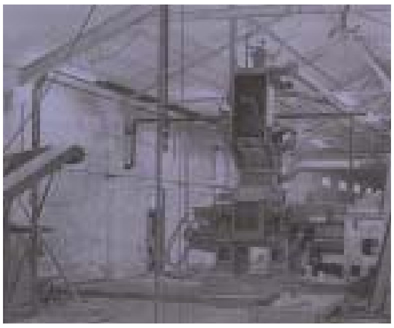
The decision to convert at least part of the redundant munitions factory at Aycliffe (Royal Ordnance Factory No 27) to a trading estate was a godsend to returning soldiers and to the many women redundant from war-time occupations.

One of our longest serving pensioners had connections with the site long before Bakelite arrived. Angus Foggett, who retired in 1980 as an area engineer, was working for HM Office of Works in London in the early 1940s, at which time part of his work was concerned with ROF 27.

Making available the space as well as the ROF buildings themselves enabled potential employers to get around the very acute shortage of building materials which was limiting many post-war developments. The Government's enthusiasm for Bakelite's move to Aycliffe was made clear by the speed with which the three large brick buildings (now C1,2&3) were erected in spite of the shortage of materials. The ROF was also the source of the first Aycliffe engineer employed by Bakelite. Archie Hovington, who retired from Aycliffe in 1980, had been the machine shop manager at the munitions factory and he was offered a post in September 1945 when the company announced its move to Aycliffe. At the same time Joe Richardson became the first local non-ROF recruit when Bakelite employed him as an engineer.

One of the first problems for the company and its employees was that there was very little accommodation nearby, necessitating long journeys to and from work.

Fred Sutton, who retired from the personnel department in 1980 after many years on the shop floor and in man-management, recalls the feelings of N.E. soldiers returning to civilian life; looking forward to being home, but uncertain of the employment prospects that awaited them. When, while he was still in the army, he heard of the possibility of work on the Aycliffe site, he immediately applied and, with the encouragement of his senior officer, took a job on the new compounding plant, beginning work before he was officially demobbed.



Cycling to and from his home in Middlestone Moor to Aycliffe each day did not present a problem.

It was very different for those who were seconded to Aycliffe from Tyseley. Not only was accommodation difficult to find but transport and communications were extremely limited. More than one local employee interviewed in preparation for this book commented on the fortitude of Tyseley workers who 'upped-sticks' to pioneer the new plant.

In early 1946, while longer-term projects were being developed, the first PVC compounding unit (later called No 3 Unit) was set up in a shell-filling building (later Y11) which, until early1996, occupied the space between the present Compounds Business Centre and the SAP Building.

New machinery was very scarce in those days and the new Unit was equipped with second-hand mixers and mills which were up to 15 years old. The unit was used to make both flexible and rigid grades. It produced a strip of material which passed down an air-cooled conveyor to a Masson-type cutter.

This noisy beast produced irregular chips rather than granulate, which were packed into fibreboard drums. The first cable insulation grade was VX 300. The Unit was also used to make 'easy-flow' black VX 100 moulding compounds from vinyl chloride/vinyl acetate co-polymers. For these grades the hot strip was not chipped, instead measured lengths were folded by hand into 'biscuits' which could be re-heated at the customer's before being moulded into 33rpm long-playing microgroove records.

The production process was rather rudimentary at this time; the recipe and the processing conditions were written up on a blackboard and as the job progressed and the plant warmed up, the supervisor would change the processing conditions to keep the heat history steady. That first PVC compounding unit was in operation until the late 1980s, even though it was only intended as a temporary stopgap.

The second winter on the site - now infamous as the 'great winterof '47' - was terrible and it could not have helped the confidence of the newcomers from Tyseley.

Fred Sutton saw a temporary change in the nature of his job due to the inclement conditions which the whole country was suffering at that time. Steam heating - dating back to the days of the munitions factory - was used to heat both plant and buildings and was bought-in at that time from the coal-fired boiler house on the other side of the estate. When supplies of coal for the boilers began to dwindle, the night shift on the PVC plant was transferred to a day-shift at Cornforth pit to dig coal out of the frozen stocks for transport to the site. While gainfully employed, the men of Aycliffe were content in their work - no matter how varied!

A co-operative community rapidly developed. Plastics were new and exciting. Few people knew much about them and a great deal of improvisation was required to get the job done.

Why is it Called that?

Longer-term employees can sometimes be identified by their use of strange building and unit references.

You might wonder where those references came from. Royal Ordnance Factory No 27 was divided into areas. The original area leased by Bakelite and now occupied by Administration and the PVC Compounds

Business was the 7A site. The area to the south occupied in part by Warehouse and Distribution and the Raw Materials Stores was the 7F site. The polymer plants have no ROF site reference because they were built on a green field. The munitions factory had numbered streets running north to south and lettered avenues running east to west .

The new Administration building, for example, stands on the corner of Street 9 and Avenue M. The narrower paths were called “cleanways” and some longer-term employees still call them that . Each ROF building had a reference linked to the site on which it was. The present canteen, for example, was originally 7AB15. Some buildings, such as the A14 and A11 stores on Street 14, still retain a part of those labels. In Bakelite times some buildings were given numbers corresponding to similar-use buildings at Tyseley, but prefixed with Y. Thus the present Compounds Business Centre started life as 7AB18 and then became Y29A as the Development Department, corresponding to Block 29, the Tyseley R&D building.

It can be confusing to find that some of those Y reference buildings contained a product unit or units with unrelated numbers. Thus Y19 contained Units 4, 5, 6, 7, 11 and 11K while Y44 contained units 10, 13, and 14. The early days of Hydro Polymers brought a major co-location programme for compounding units. Y17, Y4 and Y5 were linked together to form C1, C2 and C3 within which are 14 separate compounding units.
Some buildings, such as 7AA11/Y11 and 7AA13/Y19 have simply gone.

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Ted Thornton, who joined in 1948 to work as a technician in the Physics Laboratory, gave an interview some years ago for the Plastics Historical Society in which he pointed out how little was known about PVC at that time. There were certainly no British Standard tests for the cable insulation compounds which were being made by Fred Sutton and his colleagues. Many tests were devised in the Aycliffe laboratory and the company had a long history of involvement with the British Standards Institute in the development of national standards, a situation which continues today.

By 1948 the three large brick buildings were completed and some plant was installed before they were formally opened by the then President of the Board of Trade, Mr Harold Wilson.

To this day the central building carries the Bakelite trefoil and careful examination reveals the ghostly outline of 'Bakelite Limited'. The most northerly building was to house a Bakelite moulding powder plant, the next was for the manufacture of urea-formaldehyde and unsaturated polyester resins. The third was committed to PVC. On the field to the north of the munitions factory site a PVC polymer plant was beginning to take shape.

Polymer Production

The polymers used in the early days were purchased principally from the Union Carbide Corporation of the USA. PVC polymer manufacture on the Aycliffe site began with a three-autoclave plant, said to be the most up-to-date in the world.

Costing £1 million to build, the foundation stone was laid by the chairman of Bakelite, Mr H. V. Potter, on the 16th August 1951.

Mr Potter described the occasion as being a milestone in the company's history. "Workers in the North East are of the finest type they could possibly be," he said, "adaptable, hard working and capable of picking up new processes very quickly."

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The town of Newton Aycliffe had begun to take shape in the early 1950s.

Brian Quint, a self-proclaimed "exile" from Tyseley, wrote in the works magazine of his pleasure at getting a house in the town after five years of married life in furnished rooms in Tyseley. His happiness was tempered by the sea of mud and rubble which surrounded the house, however.
By 1952 some 400 houses had been built

and the town had 1500 inhabitants out of a planned total of 10,000. Mr Quint reported that the amenities of the town were plentiful - as long as one enjoyed the simple life. There were no cinemas, no dance halls and, at that time, no pub - though the Gretna Green Wedding Inn (now the Wacky Warehouse) was only a short distance away beside the A1.

Ray Tate, who joined the R&D staff in 1950, remembers the community at Aycliffe as being made up of a very mixed bunch of people. There were the locals and the Tyseley people of course but there were also those 'left behind' by war. He remembers a skilled fitter from the Waffen SS working alongside a Czech, a Pole and a German of Jewish origin.

Then as now, labour relations were good on the Aycliffe site and while in part that may have been due to people's relief at finding employment where they had not expected it, much credit must be given to the sense of community which developed in those early days.

Three separate units for processing PVC were installed in the third brick building at this time (then called Y17 and now C1). One was a small PVC compound production line in which a Bekum high-speed mixer fed a two mill train from which the cooled strip was led to a Masson cutter.

Because the mills were made by Francis Shaw Limited this line became known as the Shaw Unit. There was also a line consisting of a Gardner ribbon-blender, a Banbury mixer, a mill and then a large four-roll, L-formation calender. Angus Foggett, then still based at Tyseley, was a member of the project team which managed the purchase and installation of the calender. Angus estimates that the process took the better part of four years to complete. He recalled his many visits to the Sheffield works where the rolls were cast and ground. The project team escorted the rolls on their slow journey to Aycliffe, anxious that there would be no rain to cause the rolls to rust.

Expansion and Diversification

The calender produced thicker (20thou) flexible PVC sheet, in large quantities which was sold to Commercial Plastics on Tyneside for embossing. Thin (4thou) flexible films were also produced for applications such as plastic macs and mattress covers. Rigid and flexible PVC sheeting was also produced to feed the third unit in the building which consisted of two large multi-daylight presses.

Cross-contamination from the two PVC processing lines made the production of really high quality press-polished sheet very difficult and so very early in the 1950s the presses were moved to a building newly leased from the Ministry of Defence. This building (Y9) is now the raw materials store, just south of the present finished product stores. Quality was much improved by the move and the products competed very effectively with those produced at the British Xylonite factory at Brantham in Essex. Ray Tate recalls that in the earliest days of the calendering operation, before the polymer plant was operating, the polymers used on the plant came from Union Carbide in the USA and from Rumania. The Rumanian polymer was bagged and sealed in steel drums, which had to be chiselled open by hand.

Flexible PVC film was laminated to produce high clarity polished sheet of the kind used in the hoods of soft-top cars. Rigid PVC film was laminated into thicker polished sheet used for printing plates in photogravure processes and for lining chemical tanks and vessels in which corrosive liquids were stored.

The new resin plant

Commissioned in November 1953, the plant included the brick structure at the core of the present A&B plants and employed Union Carbide bulk polymerisation technology.

The local Evening Gazette published the headline “Boom Village - in Plastics”, and went on to say “The rapid expansion of plastics production for a multitude of uses has been one of the romances of industry in modern times”. It welcomed the new plant to Aycliffe because of the employment it provided.

Unfortunately, the plant proved difficult to control and polymer quality was very variable. In April 1955, one of the reactors exploded injuring nine employees and virtually destroying the autoclave area of the plant. Bakelite’s commitment to PVC was undiminished though and in 1956, rebuilding began under the supervision of the chief engineer George Brownless.

It took 18 months to complete the work, employing much of the structure and vessels of the original plant. This time the plant employed Union Carbide suspension polymer technology. It had four 3000 gallon glass-lined autoclaves and its nameplate capacity was 15,000 tonnes per year. Ray Brown, a long-serving Aycliffe chemical engineer, visited Union Carbide in the USA to learn about the new technology and he became the driving force behind the construction of the plant.

The quality of the resin produced on the new plant was very variable and the plant economics were not sustainable. The PVC compounding department was forced to try out each batch on a small scale before commencing full production. A Bakelite delegation was sent to Union Carbide in the USA to try and assess just how good the technology really was. They returned somewhat discouraged. There were suggestions from senior Bakelite personnel that the plant might be closed if there were no improvements. The Aycliffe team set to work and solved many serious problems by 1958 but the polymer produced was still very variable.

At this point the R&D director, Dr T. Love, decided to make use of some personal connections to bring further improvements. He had been in one of the teams of carefully selected scientists and engineers sent out by the British Government immediately after the end of the war in Europe to forage in Germany for technology which could be useful to Britain. It was typical of Dr Love that he not only found valuable technology but he also formed friendships with scientists and engineers in what remained of German industry.

One of the companies he visited was Wacker Chemie, a PVC manufacturer of recognised quality. Wacker's R&D director, who had become a friend of Dr Love, was invited to Aycliffe to help solve the polymer quality problems. He came with a technician and they decided that suspending agents were the problem. Excluding Aycliffe staff, the two Germans made up solutions of Wacker suspending agents for use in trial reactions. The polymers produced were a great improvement. Bakelite bought Wacker technology to tide them over until the Aycliffe team could develop its own expertise. The economics of the process were also vastly improved by Wacker's recommendation to store VCM un-cooled but under pressure and to change the autoclave cooling medium from refrigerated brine to atmospherically cooled water. Adoption of Wacker technology transformed the fortunes of Bakelite's polymer-making operations.

Ron Hards, who was works manager under BIP until 1982, made his first visit to Aycliffe in 1956. He describes it as looking then not unlike a prison camp. Tyseley management were acknowledged as regarding it as a place where temporary postings rapidly led to a search for alternative employment. What he himself found was a greater freedom from formality, with people on first name terms in the developing community. Tyseley management did not approve of such informality and visits to HQ necessitated a temporary return to old-fashioned ways if one wasn't to ruffle feathers.

New compounding plant

The markets for PVC continued to develop, and more compounding capacity was needed. The Shaw Unit was re-named No. 4 Unit (dedicated to small orders) and was moved into a rework stores building (later Y19) which was sited just to the north of the present Sports Pavilion. A new Gardner-Banbury-mills unit capable of producing one tonne per hour was installed in the same building as the calender and it became No 1 Unit.

The stores building also housed a three-roll Paint Mill used for grinding pigments into fine pastes with plasticisers to ensure that they could be properly dispersed in PVC compounds.

Next came No 5 Unit, installed in Y34, the building outside C1 now used as a heated store. This was again a Banbury mixer unit and as Bakelite became interested in other polymers its production capacity was shared between PVC and polyethylene produced by Union Carbide at its new Grangemouth plant.

The '50s had ended triumphantly for Prime Minister Macmillan with the "never had it so good" General Election rally of 1959. Things were indeed looking up for the people of Aycliffe and for the industry they were building. The influence of plastics had by this time spread even to the world of fashion; the "wet look" was in, and hemlines went up!

The Development Corporation which was building Newton Aycliffe had no remit to build places of entertainment - unless it could be sure of a profit. This wasn't easy with a population of 1500 people. The Corporation had provided a community centre in a converted cow shed in which a wide variety of amateur activities were staged. With such cultural deprivation it was not surprising that the works Sports and Social Club had become well established by this time. The folk of Aycliffe were enjoying the vitality of their growing community.

The company had made the western half of the north field available for sports and events. In the 1960s a temporary hut was replaced by a proper pavilion opened by the then MD, Mr Hodds. The Sports Field was developed to include a nine-hole golf course and a Golf Club was formed. Then as now the Sports & Social Club was run by employees and it had a considerable degree of independence from the company.

The positions of Chairman and Secretary were open to any employee who could gain the majority of Members votes, and it was often said that no one with pretensions to management status should refuse to serve in one of these two posts.

The highlights of the club year for employees were the Annual Dance and the Sports or Field Day. For their children the long-established Christmas Party and Panto visit were probably enjoyed even more and over the years many Sports & Social Club secretaries have been grateful for Ray Jackson's skills in safely bringing them through the ordeal of organising them.

The party for younger children has always included games, tea and Santa Claus. Ray Brown was probably the longest serving Santa, coming at one time into the party 'down' a chimney installed in the works canteen for the occasion. As the party venue changed, Santa came on a sleigh designed to cope with both the presents and with Santa's traditional bulk. The Panto trip for the older children had the extra excitement of a coach journey with refreshments in a bag on the return trip. Lost parents were often more of a problem than the children though the famous occasion when the passengers on the coach managed by the personnel manager turned out to include two Sunderland lads keen to enjoy the tea, was a lesson to all future coach minders. There was a Football Club, a Cricket Club, an Angling Club, a Fellwalking Club, a Motor Club, a Gardening Club and even a Scottish Dancing Club.

The Motor Club probably had the largest membership because, even if they didn't want to join the very successful treasure hunts or dances, members were very keen on cut-price oil and cheap hire of the jacks, bearing extractors, timing lights and so on that were so much a part of motoring for many people at that time. The Gardening Club, as well as holding shows, was a source of cheap fertilizers and other gardening necessities for its members. Joyce Beswick, long term secretary to the R&D directors and for many years the librarian at Aycliffe, remembers Motor Club events with great pleasure. She was Secretary of the Club until its closure in 1988 and helped to organise many outings for local disadvantaged children.

Market Development

When, over the years, new application areas have presented themselves, it has been Aycliffe practice to acquire machines of the types likely to be used by customers. New recipes could then be tried out before despatch to the customer and staff could develop their processing expertise.

New application areas of great promise have been developed using small dedicated teams drawn from Market Development Department (e.g. Bruce Mitchell, Peter Watts, Bernard Davies and John Baldwin) and Technical Departments (e.g. Peter Lockey, John Reid and Jim Mooney).

From the late 1960s bottle, medical, footwear, cellular rigid and window profile grades have been given this treatment with considerable success. Aycliffe has since withdrawn from some of those markets for economic reasons but retains significant sales of medical, cellular and window profile grades.

Expansion and Diversification

During the 1960s polymer plant was extended to include five autoclaves, increasing its capacity to about 20,000 tpa.

This configuration was held for the next decade even though world-wide consumption of PVC was growing at nearly 15% per year. There were three UK producers of PVC polymer; Bakelite Xylonite Ltd, formed by a merger early in the 1960s of Bakelite and British Xylonite, jointly owned by Union Carbide and The Distillers Company; British Geon, jointly owned by BF Goodrich and The Distillers Company; and Imperial Chemical Industries. Keeping pace with the growing demand required heavy capital investments in new polymerisation capacity and in compounding plant. Not surprisingly, Distillers had no wish to make heavy investments in polymer production at both of its subsidiaries.

British Geon gained an increase in polymer capacity while Aycliffe received investment to increase compounding capacity.

By 1965, all Aycliffe's polymer output was being fully absorbed in on-site applications and the company withdrew from external sales. Shortfalls in polymer supplies were made up by polymer purchases, mainly from British Geon. This situation continued until 1968 when British Geon was sold to BP Chemicals. The embargo on investments in polymer plant was lifted and a sixth larger stainless steel autoclave was added at Aycliffe. As time went on, the original five glass-lined autoclaves were replaced with stainless steel vessels to become the present A-Plant.

Autoclaves 7&8 were added to No 6 to form B-Plant and the total capacity grew to 40,000tpa. Co-incidentally, Vinatex commissioned its Staveley polymer plant in 1968.

In addition to compounding polyethlene from BXL's Grangemouth plant, Aycliffe was absorbing all the PVC polymers it could produce. These polymers were designed specifically for applications in which Aycliffe specialised, including calendered and press-polished sheets.

Derivatives of Wacker technology, such as the very porous VY11 were still in use together with Aycliffe recipe materials such as VY18, a medium porosity polymer used in all kinds of flexible applications from high clarity medical tubing to black footwear.

There were also higher viscosity glassy polymers for pipes and lower viscosity glassy polymers for bottles.

Expansion and Diversification

Though Bakelite had developed a satisfactory range of flexible grades, the company had had little success in the manufacture of rigid PVC compounds

when using Banbury mixers. This contrasted with ICI which had very good Banbury-processed rigid grades. By the early 1960s it became obvious that Aycliffe needed to do something radical to change this situation and a continuous compounding unit, a PR200 Buss Ko-Kneader fed by a high speed mixer, was installed as No 6 Unit in the building which already housed the Shaw Unit and the Paint Mill. No 7 Unit, a simple two-roll mill used for very small orders followed. Later in the 1960s No 9 Unit, a Columbo twin-screw continuous compounder for rigid PVC was installed next to the Buss Unit and was fed by the same high speed mixer.

As the market for powder blends for the production of PVC bottles grew, a high speed heater/cooller mixer was installed in the original PVC building as No 8 Unit. Two factors brought a further radical change to PVC compounding at Aycliffe.

There was growing competition in the market for flexible PVC compounds and Aycliffe production costs needed to be reduced to retain business. Aycliffe had become very successful in the market for PVC cable insulation, but very long production runs on inefficient Banbury units were reducing customer supply flexibility.

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Malcolm Brooke who retired in 1991 from personnel department, recalled the development of Number 10 Unit, built to solve these problems. Farrell-Bridge had available the FCM, a continuous mixer which had the characteristics of a Banbury mixer. In the new five tonnes per hour unit, high speed mixers fed an FCM which then fed a large extruder. This extruder produced a thin large diameter tube which was slit into two twelve inch wide strips and diced.

The plant was highly automated and economic, producing good looking VN 336. It soon became clear however, that the properties of this material were not up to standard. In some cases extrusion output was reduced by a quarter and customers found it difficult to get good surface finish. Cable insulation business drained away to competitors.

A major investigation was launched, led by Ted Thornton, Bob Tugby and Eddie Williams, making use of on and off-site research resources. The team concluded that while the FCM was producing the material asked of it, the extruder was not. The material was being given a different heat history than on earlier plant. This caused no chemical damage but increased ‘gelation’ level, making the material more difficult to ‘flux’ and slowing extrusion rates unacceptably. The extruder was replaced with the two mills that are in place today, satisfactory product resulted and No 10 Unit regained its star status. Problems with new technology are not Aycliffe’s pre-rogative; ICI fell into exactly the same trap ten years later when making major technology changes in rigid PVC production.

The introduction of a plant with the output of No 10 Unit forced a new look at quality control methods and on-line X-ray fluorescence equipment was installed to measure lead and antimony content rapidly. Laboratory equipment was improved by the purchase of a ‘Quantity Analyser’ which employed broad band Nuclear Magnetic Resonance techniques to measure the plasticiser content of PVC in minutes rather than days. Key quality checks could then keep up with production again.

Aycliffe in the 1970s

There had always been events when the families of employees could visit the site though they were seldom able to visit production units as is now possible on Open Days. The 1970s saw three such large social events.

Bakelite and BXL had occupied the Aycliffe site for 25 years in 1971 and the company made this an occasion for family celebration. A stone was laid outside the

Warehouse & Distribution building, refreshments were served and a good time was had by all.

The Stockton and Darlington Railway Company began operating in 1825 and its first steam locomotive, Locomotion No. 1, was placed on the tracks which pass the Aycliffe site at what is now Heighington Station. The railway companies and the local authorities have celebrated the opening of the railway at 50 year intervals.

The 150th anniversary celebrations in 1975 included a large cavalcade of veteran engines which would pass the Aycliffe site.

Alan Braithwaite, the assistant secretary of the Sports and Social Club took on the task of organising a family event and he persuaded BIP to fund the erection of a large viewing stand holding 1100 people. There had been very heavy rain the day before and the area around the stand stood in great puddles. Once again Aycliffe ingenuity saved the day and the boiler house tractor shovel delivered great quantities of boiler ash to provide dry footing. The guests had a view of the engines much superior to the public and the press photographers.

Aycliffe management have always set great store by having on site, employees able to deal with emergencies. To encourage this there was for many years a branch of the St Johns Ambulance Brigade on site with the site doctor as its president. Jacky Moses, a rigger on site, was the Brigade's Chief Divisional Officer and the unit had many successes in local and national competitions.

First-aid teams from Aycliffe still do well in the National Industrial Championships. The site fire-fighting force also takes part in competitions and for many years it had a ladies team too.

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Fire-fighting and first-aid have a very serious purpose and the competitions have had two benefits. They helped to maintain skills and fitness while providing events enjoyed by the site community. There has been a long tradition of inter-site and inter-factory competitions. Spectators have had the pleasure of seeing a great deal of water spurting about in these competitions and they can also view experts dealing with gruesome accidents in which no-one is hurt.

The last really big inter-site competition was in 1979 when all the BIP companies took part. Entertainment was laid on for the site families including a traction engine and steam organ, a band and plenty of refreshments. There was also a comprehensive display of the products made by customers from Aycliffe PVC.

The Union Carbide company had been enthusiastic about PVC but by the 1970s the company was convinced that its future lay in polyethylene.

In 1974 a willing buyer for BXL's businesses was found in British Industrial Plastics, a subsidiary of Turner & Newall. BIP wished to extend its long established range of thermosetting materials to include a major thermoplastic. It was very encouraging for Aycliffe personnel to again have an owner convinced about PVC products. Even better was the news of increased polymer production as a result of a rapid market survey conducted by BIP. This concluded that a new 50,000 tpa plant would make it possible for Aycliffe to produce all the polymer required on site and by the other PVC users in the BIP Group. There would also be polymer available for limited external sales in a total UK market for PVC polymer of 400,000 tpa.

A new Aycliffe polymer plant would need to employ technology which would ensure:

- polymers suitable for both internal and external markets
- high and consistent quality
- very low VCM levels on the plant and hence very low emissions
- very low levels of residual VCM in the final polymer

Targets 2 & 3 could be achieved if it were no longer necessary to open the autoclaves for manual cleaning. To achieve the fourth target a means of stripping residual VCM out of the polymer was needed which would not increase emissions to atmosphere and would not damage or discolour the polymer.

A number of companies were developing so-called 'clean-wall' technology which involved treatment of the internal autoclave surfaces before the VCM was introduced in order to reduce the deposition of PVC on those surfaces during polymerisation. Any deposits would then be readily removable by a jet-washer installed inside the autoclave. Thus there would be no need to open up the autoclave between reactions, releasing VCM to the atmosphere.

Technical teams were despatched around the world to find out what was available. Eventually the choice was between just two technologies. Shin-etsu of Japan had good clean-wall technology and polymers which met Aycliffe needs but their VCM-stripping system was only at the design stage. BF Goodrich had both clean-wall technology and an efficient stripping column available but their polymers were not as satisfactory for Aycliffe markets. The BF Goodrich technology was chosen for the construction of C-Plant at Aycliffe at a cost of some £32 million.

The unsuitability of Goodrich polymers provided an opportunity for Aycliffe to bring local knowledge and skills into what became a technology exchange rather than simply a technology purchase. Goodrich later modified the polymers it sold in the USA to be more like those produced at Aycliffe on the new plant.

VCM supply to Aycliffe

From the earliest days of PVC manufacture at Aycliffe until the mid 1970s, vinyl chloride supplies had always been obtained from ICI, a major competitor in PVC manufacture, Because for much of that time Aycliffe polymers had nor been sold on the open market but were consumed on the Aycliffe site, supply from a competitor had not been a problem. With the commissioning of C-Plant and the beginning of external polymer sales, alternative supplies of vinyl chloride were essential. Two suppliers were identified which could make use of a common supply route.

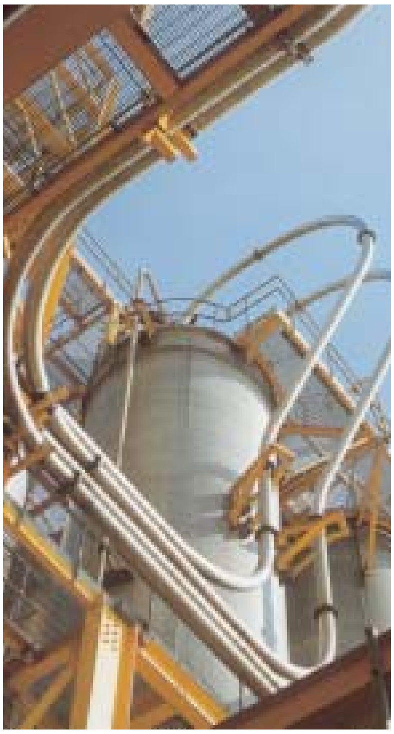
They were Akzo at Botlek near Roterdam and Norsk Hydro at Rafnes in Norway. Both could ship supplies on specialist tankers to storage spheres at Seal Sands at the mouth of the Tees. Road tankers could then move the vinyl chloride to Aycliffe. Other transport systems such as rail tankers or a pipeline were also assessed but they were rejected on safety and economic grounds respectively.

HYDRO

Such a large project as C-Plant takes a long time to complete. It was unfortunate that by the time that production began in 1978, the world-wide demand for PVC, and for other polymers, was depressed in the wake of the second Middle East oil crisis, and this had a long-term effect on polymer demand. Because the BFG technology was so new there was also some concern about the quality of the polymers to be produced by C-Plant.

In the event the very first polymer batches were useable and by the end of the first week top quality polymer was being produced. That things went so well is a tribute to the technology co-operation and also to the skills and dedication of all those from BFG and Aycliffe who were involved in the venture.

C-Plant was built on the old sports field and when the golf course disappeared under the plant the company responded to members wishes by developing the present golf course and sports field on poor agricultural land it owned to the west of the site. In those days before the Common Agricultural Policy gave us Set Aside, it took twice as long to get planning permission for the sports facilities as it did to get planning clearance for C-Plant. Since that time the company has also provided football and cricket pitches, a pond for the Angling Club and a new purpose built pavilion.



Compunding Developments

The 1970s had brought the second Middle East oil crisis which affected raw material supplies for both the basic polymer and for the plasticisers used in PVC. When supplies of standard plasticisers became scarce a remarkable collection of alternative materials and alternative recipes were tried, though with great trepidation. Customers continued to be supplied with no serious hitches - though at a reduced level. A great deal was learned about alternative plasticisers and Ted Thornton established a new record for a Works Trial, a run close to 1000 tonnes, a record which probably still stands.

The decade saw growing markets for rigid PVC compounds for use in a range of applications including many in the construction industry. There were demands for both gelled, pelleted material and for dry-blends produced in high speed mixers. No 11 Unit at Aycliffe was a high speed heater-cooler mixer, installed in the same building as No 6 Unit, to produce such dry-blends. Later on a Kestermann twin-screw compounder was installed to produce gelled compound as an alternative processing route for No 11 Unit dry blends, and designated 11K Unit.

No 12 Unit was a high speed heater/cooler mixer installed in the same building as No 10 Unit. It made masterbatches of lesser ingredients of the formulations made on that unit. No 13 Unit was yet another Buss Ko-Kneader installed within the No 10 Unit building to make rigid PVC. No 14 Unit was another high speed heater/cooler mixer for dry-blend manufacture also in the No 10 Unit building. No 14 Unit became very important in the 1980s when the market for precisely formulated window profile and cellular rigid compounds grew rapidly to well over 100,000 tpa.

Since the 1960s the Aycliffe PVC compounding business had been a key player in the market for specialist clear, flexible PVC grades for use in medical devices and in food contact applications. Most of these clear flexible grades had been made on No 3 Unit, an upgraded version of the original Aycliffe compounding unit in Y11. While the products from this unit were always fully approved by the regulatory authorities and our customers, the unit was expensive to operate and the Department of Health became concerned about the difficulty of keeping the unit free from potential contamination. Consequently the company decided, in the late 1970s, to build No 15 Unit, isolated from other processes, and encorporating a Thyssen 160 continuous compounder.

This new unit was dedicated to medical device grades, food contact applications and for other high-specification clear flexible applications. Later, another second-hand Buss Ko-Kneader was installed in the most northerly red-brick building as No 16 Unit while a Kestermann K130 twin-screw compounder in the same building became the new No 12 Unit.

’80s Expansion

At the beginning of the 1980s Turner and Newall sought to redirect its business away from materials production towards automotive engineering products. At the same time cost pressures were draining the resources of the plastics and chemicals industries. Rationalisation was the order of the day and in Western Europe as a whole, the number of PVC polymer manufacturers shrank from 32 to 14.

Norsk Hydro, one of Aycliffe’s two vinyl chloride suppliers, was able to resist these cost pressures better than other companies because it was an ‘integrated supplier’ with a chain of production from hydro-electrical power generation and North Sea gas, down through vinyl chloride production to polymer manufacture, compound manufacture to a limited number of semi-finished goods. The vinyl chloride Norsk Hydro produced was also sold in Europe and in the Far East. At that time Norsk Hydro was seeking ways of consolidating its vinyl chloride customer base. It already owned Vinatex, one of the other UK PVC polymer suppliers, and in July 1982 agreed to purchase the BIP PVC polymers and compound businesses too, forming Norsk Hydro (later Hydro) Polymers Limited.

In the same week of July a further consolidation of PVC manufacture took place when ICI and BP Chemicals swapped PVC and polyethylene businesses to leave ICI with all the PVC production.

PVC processors were also affected by rationalisation and the BIP sheet and film businesses became part of Wardle Storeys, one of HPL’s major customers for PVC polymer.

Once Norsk Hydro owned both Vinatex and the Aycliffe site, internal rationalisation resulted in the closure of the Vinatex polymer plant at Staveley in 1985. A further autoclave was added to C-Plant bringing its capacity to 125,000tpa and all PVC compounding capacity was transferred to Aycliffe from Havant.

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Co-location and Compounds

Like Topsy, the PVC compounding business at Aycliffe had 'just growed' in response to market demands over the years. A variety of types of compounding units were housed around the site in five different buildings. Aycliffe was the respected major UK supplier of PVC compounds but it was becoming plain that the plants could be operated more efficiently and more economically if they were co-located. The formation of Hydro Polymers Ltd out of the combined resources of Vinatex and BIP Vinyls Division provided an opportunity for a fresh look at the situation which led to a new strategy:

- All PVC compounding activity was to be concentrated at Aycliffe and key staff from the Vinatex business were offered appointments at Aycliffe.

- All the units based on Banbury mixers were to be scrapped. The smaller Banbury mixer in the Y29B Semi-scale used by Technical Department to prepare customer-trial materials was also scrapped.

- Future business would depend on No. 10 Unit, powder dry-blend units and continuous compounders of the Buss or twin-screw variety.

- All the compounding units were to be concentrated in an area close to No. 10 & 15 Units, close to the plasticiser tank-farm and polymer and filler silos.

After some 40 years of service to many different businesses, the three original brick buildings opened in 1948 by Harold Wilson came into their own again. They were refurbished, linked together to form a PVC compounding centre and renamed C1, C2 & C3.

C1, the southernmost building, houses three powder dryblend units listed as CC16, 17 & 18. There are also raw material stocks and a Gardner ribbon-blender used to make intermediate masterbatches of lesser ingredients. C1 & C2 are linked by a large steel structure clad in PVC coated corrugated steel whichhouses units CC1-8 of the Buss or twin-screw type together with the high-speed heater/cooler mixers which feed them. CC9, a further powder dry-blend unit, is also sited in this building.

C2 itself, houses control laboratories and the plant control room, together with all the finished product handling and packaging equipment.

C3 houses a stores area together with units CC11 & 20 which are large and small Buss units respectively. The co-location of plant has indeed proved to be more efficient and it has left the rest of the site quieter and cleaner. Present PVC compound capacity is 85,000 tonnes per year and by the turn of the century it will have risen to 120,000 tonnes per year.

During the early '90s, major gains in productivity in the resin and compound plants were being achieved on the back of the Total Quality Management initiative. Despite this, it was becoming increasingly apparent that in order to take advantage of the growing UK market, then further new production capacity would be needed. The key issue was the scale and type of resin expansion, and after much debate, the decision was taken, at the end of 1994,

to construct a new line, as the basis of D-Plant, using Hydro's own proprietary large-reactor technology, and simultaneously to expand the capacity of the existing C-Plant.

This development provides a further 60kt of PVC resin, and takes the Aycliffe resin operation to 200kt, at a cost of £35m.

The new plants, which are capable of further expansion, transform HPL's scale and competitiveness, and provide a springboard for the business into the next century.

With greater resin availability, the opportunity could also be taken to expand PVC Compounds, and during 1996 plans were laid and approved to install additional powder and gelled capacity, at a cost of £5m, and due to come on stream at the end of 1997.

Meanwhile, both energy costs and environmental impact have been greatly improved by the phase-out of coal-burning steam generation, and the installation of the first gas-fired combined heat and power generation unit.

Simultaneously, a further major investment in information systems, using the class-leading SAP software, is being installed to provide the very best planning, transactional and management systems to support the expanding businesses.

As we look back over these 50 years at Aycliffe, it appears that there has been a process of continuous change. Today change is even more dramatic, as Hydro spends over £50m on current projects, and effectively doubles the scale of activity during the late '90s.

PVC and Hydro Polymers are poised for an exciting and dynamic period of growth - an interesting chapter when the history of 100 years at Aycliffe comes to be written.

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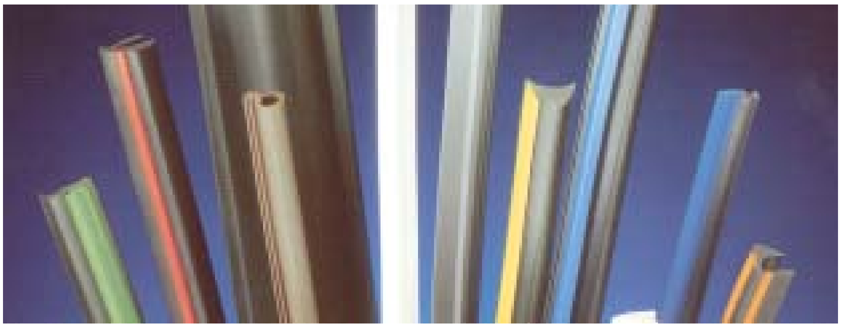
The Aycliffe site had a major advantage in being largely based on a Royal Ordinance Factory. Such factories are always built with a great deal of space between the buildings so as to reduce the effects of an accident in one building on surrounding buildings. Over the years most of the blast-mounds between buildings have been flattened leaving grassy areas on which many types of wild flower can grow. Part of the ROF site was never developed after the initial levelling and that area has become a wild wood. There are many animals and plants in the wood, safe and undisturbed within the site security fence. Over the past three years the company has set about a programme to make the site even more pleasant for employees and for wildlife. A shallow pond where insects can breed has been established in the undisturbed area. It is hoped that increased insect life will bring even more bird species to the site. Appropriate wild flowers are being encouraged to grow on poor quality land areas unlikely to be used for some time. An area where orchids grow freely is being managed so as to encourage their growth while fitting in with the tidiness essential to much of the site. New lawns, walkways, flower beds and seats are being installed for enjoyment by all on site.



Hydro Polymers is fully regulated by the Environment Agency under the Integrated Pollution Control regulations and by the Health and Safety Executive under the Control of Industrial Major Hazard Accident regulations. The company has a good relationship with the inspectorates and they have occasionally brought visiting inspectors to observe HPL as a good example of how a company should operate. Of course, it is also in the interests of all employees and their families living nearby that the company should operate safely and responsibly.

Not everyone likes the chemical and plastics industries however and there are environmental pressure groups which are convinced that our industry and its products have an unacceptable environmental impact, particularly with regard to its use of chlorine. Because PVC employs 30% of all the chlorine manufactured and because PVC is to be found in all kinds of domestic and commercial situations, the industry has been targeted with adverse and often inaccurate publicity.

HPL has always sought to understand and to minimise the environmental effects of its operations and products. It has trained its employees to see their part in the good performance of the company and in speaking out when the products they make are criticised. The company has welcomed and contributed to the public debate on environmental matters and is very willing to enter into dialogue with those who are doubting or critical of the industry. Well researched and accurate data concerning the company is readily available in the form of publications and presentations. HPL will seek to promote a reasoned understanding of the costs and benefits of PVC and it will vigourously oppose those who seek to damage the company and its business for ill-founded or dogmatic reasons.

The Origins of PVC

From earliest history, human beings have sought to use and modify the things around them to improve their quality of life. Among the natural materials they used, such as wood, leather, bitumen, wool, silk and cotton, there are materials that we now recognise as natural polymers. Specialists in every trade soon discovered that, by applying simple chemistry, it was possible to make radical improvements in the quality and consistency of these materials. Natural organic polymers have always been valued for their combination of lightness, toughness, strength and insulating properties though modifying these materials to suit new applications has often required long, tedious and expensive processes.

In the 19th Century chemists began to apply their skills to modifying natural polymers. They widened the range of properties available and made possible the development of new applications. It became clear, however that there were limits to what Nature could supply. Quantity and quality were very dependent on successful harvests. Poor weather, disease, war and political upheaval could interrupt supplies from distant sources. These factors lead to an intensive search for synthetic materials originating from local resources to replace the natural polymers which had become so important to industry and the public. The plastics we use each day are mixtures of those synthetic polymers with other ingredients. The word ‘polymer’ means ‘many parts’ and it is used to mean materials which have molecules made up of chains of many smaller molecules or ‘monomers’.

The first almost completely synthetic polymer was cellulose nitrate, a close relative of the explosives used to fill shells and bullets on the Aycliffe site when it was a munitions factory. Discovered by Alexander Parkes, cellulose nitrate was first seen by the public at the Great Exhibition in London in 1862. While it was not fully synthetic it was a long way from the wood cellulose from which it was derived. It was turned into a tougher and better plastic by John Wesley Hyatt, an American who, in 1869, blended it with camphor. This acted as a toughener and plasticiser and he called the product “Celluloid”. In the UK the material was called Xylonite and the company which made it, British Xylonite Ltd., was an important contributor to the Aycliffe site history. At prices many people could afford, Celluloid became popular in a wide range of decorative and utilitarian products such as combs, buttons, cutlery handles, billiard balls etc.

Perhaps the first wholly synthetic polymer was Bakelite, invented in America in 1909 by a Belgian, Dr Leo Baekeland. He eventually founded Bakelite Ltd., the company which began plastics production at Aycliffe. Bakelite is a thermosetting plastic made from synthetic phenol and formaldehyde.

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PVC in Comparison With Other Plastics

Bakelite provided the stiffness, lightness, strength, heat-resistance, mouldability and insulating properties essential for the equipment used around the turn of the century for the first public generation and distribution of electricity. However, the material lacked the flexibility and toughness of rubber, and the hunt continued for materials which could replace rubber. As has become clear since that time, there are areas where rubber can be replaced but there are others where it still has pride of place.

Vinyl chloride had first been synthesised in 1835 in a German laboratory but it was not until 1872 that it was first converted into PVC on a laboratory scale. By 1912, techniques were available for its production on a larger scale and PVC was first produced commercially in the USA in the late 1920s. German industry began production in the 1930s and British production began in the 1940s. Plastics are sometimes seen as complete newcomers but in fact, most of the plastics we use every day were in very limited commercial production by the end of the 1930s. During World War II, when it was no longer possible to obtain regular supplies of rubber from Malaysia or Brazil, locally made synthetic polymers became vitally important to the war effort. Perhaps the most important reason for the larger-scale development of PVC was the discovery that, when blended with the right ingredients, it could replace and improve on rubber in cable insulation.

With the arrival of The Plastics Age, PVC, nylon, polyester, Perspex and Polythene, entered the language and become household names. So why did plastics make such rapid progress? There are a number of very good reasons which are just as valid today. Plastics replace traditional materials in many applications because they are lighter and tougher, they do not rust, corrode or rot, they can be flexible or rigid, transparent or opaque. They are good insulators of heat and electricity and they can be self-coloured, avoiding the need for painting.

Plastics are more easily shaped into final products than traditional materials and complex shapes can be made economically in one-step processes. Some plastics can be made very weather-resistant and these have found extensive use in building and construction applications. Clear thin plastics films and containers have proved to be very effective in packaging applications where they can perform well while being much lighter and stronger than glass, metals or cardboard. Because many plastics are biologically inert and easily formed, they can economically be made into pre-sterilised, single-trip medical devices which reduce the risk of cross-infection during treatment.

The manufacture of all the plastics we use takes only 5% of our annual oil consumption. The rest goes on transport, heating and power generation. Most of the plastics we use each day are based solely on oil or gas from our rapidly diminishing, non-renewable resources. PVC is more economical in its use of non-renewable resources in that it contains 54% chlorine and only 46% hydro-carbon from oil or gas. The chlorine in PVC is derived from common salt, which is also a natural resource of course but our reserves are immense even before we use salt from the sea.

As part of the polymer molecule the chlorine becomes inert. It gives fire resistance to the PVC and makes it possible to mix PVC polymer with

many other ingredients in recipes with a wide range of very useful properties.

From basic raw materials to the PVC products we have in our homes there are four manufacturing stages:

- the manufacture of vinyl chloride monomer or (VCM) from gas and salt
- the polymerisation of VCM into PVC
- the mixing of this basic polymer with other ingredients or additives to make PVC blends
- the moulding or extrusion of the blends into final products

Stages 2 & 3 take place at Aycliffe.

The VCM which Hydro Polymers uses is manufactured by Norsk Hydro in Norway, and is shipped by tanker as a liquefied gas to Teesside. Then it is moved by road tanker, by a company specialising in liquid gas transportation, to the Aycliffe site. At Hydro Polymers, the liquefied VCM is transferred to autoclaves where it is dispersed, at about 50°C, as droplets in water which contains suspending agents. A catalyst is added to initiate the polymerisation process and after about five hours most of the VCM has been converted to solid particles of PVC in a water slurry. The polymerisation proceeds under close computer control in order to obtain the high and consistent quality polymer which the market demands.

When the polymerisation has been terminated, any excess VCM is stripped out of the PVC slurry and recycled back into later reactions. The PVC powder is then dried and its quality is fully checked before sale, either to customers which do their own blending or to the HPL compounding plant. Blends may be sold either in the dry powder form used in the extrusion of pipes or window profiles or in the hot-melt-processed pellet form which is used for most other extrusion or moulding processes.

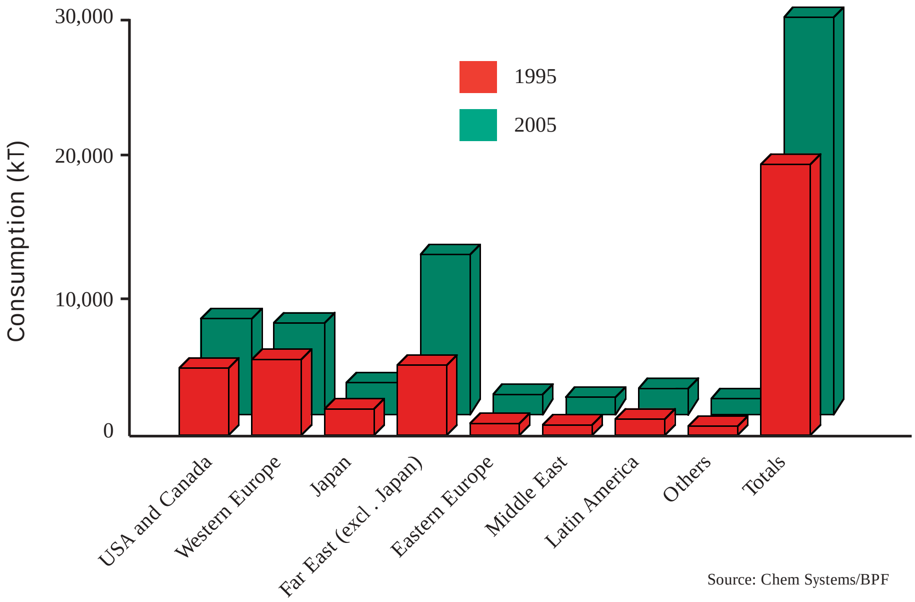
Nearly all the plastics we use each day consist of basic polymers blended with other ingredients. PVC is unique in the many different types and quantities of ingredients it will accept in such blends. Blends can be produced which are precisely tailored to many and various applications. HPL meets its customers' needs with up to 1000 different blends and colours each year.

PVC has become the second largest commodity plastics material after polyethylene. It is manufactured and traded globally and in 1996 world production was in the region of 20 million tonnes, forecast to rise to 30 million by the year 2005. West European production is about five million tpa and a small but steady growth has been predicted for the rest of the 1990s.
The public often sees plastics as "short-life" or "throw-away". This is probably because plastics toys have not lasted long or because the plastics packaging they buy each day has apparently only a short useful life. There are many short-term uses for PVC but it is much more often used in longer-life applications than other plastics and that "long life" may be 50 years or more.

The consumption of PVC in Western Europe is shown by business sector in the pie charts below.

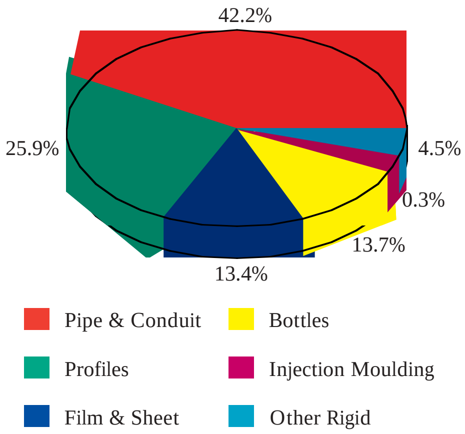
PVC now finds its way into all aspects of domestic, commercial, medical and industrial life.

World PVC Market Forecast



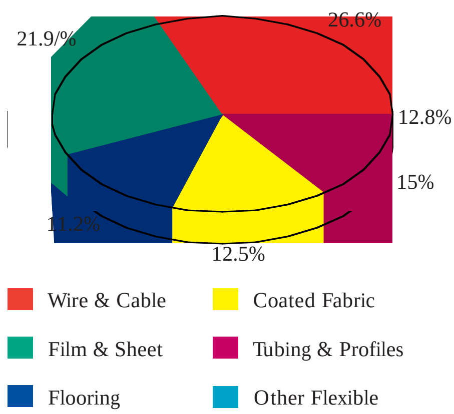
Source: Chem Systems/BPF

West European PVC Consumption by Business Sector Rigid PVC



Source: Modern Plastics International/BPF estimates

West European PVC Consumption by End User Market Flexible PVC

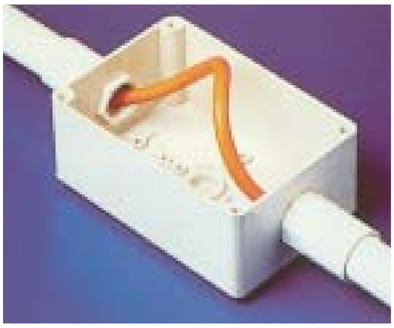


Source: Modern Plastics International/BPF estimates

Excellence in technical service has long been recognised as central to the success of Hydro Polymers operations. In addition to recipe development, a great deal of time, effort and money have been invested in learning the best ways to process the polymers and blends through the customers' equipment.

The ability to operate this equipment and to provide advice on how processing can be improved has been essential. This is the background to the Aycliffe Process Development Laboratory which grew out of an older extrusion and moulding shop in Y29C. The Aycliffe site has produced polymers and compounds for use in most of the sectors reviewed below.

Ducting and Conduit



PVC finds extensive use in conduits for electrical and communication cables, both within buildings and underground where it has very good resistance to the effects of the environment. These applications have proved to be suitable for second-life PVC recyclate from, for example, window frame manufacture. From accelerated weathering tests it has been estimated that PVC ducting, pipe and conduit have an assured working live in the 50-100 years range.

Pipes

About 25% of West European production of PVC is used in the manufacture of pipes. PVC pipes have found a strong place in the market for water supply and drainage. PVC dominates the European market for gutters, drainpipes and domestic underground drainage. Economic end-of-life recycling of these long-term applications is possible.

Sheet and Film

Rigid and flexible PVC film and sheet consume some 20% of West European PVC production. These materials find extensive use in the packaging of food products and pharmaceuticals, in furniture and building applications. They have the transparency, lightness and stiffness needed in packaging applications and, when correctly formulated, impart no taste or smell to the products they contain.

Profiles and tubing

Flexible PVC grades have been used for the majority of “single-trip” disposable medical tubing, IV bags, bloodbags and devices since the 1950s. PVC is the most thoroughly researched material for these demanding applications and no other material has yet made substantial in-roads into this market sector. In addition to medical products, flexible PVC tubing is used in the supply of foodstuffs and beer, where the formulations are chosen to maximise biocompatibility and to minimise the transfer of taste and smell.

Windows

Window and roller-shutter profiles are the largest user of rigid PVC after pipes. Rigid profiles and tubing account for 13% of the West European PVC production while flexible tubing and profiles employ some 16%.

First in Germany and then in the UK, PVC has taken the majority of the replacement window frame market ahead of wood and aluminium. Now PVC window frames are being used more and more in new houses. PVC profiles are self-coloured, require no painting and very little maintenance. No other thermoplastics have yet matched the physical properties, weather resistance and low maintenance requirements of PVC.

Moulded components

Plastics materials have replaced metals in many moulded components used in construction, automotive, domestic appliances, computers and other office equipment.

The moulding processes involved may be injection moulding, blow moulding or rotational moulding. Both flexible and rigid PVC formulations are employed in all these processes to make mouldings for many applications. Hydro Polymers, through its partnership with the Geon Company of the USA, has developed the first closed-loop programme for used computer housing and keyboard - recycling them back into the original application.

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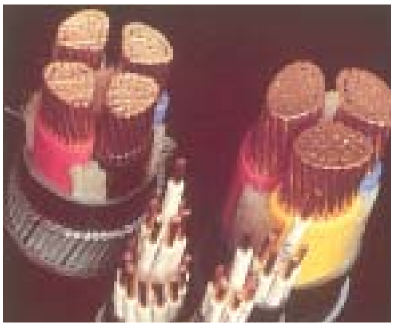

Flooring

Vinyl flooring in the form of tiles or continuous sheet employs some 5% of PVC polymer production. A wide variety of patterns and construction types is available and PVC is also used as backing material on a variety of textile carpets. PVC flooring is a relatively long-term application and replacement usually takes place because of changes in the use of the building or because of fashion. The flooring can be recycled after use and pilot projects are in progress to explore the value of such recycling. The recycled material is used as the base layer of new flooring.

PVC coated fabrics

PVC coated fabrics find applications in lorry sheeting, synthetic leather, rainwear and car interior components. They have good weather resistance, flexibility and abrasion resistance. They have replaced tarpaulins and waterproofed canvas and have found acceptance in some architectural structures such as sports pavilions.

Wire and cable insulation

From the beginning of Aycliffee's history, this has been an important business sector. Especially enhanced cable materials have been produced by Hydro Polymers for over ten years in response to requirements for improved safety standards. The insulation and sheathing of power and communication cables now consumes some 9% of West European PVC production.

When PVC insulated cable has come to the end of its useful life, then both the conductor and the insulation may readily be recycled. The recyclate finds applications in lower specification products such as car mud flaps, floor mats and similar applications.

Bottles

In Western Europe as a whole, bottles take some 9% of PVC production, but there are wide variations from country to country. In some, still mineral water and vegetables oils are supplied in bottles yet made PVC bottles while in others only glass is used. Toiletries and fruit squashes are often packed in PVC bottles because the PVC does not impart either taint or smell to the contents. Like other containers, PVC bottles can be recycled at the end of their useful life. HPL was a founder member of RECOUP, a trade association committed to assisting local authorities collect and sort plastics bottles from domestic waste for recycling. In 1996 over 5000 tonnes of plastics bottles were collected and there are plans to increase that figure to 60,000 tonnes by early in the next century as the Packaging and Packaging Waste regulations take full effect.

PVC coated metal surfaces

PVC plastisol coatings have a superior abrasion resistance to other polymer coating systems and coated steel or aluminium can readily be formed into various corrugated profiles without loss of protection. PVC coated steels require much less maintenance than painted systems and they are generally cheaper than tile or slate systems for industrial sector roofing. Almost all present day motor cars have flexible PVC coatings used as 'underseal' or as internal panel coatings to protect the car from weather, salt and stone impacts.

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Acknowledgements

Page reference

3	Cartoon from The Northern Despatch, 5.9.46
5	Cuttings from The Northern Despatch, 1947.
8/9	Cuttings from The Northern Despatch, 20.11.47
10	Cuttings The Northern Echo, 21.7.48 & The Northern Despatch 9.11.48
	Cartoons from The Northern Despatch, 11.12.47 & 22.7.48
12	Cuttings from the Yorkshire Post and Leeds Mercury 25.11.53
	& The Northern Despatch 24.11.53
17	Cutting from the Evening Gazette, 24.11.53
21	Picture courtesy of Mrs J. Beswick
26	25 year celebration photograph courtesy of Mr M.J. Humphrey
	Stockton & Darlington Railway celebration photograph courtesy of Dr J. Baldwin
27	Cuttings courtesy of Mr J. Moses and Mrs J. Gibson
	First aid team photograph courtesy of Mr P. Soulsby
43	Picture from 'The History of Bakelite Limited' by T.J. Fielding, courtesy of Mr M. Scarr

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Written by Dr. John Baldwin
Compiled and edited by Vanessa Killoughery

Hydro Polymers Limited
Newton Aycliffe
Co. Durham
DL5 6EA
England

www.hydropolymers.com

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