1935-2015
80 YEARS
COMPANY HISTORY
IN 8 DECADES

KAUTEX MASCHINENBAU

1935-2015
80 YEARS
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IN 8 DECADES

"Power does not make noise, it is there and acts."

Motto of Kautex-founder Reinold Hagen (1913-1990)

Dear Readers,

Our company will be 80 years old in 2015. Therefore, we're taking a look back at our company history, which hasn't always run in a straight line. Rather, we're looking back on highs and lows, on successes and failures, on what used to be, and what is today. As the old saying goes, the only sure thing in life is change. Figuratively, the same also holds true for Kautex Maschinenbau.

Our company founder, Reinold Hagen, learned this early. He had hardly established the company 1935 in Siegburg, when he had to rebuild it in 1945 in the vicinity of Bonn. The war had destroyed a large part of the operation, but the possibility remained to create something new and look to the future. In the 30 years that followed, Reinold Hagen succeeded in creating a company known at the international level, both for manufacturing plastic hollow containers, and for building the machines required to produce them. Handing off the machine building spin-off to the Krupp group in 1977, and thus giving it a chance for independent development, shows, among other things, his feeling of corporate responsibility. This was followed by roughly a quarter century of affiliation with this global group, which has shaped some of our employees until the present day. They are the ones who stood by Kautex Maschinenbau in the first four years "after Krupp" (2000 to 2004), when the company had to struggle against setbacks and great uncertainty. The overriding tasks of the past decade have been to stand together (both in Bonn and internationally), to consistently align the existing know-how, management and personnel with customers' requirements, and to exert all available strength on new developments.

We have had the responsibility to lead Kautex Maschinenbau for the past 10 years. This shows great trust on the part of our partners, for which we are very grateful today. Above all, we thank our customers, who continually trust and challenge us. Without their trust, and without their challenging requirements, it would not be possible to further develop our company.

We extend heartfelt thanks to all current and former colleagues who have contributed to this history, particularly Peter Klüsener, who made an especially valuable contribution with his unique knowledge of the technical history of blow molding. In addition, we thank Dr. Barbara Hillen, the historian from Bonn who collaborated authoritatively in compiling this history (based in part on her biography of Reinold Hagen, which was published in 2013 for the 100th anniversary of his birth).

Immerse yourselves now, dear readers, in the 80-year history of Kautex Maschinenbau, and in eight fascinating decades of German economic history.

Bonn, July 2015

Olaf Weiland

Andreas Lichtenauer

01 The beginning

After the global economic crisis of 1929, the signs of the times in the German economy start pointing to growth again in the mid 1930s. The metal industry is booming. At the same time, the Nazis establish an inhuman dictatorship in Germany, and are responsible for the Second World War, which kills millions of people. Anyone in Germany who survives the war has to live with its consequences, and in many cases has to start all over again economically. Reinold Hagen (1913-1990) is one of them.

Hagen family, 1932; Reinold Hagen, 2nd from right

Due to his father's premature death in 1935, Reinold Hagen is forced at the age of 22 to break off his fledgling career as an engineer at Robert Bosch in the Feuerbach district of Stuttgart. He returns to his native city of Siegburg, goes into business for himself with a metal and galvanizing workshop, and as the oldest of seven siblings, takes care of his family's economic livelihood.

1935-1944

As a militarily important metal processing operation, Reinold Hagen's company has no shortage of orders, but does have shortages of materials and labor. Necessity is the mother of invention. Unbiased and open to new discoveries, Reinold experiments during the war years with PVC, and produces semi-finished goods such as gaskets, sleeves, hoses, and profiles. From these beginnings comes future development. Even before the end of the war, the focus of his production shifts from surface treatment of metals to processing of plastics. By this time, Reinold Hagen already has 220 employees.

Galvanische Werkstätten (Galvanic Workshops) in Siegburg, 1935-1945

The entrepreneur Reinold Hagen

It takes great courage and self-confidence to go into business for yourself at the age of 22. Reinold Hagen has both when he founds the Galvanische Werkstätten (Galvanic Workshops) in Siegburg in 1935. His father, Theodor Hagen, an architect, had already prepared him for this as a child by showing Reinold how he could earn an additional allowance by skilled manual work, for example, on radios. His parents' good example makes a deep impression on Kautex's founder: by working constantly in their extended family, conveying a feeling of social responsibility, and being engaged both in their church and in society (his father as a city councilor in Siegburg, and his mother as a member of the county council in Siegkreis). As an entrepreneurial visionary, Reinold Hagen combines traditional values like commitment and perseverance with an entrepreneurial spirit, the capacity for innovation, and a rich store of ideas. In this way, for several decades he becomes the driver and head of a company that achieves international recognition.

Reinold Hagen, 1938

Metal finishing

Magdalena and Theodor Hagen, Reinold Hagen's parents, in the 1920s

In the first few years, Reinold Hagen concentrates on surface treatment: enamels, hard chrome plating, metal coatings (e.g. for crankshafts), and the production of stamped and drawn articles. During the war years, processing blasting caps is also part of the range of products. However, during the war years, the non-ferrous metals that he needs for manufacturing semi-finished goods became ever more scarce. The thermoplastic material polyvinylchloride (PVC), which has been known since 1912, serves as a substitute. In tests, it had shown great advantages as compared to other materials.

War economy

Reinold Hagen appreciates this plastic's light weight, and its resistance to chemicals. The lack of metallic raw materials leads to a decisive development for the company in the 1940s, with the manufacturing of gaskets and sleeves for chemical devices, and the production of hoses and profiles. Dynamit Nobel (Troisdorf) supplies Hagen with PVC, until Dynamit Nobel abandons its plastics division to specialize in manufacturing munitions. During the war, Hagen takes over all of Dynamit Nobel's machines and formulas, which he needs for further processing of PVC.

Employees

Since a majority of the workforce is diverted to military service, starting in 1940, Reinold Hagen must continue production for five years with the aid of forced labor. Eight French and 56 Russian workers are involved. They make up a quarter of the total workforce, and contribute to the further development of the company. Hagen himself continues to concentrate on technically upgrading the plant, while his wife Anne Hagen (born Lütz, 1904-1987) takes over the bookkeeping. Thanks to her cooperation, the company's internal organization keeps pace with its technical progress. By 1944, the company already has 220 employees.

Advertisement from 1940

Facts and figures 1935-1944

Company

- 1935 The Galvanische Werkstätten (Galvanic Workshops) are established in Siegburg
- 1936 20 skilled employees are working in a 2,400 m² plant
- 1944 220 workers are employed in metal and plastic processing

Customers/Suppliers

- Metal processing companies from the automotive and arms industries
- First contacts with BASF and IG Farben

Products

- Pressed and stamped items, gaskets, sleeves, hoses and profiles made of PVC

02 Pioneer era

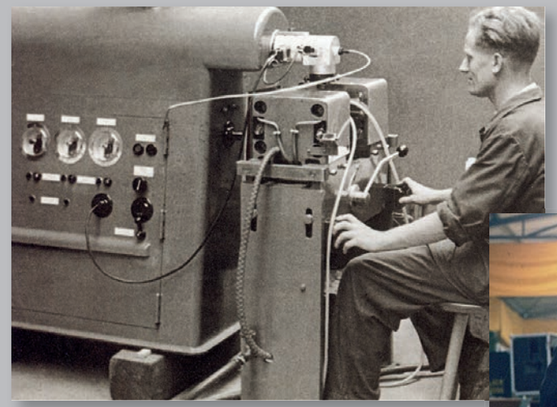
Summer 1945: Germany lies in ruins, and is administered by the Allied Control Council. While heavy industry and the machine building industry are subject to dismantling, processing companies more easily receive approval for production, and make their contribution to the reconstruction effort, which receives its most important stimulus from the currency reform of 1948. Due to the destruction of the cities, many people live in emergency housing. The first post-war decade is characterized by a reorganization of civic life.

Ceramics factory in Hangelar, acquired in 1940

In 1955, the Federal Republic of Germany, which was founded in 1949, largely achieves political sovereignty with the formation of the German Federal Armed Forces. With its commitment to a social market economy, and to a security partnership with the West, the Federal Republic of Germany differentiates itself from the Soviet backed German Democratic Republic and its planned economy.

This decade is also a time of new beginnings for Reinold Hagen. On March 6, 1945, the Galvanische Werkstätten in Siegburg are destroyed by incendiary bombs. After the war, Reinold Hagen starts rebuilding his company in Hangelar. In 1940, he had already acquired the premises of an old ceramics factory. The machine building business has its origins in this period of rebuilding. Since everything is improvised, a lot of tinkering is done, both on the products and on the machines required to manufacture them. The demand for everyday articles, profiles and other semi-finished goods from the re-emerging society of the post-war period is enormous. This also requires new raw materials. The end of rubber as a raw material appears to be near. This gives Reinold Hagen an occasion for renaming the Galvanische Werkstätten with the new beginning in 1945: On a whim, he picks the name “Kautex” as a play on words for “ Kautschuk ex”. In German this alludes to rubber’s disappearing role in industry and the turn to new raw materials, although Hagen himself never processed rubber. Experiments with PVC lead in 1949 to the first machines for producing blown plastic products. From this time forward, Reinold Hagen’s two brothers Norbert (1920-2013) and Theo (1926-2007) become leading employees at Kautex.

1945-1954



Blow molding machine in the Kautex plant

Kautex logo in 1947

Rare photo of the company’s three founders, Norbert, Theo and Reinold Hagen (from left) in 1985

Plastic processing since the 1930s

In the 1930s, plastics are already a driving force in the Western world for economic growth and improved standards of living. However, due to the war, Europeans lack access to the blow molding processes developed in the USA. Kautex is prepared to enter new process-technical territory, and sees itself primarily as a plastic processor. Its partners are suppliers from the chemical industry, as well as declining industrial companies with whom Kautex collaborates on development as an equal partner.

Heat-shrink tubing and the extrusion process

In 1949, Reinold Hagen's brother Theo develops a process for inflating PVC parisons and drawing them onto profiles as casings, so that when cooled they will remain firmly in place. Kautex now produces heat-shrink tubing. Through experimentation, Reinold Hagen strikes on the idea of blow molding thermoplastic material in such a way that it retains its shape in the same way as had been done for centuries with glass.

Advertising for plastic products

Advertisement for heat-shrink tubing in the 1950s

Production of heat-shrink tubing runs in two shifts on four production lines. Produced continuously and delivered in any desired length.

The process is not entirely new, even for plastic processing. In 1851, an American named S. T. Armstrong undertook the first attempts at the blow molding process using gutta-percha as the raw material. In 1899, in Germany, the Rheinische Gummi & Celluloid factory in Neckarau-Mannheim made a similar attempt to reshape celluloid. However, at that time, there was a lack of appropriate materials and machines for creating products, for example, for the packaging industry. No progress is made in the development of blow molding technology until the 1930s and 1940s, with the use of polyolefins and PVC. Stabilization of the raw materials situation after the

currency reform is a prerequisite for Kautex's success. Starting in 1950, blow moldable polyethylene is available in industrial quantities.

The world's first 10 liter polyethylene carboy

Norbert Hagen seizes on the idea of blow molding, and develops the process on a converted screw press. This is a prerequisite for the first 10 liter carboy made of polyethylene (PE), the world's first seamless bulk container, and the first blow molded 10 liter bucket. This breakthrough in blow molding is not possible until PE is used, which is more easily extruded than PVC. Machines for this sort of plastic processing don't yet exist; they are developed at the same time at Kautex.

Printing plastics with specially constructed manual silkscreen printing machines, before 1952

Reinold Hagen's young son Winfried demonstrates in Kautex advertising how light the plastic bottles are.

Advertising for innovative plastic bottles

Facts and figures 1945-1954

Company

- 1945 Rebuilding of the company near Bonn, and the start of machine building
- 1947 Kautex employees 47 workers
- Reinold Hagen's brothers Norbert and Theo join the company

Products

- 1950 The first 10 liter container made of PE at the ACHEMA fair in Frankfurt
- Shoe soles, dolls' heads, cosmetic bottles, and other everyday objects
- 1954 The first blow molded automotive part, a housing for intake noise dampening

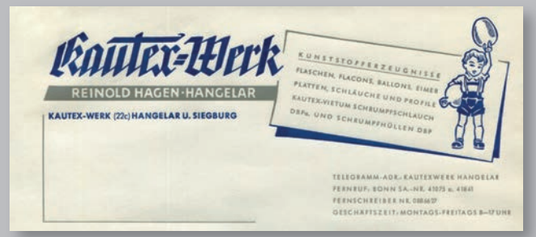
Machines

- 1949 The first machine for blow molding PVC parisons, and experiments with thermoplastic material
- Around 1950: Production of own manual screen printing equipment (1952 Five screen printing machines can be imported from the US.)
- 1954 Standard "V8" system for blow molding hollow containers up to 5 liters (Mold movement principle remains in use until the 1980s)
- Machines for containers up to approx. 50 liters in collaboration with the Bussmann company
- Machines for Schildkröt, the well-known doll manufacturer from that era

Technology

- Surface treatment of split leather with a plastic coating
- Pressing plates and belts from thermoplastic materials
- 1948 The beginnings of extrusion blow molding
- 1950 Patent application: "Process and equipment for manufacturing bottles and similar hollow containers with a filling opening from thermo-plastic materials" (extrusion blow molding)

03 International expansion



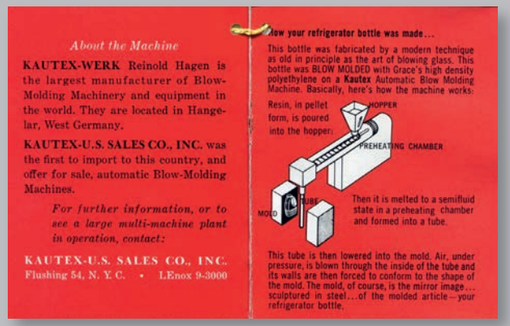
Kautex plant letterhead from 1960

Germany during the Konrad Adenauer and Ludwig Erhard era: West German society grows accustomed to its newly achieved prosperity. In 1955, the millionth VW Beetle is sold. In the same year, the industrial fair in Hanover draws 4,000 exhibitors from 18 countries like a magnet. Through the Marshall Plan, the Federal Republic of Germany receives start-up financing, in order to bring it into the Western alliance for the long term. The resulting economic upswing is so enormous that it goes down in history as a "Wirtschaftswunder" (economic miracle). In 1958, Germany is additionally a founding member of the European Economic Community. Stable economic and political conditions offer outstanding prospects to an innovative medium sized company like Kautex.

Subsidiary in Linden, New Jersey, USA

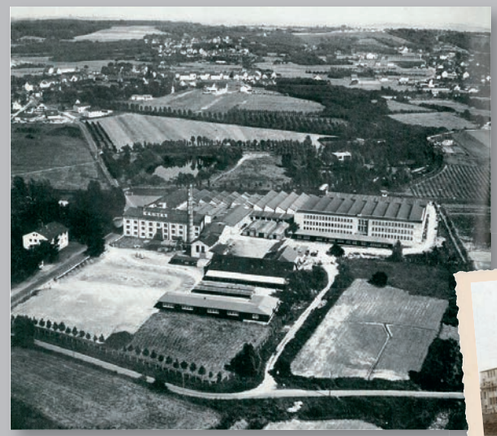
During this time, Kautex develops from a large handicraft business into an internationally operating company with industrial structures. In 1955, with the export of the first machines to the USA, a transatlantic knowledge transfer begins for Kautex with respect to raw materials and process technology.

1955-1964



Product insert for the American department store chain, Macy's, shows customers how their plastic bottle was manufactured.

In 1960, the first Kautex subsidiary in the USA is established (Kautex Machines Inc., Linden, New Jersey, until 1990). The company no longer produces exclusively to meet its own requirements, but also supplies the plastic processing industry around the world. This includes primarily extrusion blow molding machines, but also screen printing machines for printing many hollow containers, and machines for processing and preparing plastics, such as flame treatment systems, granulators, and dry mixers. At the beginning of the 1960s, Kautex know-how means not only the construction of individual machines, but also encompasses the building of entire production lines.



The company premises in 1964

As Kautex comes up against space limitations due to increasing demand, Reinold Hagen moves hollow container production in 1960 into the former "Rhenania" porcelain factory in Bonn-Duisdorf, from which 160 employees are absorbed. The machine factory with development and distribution is expanded on the previous plant premises.

The Bonn Duisdorf plant in the 1960s

Employee loyalty

Between Bonn and Siegburg, there are several plastic processing companies and plastics machine builders. Kautex founder Reinold Hagen is concerned that “industrial espionage” could harm his business. The industry has a future, and ideas for further development are in fact in demand. However, Kautex is an attractive employer and understands how to build employee loyalty.

First editions of the employee magazine in 1953

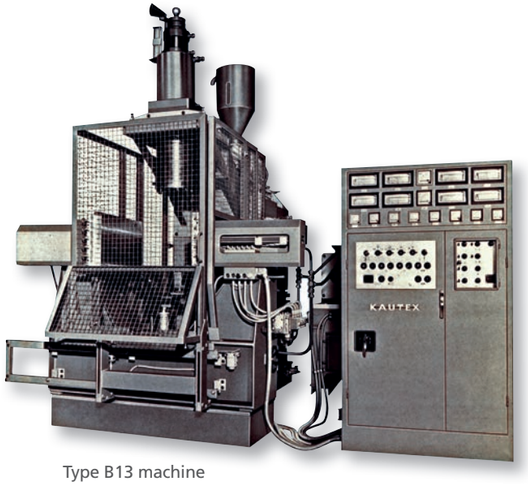
Reinold Hagen surrounded by interested apprentices, 1962

Wage packet inserts from 1962. An idea contest intended to spur greater employee engagement.

In order to bolster plant employee loyalty, Kautex begins publishing an employee magazine in 1953. At the same time, the company provides a library, and founds a sports association and a plant choir. By offering comprehensive social services, the company has a sufficient number of skilled personnel, and has the capacity to expand on this basis. Although the number of employees grows from 47 in 1947 to 1,500 in 1966, the proprietor managed company retains its family atmosphere.

A wide range of products

During this decade, marketing plastic bottles occurs primarily in the packaging industry, and is focused on manufacturers from the chemical, chemical technology, cosmetics, and pharmaceutical industries. A global economic upswing is reflected in the increasing diversity of the consumer market.



Type B13 machine

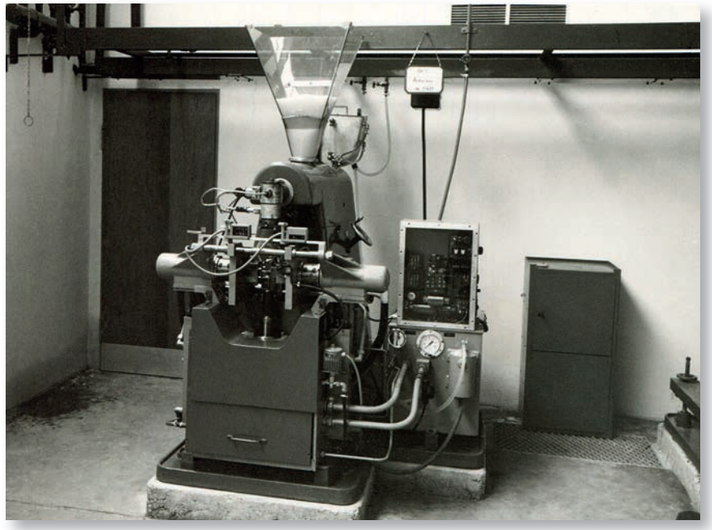
The first officially approved gasoline can made from plastic, 1962

In the 1960s, technical components manufactured with the blow molding process are also introduced into Kautex’s product range. For the automotive industry, for example, Kautex manufactures complicated ducts for hot and cold air supply, intake air boots, and brake fluid containers.

The first polyethylene brake fluid container in 1959

From complete units to the building block system

In the early years, Kautex machines serve exclusively for expanding the company's own processing capacity, until friendly foreign businesses notice and purchase these machines. The decisive interest comes from the USA, which has roughly a ten year lead in terms of experience with polyethylene. Initially, the machines are developed as complete units. Due to the constantly increasing diversity of end products, Kautex switches at the beginning of the 1960s to a building block principle. Individual modules are put together into a system, depending on the particular case for the desired range of products to be manufactured. A blow molding system consists basically of three units: an extruder with an associated parison die head, a blowing unit, and a control cabinet. The building block system makes it possible to combine different extruders with various blowing units, which is an important pre-requisite for the most economical manufacturing possible. During this time



Blow molding machine from 1957

Reinold Hagen's trade fair pass for the 1960 Hannover Messe

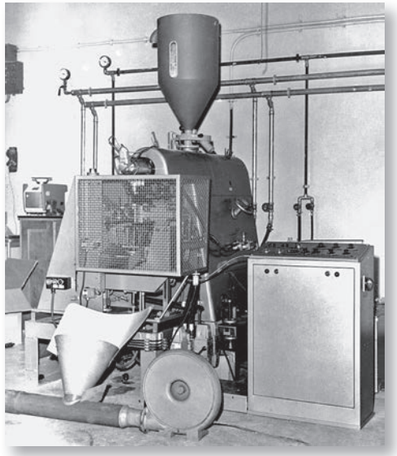
period, the ability to rapidly retool is already a decisive argument for customers, because it allows product ranges to include various hollow container sizes and shapes.

Development of partnerships with suppliers

Unlike any other machine builder in the plastic processing industry, Kautex harks back to its own experiences with hollow container production. By taking the side of the manufacturer, and putting itself in the customer's position, the Kautex machine building spin-off succeeds in offering polished and well thought out engineering. Improved wall thickness control is only possible with suitable industrial electronics modules from Siemens. The system of developing on an eye-to-eye level with customers also works the other way around. Raw materials suppliers like BASF come to Kautex with requests to test the properties that novel materials show during extrusion. This results in a reciprocal, interdisciplinary exchange.

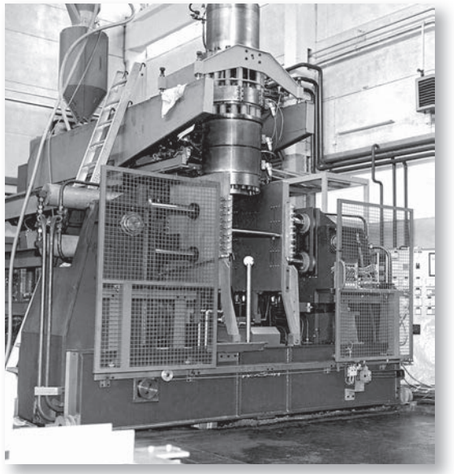
B series

Previous experiences with plastic product manufacturing and machine building lead at the beginning of the 1960s to the development of the B series. Its most distinctive feature is the clamping unit

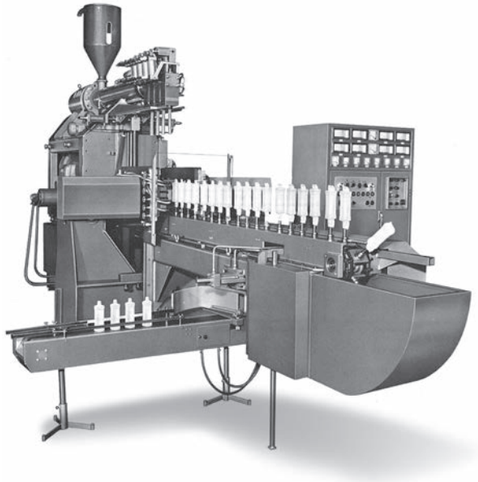


Type B1 machine

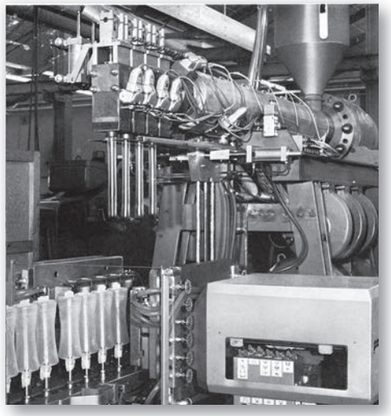
without tie bars, which facilitates mounting a wide variety of specialized mechanisms, including mechanisms for spreading and removal. The type B3 machine lends itself to many applications, because it can process all conventional blow moldable thermoplastics, and wins customers over with high production rates. The B13 Multi machine, also known as the "Multidorn" (multi-mandrel), is equipped with multiple extruder heads and blow molding tools. Even today, it still enjoys a reputation as a true high performance machine.



Type B30 machine



Type B13 Multi high performance machine



Detail of a B13 with a multi-mandrel unit and quadruple angle head insert, which facilitates quick retooling according to the building block system.

Facts and figures 1955-1964

Company

- 1955 First export of blow molding machines to the USA (Partners in dialog and business are initially glass companies with plastics experience, such as Owens-Illinois)
- 1960 Founding of the subsidiary Kautex Machines Inc., Linden, New Jersey (USA), and later in the 1960s the founding of Kautex U.S. Sales Co., Inc. as a distribution company in the Flushing neighborhood of Queens, New York

Patents

- 1958 The first use of reinforcing edges on the bottom of thin-walled hollow containers (L ring)
- 1963 The company has 120 domestic and foreign patents
- 1964 Accumulator heads with ring piston accumulator

Products

- 1956 First 50 liter drum made on Kautex's own machines
- 1961 Containers up to 100 liters in volume
- 1963 First officially approved gasoline can; within three years, one in ten automobile drivers in Germany has one

Machines

- 1963 Introduction of the B series with the B13 Multi (Multidorn) at the plastics fair in Düsseldorf

Technology

- 1963 Novel accumulator head for intermittent output, which opens new prospects for large hollow container manufacturing
- 1963 Multi-mandrel process for large customers
- Refined calibration techniques for forming individually designed bottle neck openings

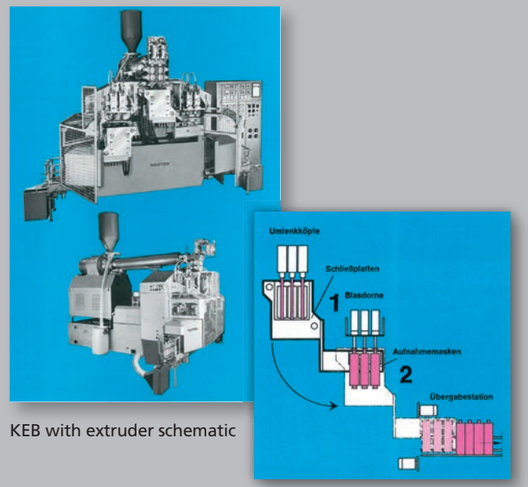
04 Kautex sets standards

The social market economy proves its value in West Germany. There is full employment, and the Federal Republic attracts workers from Southern European countries. Many citizens hope for reforms from a government led by the SPD under Willy Brandt. Social legislation for workers, seniors, women, etc. is improved, but the state often lacks the money needed for this due to a global economic downturn in the mid-1970s. At the international level, Germany succeeds in adopting a course of reconciliation with Eastern European countries. Hot spots in the Middle East dominate the 1970s. As a result of the Yom Kippur War, the OPEC states throttle their oil production. Petroleum becomes a political weapon against western industrial states that depend on fossil fuel. This decade is also under the controversial shadow of the Vietnam War, whose end in 1975 creates the conditions for future economic relations and the reconstruction of the country.

Examples of packages produced on Kautex machines

Kautex logo from the 1960s and 1970s

1965-1974



KEB with extruder schematic

For Kautex, this decade is marked by brand recognition. The company develops customer service and draws attention with the world's first series produced plastic gasoline tank (1973) and extraordinary achievements like the 5,000 liter heating oil tank (1974). The "K in a circle" logo and the motto "Können in Kunststoff" (proficiency with plastics) are registered as trademarks in 1963. In-house hollow container processing, with up to 150 machines in operation, is a driver for developing efficient production methods. The focus is not just on individual machines, but rather on entire production lines and sometimes even on entire production facilities. Another new element is the customer service concept. Around the world, installers bring Kautex machines into service, or train customers' workers. In a new demonstration workshop, now called the Technikum, new machines are tested in longterm operation. There is still too little known about the flow and transport properties of new raw materials, particularly high molecular weight polyethylene. During this time, raw materials production workers, machine builders, and processors become a single team with similar interests. At the same time, as a manufacturer of plastic products and of plastic processing machines, Kautex succeeds in seeing things from the user's point of view. By marketing machines, Kautex unintentionally increases competition in the plastics market. In the long term, Reinold Hagen can only resolve these conflicting objectives by spinning off the machine building business.


A view of the assembly plant

The company grows

Reinold Hagen, who started as a sole proprietor, adapts the company's form of ownership to its growing size, and establishes Kautex GmbH in 1972. His sons, Winfried and Reinold Hagen, Jr. are now also working in the family business.

High molecular weight polyethylene: new stimulus for blow molding technology

In the mid-1960s, new raw materials stimulate the development of blow molding technology. With the invention of high molecular weight polyethylene, the industry comes up against the limitations of previous extruder concepts, head designs, clamping forces of the machines, and pinch edges of the blowing tools. High molecular weight polyethylenes demand new concepts, which require time intensive and costly development work. This results in new process technologies, some of which are still valid today.

Examples of various manufacturing options in the 1960s

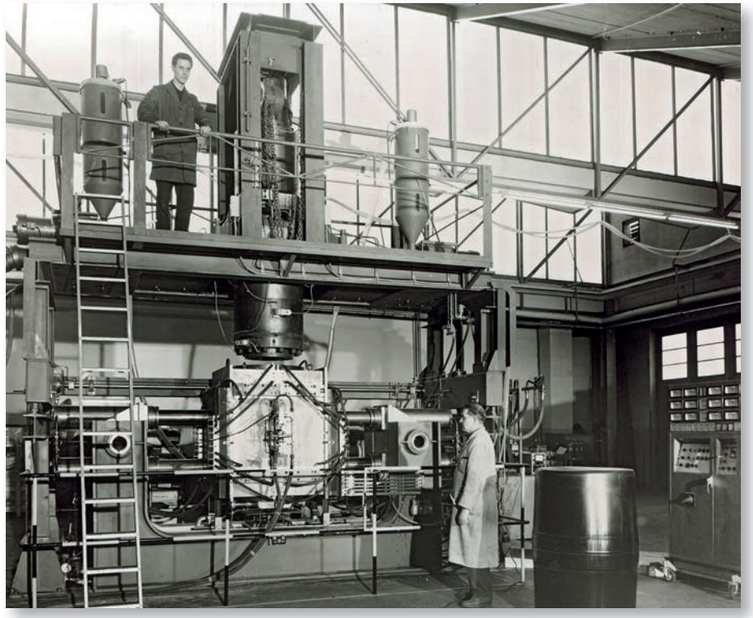
Wall thickness programming

When inflating the plastic parison in the blow mold, the geometry causes some parts of the parison to be stretched more than others, which leads to non-uniform wall thicknesses in the blown part. In the 1950s, clever minds had already come up with the idea of deliberately imparting non-uniform wall thickness to the parison during ejection from the parison die head, in order to achieve uniform thickness after inflation. Denes B. Hunkar (USA) invents the first electronic wall thickness programmer in 1958, and sells it after starting his own business in 1962.

At the end of the 1960s, Kautex starts using these devices, so that the die gap of the head tool is adjusted dynamically and with cyclically reproducible precision during ejection of the parison. Starting in 1970, the so called 25-point wall thickness programmer from the Moog company is used as an alternative, until by 1976 they have completely replaced the Hunkar devices in Kautex machines. After that time, electronic wall thickness programming increasingly becomes part of the basic equipment of each Kautex machine.

A new market: heating oil tanks

In 1965, Kautex sets new standards for plastic extrusion. By presenting the first 570 liter container blown on its own machines, the company demonstrates that such large

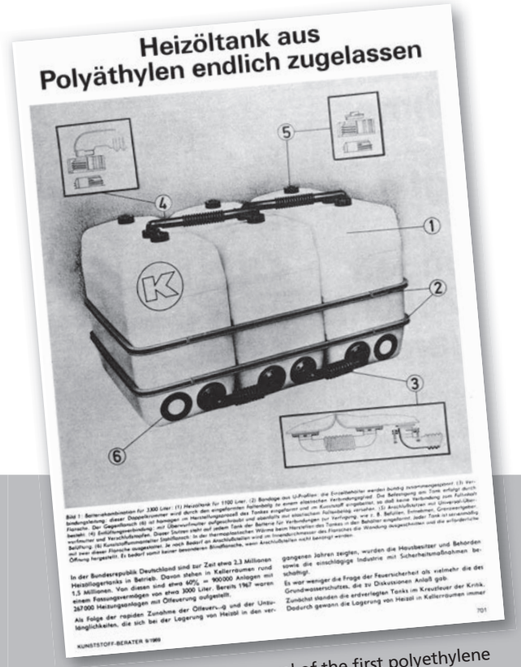


Machine for manufacturing the world's first 570 liter tank, 1965

container sizes are no longer the sole reserve of sintering and polyester processing. New home heating techniques require a rethinking in many respects: During the German reconstruction phase, more and more households retire their coal furnaces and switch to clean oil-burning systems. The oil for this is often stored in non-corrosion-resistant sheet steel tanks. During a visit to his own boiler room, Reinold Hagen gets the idea (according to company folklore) of taking advantage of advances in materials technology to produce plastic heating oil tanks, and building suitable machines for this purpose. In 1968, an estimated 2.3 million heating oil tanks are in use in the Federal Republic, of which 1.5 million are basement tanks. A gigantic market is opening up when Hagen becomes convinced that metal tanks can be replaced with plastic tanks. In 1969, Kautex applies for a patent for the first 1,100 liter polyethylene oil tank. After a lengthy testing process, it is officially approved that same year.

FIFO®-accumulator head

As a Kautex employee, the young engineer Harald Feuerherm develops the "first-in-first-out" method (FIFO®) for the 1968 Hannover Messe. In this method, an accumulator head is designed so that the first melted plastic that is transported to the accumulator head by the extruder is also discharged first. Advantages include uniform dwell times and a very constant temperature in the melted plastic. Kautex designer Albert Göttner develops the FIFO® accumulator head with overlapping heart curves, and thus significantly influences the accumulator head process. The process and the device are protected by patents.


Heizöltank aus Polyäthylen endlich zugelassen

Advertising for the approval of the first polyethylene heating oil tank

Facts and figures 1965-1974

Company

- 1964 The "K in a circle" logo is registered as a trademark
- 1967 New workshop built (now Workshop 2)
- 1972 Transition of the Kautex plants to a limited liability corporation (GmbH)
- Japan Steel Works manufactures Kautex machines under license

Patents

- 1968 FIFO® accumulator head
- 1968 Transfer masks on in-line shuttle machines
- 1969 Heating oil tank with a volume of 1,100 liters
- 1971 Parison die heads with overlapping heart curves

Products

- 1965 Streetlight poles made of PE, also with the 2-layer technique (coextrusion)
- 1965 The first blow molded 570 liter container
- Large blow molded parts like heating oil tanks, fuel tanks, and canisters and drums for transporting hazardous fluids
- 1973 The world's first series production plastic gasoline tank (VW Passat)
- 1974 Heating oil tanks up to 5,000 liters

Transfer masks on in-line shuttle machines

Starting in 1968, Kautex uses transfer masks on so called in-line shuttle machines, which facilitate orderly automatic transfer of the blown parts to subsequent machine stations. This process wins worldwide recognition in machine building for the packaging sector. Many copies lead to patent litigation and eventually result in unusually high royalties for Kautex Maschinenbau.

The first automobile fuel tank made of plastic

Because the automotive industry still offers many unexplored possibilities for the use of plastic parts, and because consumer interest in greater personal mobility has not lagged for a long time, Kautex invests heavily in this future market. As early as 1964, Kautex experimented with Ford on plastic fuel tanks made of polyamide, but could not bring them to the point of series production.
At the beginning of the 1970s, at its own expense, Kautex develops three machines that are used at Kautex itself. They are also used, initially on a loan basis, at BASF (now LyondelBasel) and VW. Kautex looks back on a decade of experience in automotive supply. Due to this close collaboration in development work between Volkswagen, BASF and the Kautex engineering, the new plastic fuel tank is installed for the first time in individual vehicles for the German Federal Post Office in 1972, and enters series production in 1973 in the VW Passat variant. The first VW Passats receive their tanks from the Kautex-Werke plants. However, starting in 1976 at the VW plant in Wolfsburg (Germany), and this makes Kautex very proud, VW begins to produce its own tanks in-house on six blow molding machines, that Kautex builds in a row.

Machines

- Expansion of the B series: seven different type B machines by 1966
- 1968 KEB series for fully automated production of hollow containers made of thermoplastic materials
- 1972 Optimization of the KEB series: “Single cell” machines (KEB1 and KEB4) with higher performance
- 1974 Introduction of the KB250 at the plastics fair in Paris

Technology

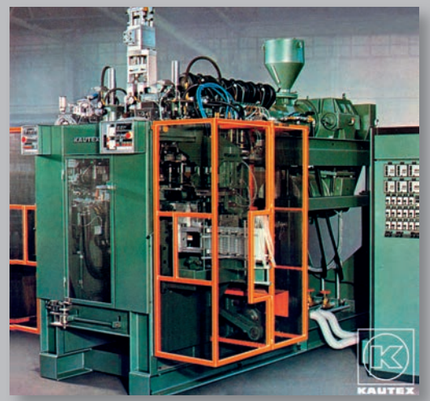
- 1968 High molecular polyethylenes lead to a redesign in machine building
- Introduction of grooved and cooled feed zones in the extruder designs
- Equipping plasticizer screws with mixing and shearing parts to help with homogenization
- Wall thickness controllers with integrated parison length control
- Controlled pre-inflation of the parison

The plastic gasoline tank goes into series production in 1973 with the VW Passat.

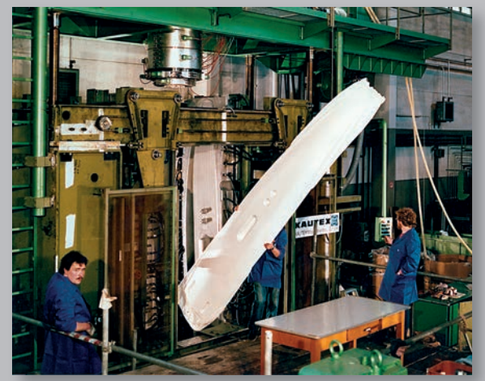
05 Machine building goes its own way

In the 1970s and 1980s, the Federal Republic of Germany must overcome new crises and problems. Internationalization and structural changes alter the economy. Due to advances in computer technology, people around the world are in transition from the industrial age to the information age. The inexpensive “Commodore 64“ microcomputer and the “Walkman”, a mobile device for playing audio cassettes, become integral parts of German youth culture. 1982 Helmut Kohl is elected as Chancellor of the Federal Republic.

The longstanding arms race in the East-West conflict is considered by many people to be a security threat, since medium range atomic missiles seem to lower the threshold for nuclear war. This gives rise to the peace movement in Western Europe. In 1983, the “Greens” succeed in entering the Bundestag, and “alternative” parties are also founded in other European countries. The second oil crisis of 1979-1980 results from the Islamic revolution in Iran, and the subsequent Iran-Iraq War. Like the first oil crisis, the second oil crisis also has a recessionary effect on



Type KEB2-2 machine

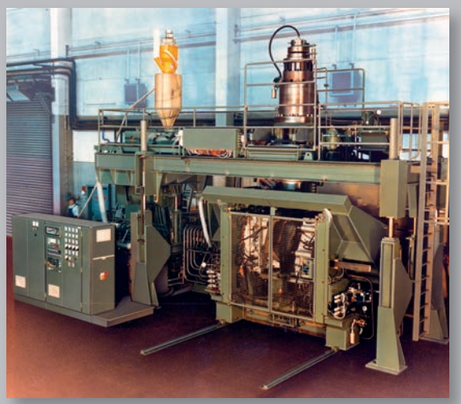


Surfboard production, 1979

the world economy. European automotive manufacturers are under increasing price pressure from Japanese competitors, whose international success continues.

Looking towards the automobile industry during this decade is an important step for Kautex Maschinenbau, which is helped by belonging to an internationally operating group of companies. The most important step for the machine building business in this decade is its separation from the plastic processing division. High molecular weight polyethylene dominates the market for large hollow containers, and forces the industry to undertake intensive and extensive technological development. Two “raw materials crises” bring a new appreciation for the cost of plastics: More efficient processing procedures with an emphasis on quality prevail.

Excess capacity in the machine building and plastic processing sectors intensify competition, reduce revenues, and slow the pace of development to the same degree that they reduce growth rates. Specialization sets in. Under Krupp, Kautex Maschinenbau develops into a customer centric company that supplies a wide range of products for various applications of blow molding. In doing so, Kautex takes advantage of the new possibilities offered by computer technology, and increasingly uses programmable logic controllers and microcomputer controllers in its blow molding machines.


Type KB250 machine

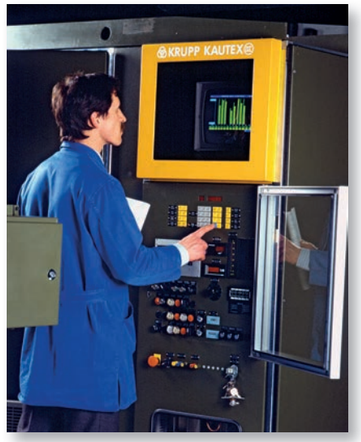
1975-1984

Takeover by Krupp

In 1976, Kautex Maschinenbau is established as a spin-off, and is acquired in 1977 by Friedrich Krupp. However, a change of name to Krupp Kautex Maschinenbau GmbH does not occur until 1980. The takeover opens up a larger international market to Kautex. The company focuses on further development of blow molding machines and technology, with an emphasis on manufacturing automotive parts and packaging. Even after being detached from company founder Reinold Hagen, the manufacturing facility in Bonn-Holzlar remains the company's main location, and the patent departments from both companies (Kautex Werke and Kautex Maschinenbau) continue to work closely together. In 1989, Reinold Hagen sells Kautex Werke to Klöckner Werke AG in Duisburg, before being incorporated into the American industrial conglomerate Textron in 1996, and operating since then as Kautex Textron. Due to growth, the workshop space in Bonn-Holzlar is no longer sufficient for Kautex Maschinenbau.

KRUPP KAUTEX

Logo 1979



State-of-the-art computer control, 1979

Machines are therefore now also built and tested in Essen, where the Krupp group can provide workshop space. Many Kautex employees regularly commute between Bonn and Essen.

Computers for machine control

Kautex machines have already had fully automated operation for many years. This reduces production costs and liberates people from monotonous hand movements. In the 1970s, the individual steps in a machine's cycle are triggered by electrical switching operations. Electrically operated contactors are used as switches, and the switching processes are triggered, for example, by closing a limit switch or reaching a preset time. Kautex soon recognizes the opportunity to realize greater functional scope and more complex logical dependencies in less space and at a lower cost, by using electronic semiconductors instead of the electromagnetic contactors. In the mid-1970s, "Sigmatronic" modules from the BBC company (now ABB) are used, and in 1978 Kautex is the first blow molding machine builder in the world to show a large blow molding system with a programmable logic controller (PLC) from Siemens at the "Europlastique" fair in Paris. The advantages are convincing: Simpler operation, and faster and more cost effective changes to machine settings, for example when changing shapes. LEDs are used for the display. In 1981, Kautex Maschinenbau delivers the first machine with a Siemens S5-110A PLC (a KEB4 machine for Kautex Werke).

Wall thickness programming on a KEB machine, 1979

These first PLC controllers for blow molding machines already have a CPU (Central Processing Unit), and the program is saved in an EPROM (Erasable Programmable Read Only Memory). Wait times and other settings can now be flexibly changed and saved. On the other hand, separate controllers are used for example, for heating, wall thickness programming and other motion sequences. In the early 1980s, Kautex Maschinenbau is already working towards the next milestones. Separate controllers are no longer needed, because their tasks can now be taken over by the microcomputer controller. The same is true for the Moog wall thickness programmer. All necessary configuration values are now entered in the same place, and are also centrally stored. In 1984, the first Kautex machines with a microcomputer controller based on a Siemens S5-210A are delivered, on a machine from the KEB series for the customer Sauer Deutschland (now Sauer Polymertechnik) and a type KB50 machine for the customer Mobil Polymer Belgien (now ExxonMobil).

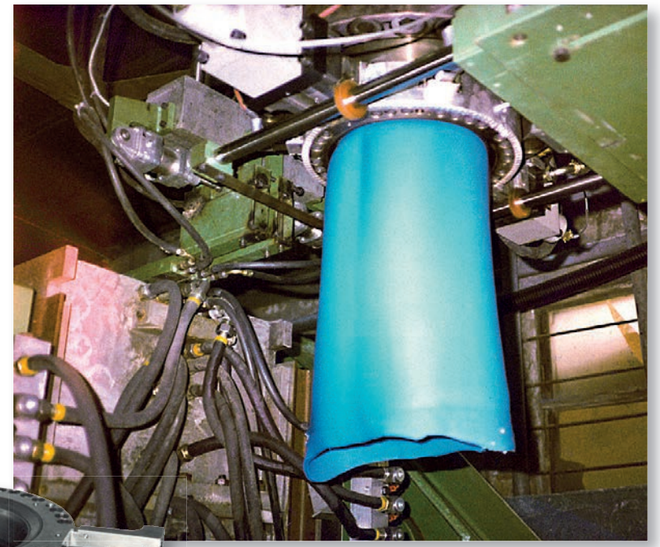
Wall thickness programming: now also asymmetrical

In 1975, two years after completing roughly ten years of employment with Kautex, the designer Harald Feuerherm from Troisdorf invents a device for dynamic ovalization of die rings. This adds an extra degree of freedom to controlling parison wall thickness, and approaches the theoretical optimum. In 1978, Feuerherm goes into business for himself, and sells these devices under the German name "Partielle Wanddickensteuerung (PWDS®)" (partial wall thickness controller).
At the 1979 K Trade Fair in Düsseldorf,

KEB brochure from 1983

Checking the wall thickness distribution on the Super Handling tank

Kautex and Feuerherm display a type KEB30 Kautex machine, on which a 30 liter canister is produced. This machine is equipped with PWDS®, and immediately represents the state-of-the-art in blow molding technology with respect to the quality of the canister and the cost effectiveness of manufacturing it. Feuerherm and Kautex Maschinenbau continue to closely and very successfully collaborate to this day. Feuerherm has become a family company, in which the third generation is already working. By 2014, the company had delivered more than 1,000 PWDS® systems.



Production of the Super Handling tank with partial wall thickness control

PWDS unit for the Super Handling tank

Plastics change the automobile industry

During this decade, Kautex increasingly dedicates itself to the automotive industry. After the plastic gasoline tank has established itself, there is a constantly increasing number of mass produced plastic parts in automobiles. Innovations in vehicle manufacturing increasingly aim to reduce weight, fuel consumption, and emissions. These goals are realised by using polyurethane, which lends itself to automobile manufacturing as an elastic raw material with many applications.
In 1979, Kautex prepares the first machines for manufacturing extrusion blow molded intake air boots, which are also made from polyurethane, and no longer from rubber.
In 1981, the first blow molded rear spoilers and bumpers for cars are produced on Kautex blow molding machines, and starting in 1983 plastic fuel tanks for Lada cars are also produced.

Facts and figures 1975-1984

Company

- 1977 Takeover by Krupp

Products

- 1979 Surfboards
- 1979 Intake air boots
- 1980 Super Handling drum (220 liters) made of HMWPE
- 1981 Rear spoilers and bumpers for automobiles

Machines

- 1976 Kautex blow molding machines become a component of VW's production lines in Wolfsburg
- 1983 The first machines for Lada fuel tanks

Technology

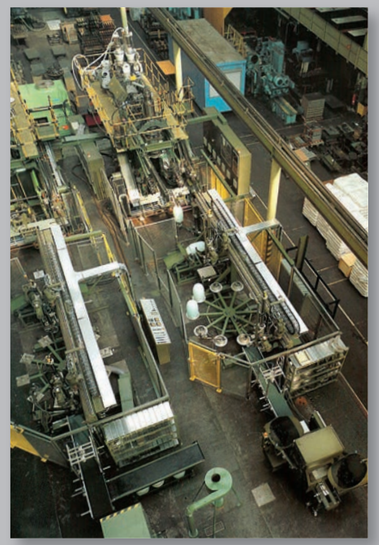
- 1978 Programmable logic controller with a Siemens S5
- 1978 Coextrusion process
- 1979 Fully automated deflashing
- 1979 Integration of PWDS® technology into Kautex machines
- 1984 Introduction of microcomputer control

06 More possibilities through coextrusion

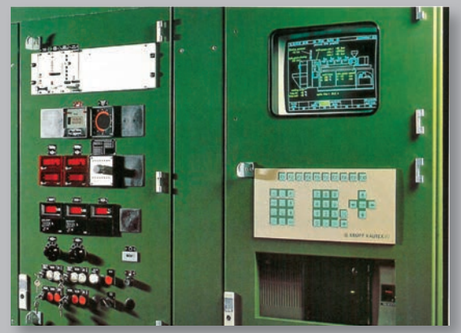
The decade between 1985 and 1994 is in many respects a time of upheaval: politically, socially, and technically. The 1980s go down in history as an era of fitness and leisure: Fitness and leisure activities are more beloved than ever.

At the same time, the collapse of the Soviet Union leads to the non-violent downfall of East Germany, which culminates in 1990 with the reunification of the two German states. Socially, this process is a huge challenge, but it also holds many opportunities, including economic opportunities. A common European internal market is created in 1993 with the elimination of customs duties at borders within the European Union.

Globally, industrial nations develop by means of accelerated progress into an information society. For example in 1991, during the First Gulf War, millions of viewers from around the world watch the invasion of Iraq by the US armed forces and its allies on live TV – a first in the history of television, and in military history. Computer technology is now an accepted part of all areas of life. Electronic data processing is thus no longer reserved to corporations. From this time forward, it is impossible to conceive of developing blow molding machines without computer technology.



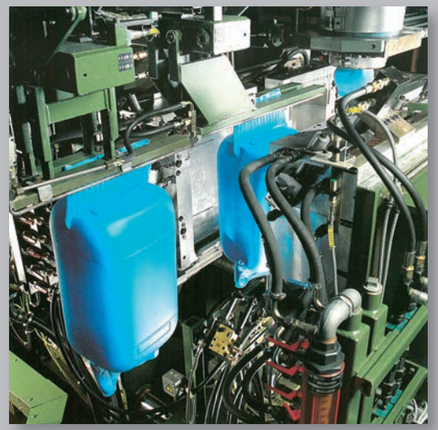
Production line for fully automated production and quality control of 30 liter canisters and 120/220 liter drums, 1990



Control cabinet with MCC controller for KEB and KB machines

Kautex responds to increasing demands for improved barrier properties of plastic fuel tanks, which are made in the 1980s, for reasons of environmental protection and health. An important milestone in this decade is the sale of the world's first six-layer coextrusion system to Walbro Automotive. The multilayer process for fuel tanks, but also for food and chemical packaging, prevails as a fully automated production concept. Computer technology also provides a basis for process optimization during control and monitoring.

Multi-layer plastic fuel tank for the Mercedes Type W202 (C-Class from 1993)



KB35 mold clamping frame with blowing mold and cooling mold to increase performance, 1990

1985-1994

Growth in the group

After further acquisitions of plastics machinery manufacturers in the 1980s, the Krupp group brings these companies together in the holding company Krupp Maschinentechnik GmbH. This creates room for further development and investment. One visible sign of this is a new 11,000 square meter manufacturing and office complex on Kautexstraße in Bonn, which is dedicated in 1998. In 1990, the Krupp companies in plastics technology include: Krupp HEB (tire machines, Hamburg-Harburg, now Harburg-Freudenberger), Werner & Pfleiderer (extrusion equipment, Stuttgart, now Coperion), Krupp Kautex (extrusion blow molding machines, Bonn), Krupp Formaplast (injection molding, Essen),

New construction completed in 1988 at the headquarters in Bonn

Krupp Corpoplast (PET stretch blow molding machines, Hamburg, today KHS AG), and Krupp Bellaform (thermoforming and profile extrusion systems, Heidesheim).

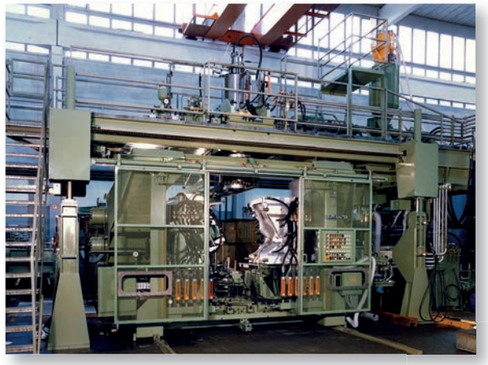
Dedication of the new building in 1988

Six-layer coextrusion

In the 1970s and 1980s, plastic fuel containers are primarily made of a single layer of polyethylene. After blow molding, these tanks are coated with fluorine, in order to prevent diffusion of gasoline vapor through the container wall. The introduction of the first plastic fuel tanks in the United States does not occur until about 15 years later than in Germany. In 1988, Kautex delivers a type KB250 system for producing plastic fuel tanks to Ford in Milan, Michigan. This system is also combined with a device for interior fluorine coating.

In the mid-1980s, it's becoming apparent that the admissible limits for hydrocarbon emissions will be made more stringent, first in California, and later in the rest of the United States, in Western Europe, and in Japan. Therefore, in 1986 the company starts developing the process and the machine technology for manufacturing six-layer tanks. These tanks achieve their vapor barrier from a so called barrier layer, which is made of a specialized plastic in the middle of the tank wall. An adhesive layer is installed on both sides of the barrier layer. Recycled production waste serves as the so called regrind layer. Finally, inner and outer layers of polyethylene are needed, so that the new tanks are equipped with a six-layer container wall, so that fluorination is no longer needed. The vapor barrier is significantly improved, and above all is guaranteed for the entire life of the tank.

Kautex has had very good experiences with discontinuous parison ejection, especially with tanks and other large blow molded parts. First attempts at six-layer production are therefore based on this process.
This also applies to the world's first examples of a coextruded tank, which Kautex displays at the K Trade Fair in Düsseldorf in 1986. They are produced in Essen using a type



Type KB250 large blow molding system

Schematic diagram of the six layers of the coextrusion, using a tank as an example

6-layer CoEx tank, 1989

KB250 large blow molding system, which is equipped with a complex accumulator head system for discontinuous ejection of six-layered parisons. However, these sample tanks do not have the required quality. After several years of further development work, Kautex switches over to a continuous process, and achieves much better results in this way. During the K Trade Fair in Düsseldorf in 1989, Kautex displays a system that operates according to this principle at the in-house exhibition in Bonn, and customers are able to convince themselves of the quality of the six-layer tanks that are produced on it.

Type KB400 machine

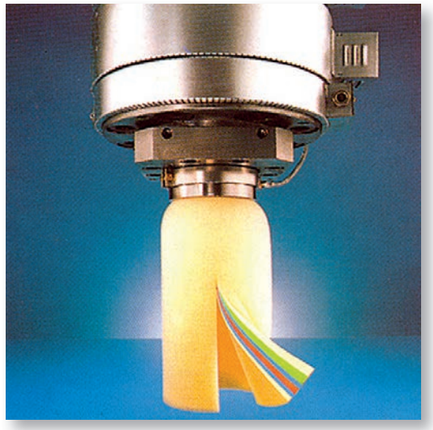


Diagram of coextrusion

In addition to the machines delivered in 1992 and 1993 to the USA, further type KB250 and KB400 machines follow, for Ford (also in 1993), for Walbro Automotive (1994), but also for the Fina (today Total) company's pilot plant in Belgium (1993). For further development work in the Bonn Technikum, Kautex makes a new type KB250 system, which is equipped for continuous six-layer coextrusion.

Growth market in the USA

The year 1985 represents a new beginning for machine sales in North America. Kautex Werke hands the sales and service business of Kautex Machines, Inc. (Linden, New Jersey) over to Krupp Industries, Inc. (KIS, USA). Initially, both organizations operate in the same location, and the Krupp subsidiary is separated from Kautex Werke in a stepwise manner. Machines are now sold again, not only blow molding machines by Kautex and Corpoplast, but also tire presses by HEB. There is great interest in the market for fuel tank blow molding machines, which until now has been the domain of American manufacturers. In 1988, a first machine is sold to Ford. From then on, all signs point to growth, and the fuel tank blow molding machine business significantly boosts the revenues of the North American subsidiary. In 1986, it's renamed as Krupp Plastics and Rubber Machinery, Inc. (KPRM, USA), and moves to Edison, New Jersey due to the strong growth and need for space. The year 1992 represents an important milestone in the history of the company: The KB250 coextrusion test system, which has been retooled multiple times – and in the meantime has blocked melt accumulators –

Type KB260 machine

Informational brochure for IML, 1986

is taken over by Walbro Automotive (now TI Automotive) for its plant in Ossian, Indiana (USA). The Ford plant in Milan, Michigan (USA) follows in 1993 with the first system (type KB260) that is built exclusively for the continuous six-layer coextrusion process. With this technology, which represents the breakthrough into the North American market, the company soon claims the title of market leader for itself in this sector.

In-mold labeling

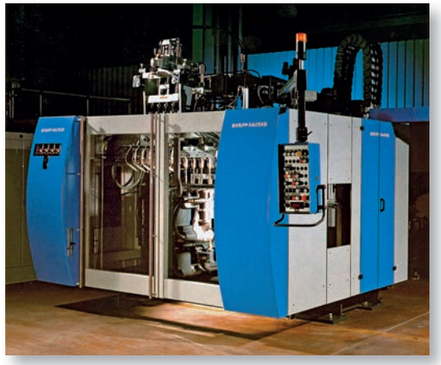
In 1986, Kautex presents another exciting process: Labeling in the blow mold in a single operation, during the production of

the hollow packaging container. The IML module (in-mold labeling) is suitable for all Kautex blow molding machines from the KEB series, and can also be retrofitted. Interim storage of products, costly later labeling, and maintenance and service of downstream labeling systems all become redundant.

Cooler boxes

Cooler boxes

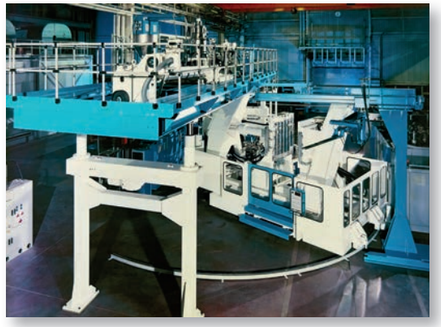
In 1986, Kautex Maschinenbau looks back on the successful conclusion of a development partnership agreement with Norsk Hydro. They develop a machine for manufacturing cooler boxes, in which salmon can be transported from Scandinavia to North America. It's a good idea, but doesn't succeed in the long run, because meltwater poses too great a challenge. Even Kautex can't do the impossible.



Type KBS1-30 machine

The KBS series

In 1992, the era of another successful series begins with the sale of the first KBS1. The series is expanded in 1995 up to machine size KBS1-30D for blow molded parts with volumes up to 35 liters, and is extended in



Type KBS2 machine

the KBS2 series to the entire blow molding range from 20 liters to 1,000 liters. In the years that follow, machines from this series acquire a reputation for being extremely versatile. Whether for fuel tanks in various sizes, or for complex or symmetrical containers, the KBS series proves itself with high output rates, and at the same time can be modularly adapted for specific requirements.

Computer control

Computer control replaces contactor control technology, which helps significantly in developing new high performance machines, such as the KBS1 in 1992. That same year, the first remote maintenance system is presented. Shortly after its introduction, the acoustic coupler is replaced with a modem. In 1993, the KBS2 is added for large blow molding. Computer technology is used here, above all, for monitoring and storage of process data, in order to produce with the least possible amount of waste. The machines can now be more conveniently configured, and production settings can be saved and more quickly retrieved. The introduction of hydraulic accumulators and three platen

Illustration of the user interface of microcomputer controller in the prospectus

clamp design, and the upscaling of existing models are typical characteristics of the 1990s. Despite the high technical standards that blow molding machines have achieved, and the resulting complexity, maximum ease of operation and reliable control and monitoring are required. This goal can only be achieved with the aid of microcomputer technology. The modem connection that was introduced in 1992 is not replaced with a modern internet connection until 2011.

Central data collection and analysis of machine and production data in a customer's operations office, 1990

Facts and figures 1985-1994

Company

- 1986-1988 New manufacturing and administration building in Bonn-Holzlar
- 1988 Krupp transfers its shares to Krupp Maschinentechnik GmbH
- 1989 Krupp Kautex Maschinenbau employs approximately 500 workers
- 1989 Opening of a sales office in São Paulo, Brazil
- Expansion of "after-sales service"

Machines

- The first coextrusion blow molding machine for manufacturing plastic fuel containers and blow molded parts for products with volumes up to 1,000 liters
- 1988 The first Kautex machine for plastic fuel tanks for Ford in Milan, Michigan
- The largest blow molding system in 1989 is the KB800
- For years, Kautex has been providing the toy industry in the East Germany with its machines, so that after reunification, these companies can enter the market at the global level
- 1992 Introduction of the KBS series

Technology

- Between 1983 and 1989: Kautex delivers more than 250 microcomputer controllers (MCCs) for extrusion blow molding systems around the world
- 1986 IML process: In-mold labeling
- 1989 Six layer extrusion for plastic fuel tanks
- 1992 Presentation of a remote maintenance system

Products

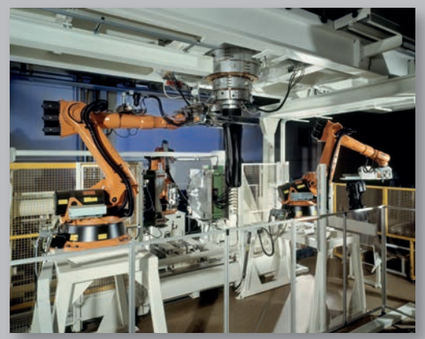
- 1986 Six-layer CoEx fuel tank
- 1989 Cooler boxes and ski cases

07 Boom years and upheaval

It takes years of effort to promote the economic and social reunification of Germany. The most populous country in Europe has to contend with growing unemployment figures (over 4 million in 1996 and 2004). Globalization results in relocation of jobs, and mechanization in the workplace renders an increasing number of job areas superfluous. However, well trained specialists are in more demand than ever.

SIG Kautex logo

Adcuram logo



Parison transport by robots

At first, it looks as though the end of the Cold War will lead to further disarmament and global peace efforts. With the USA as the sole superpower, there is a certain degree of consensus that economic development will be characterized by deregulation and globalization. The terror attacks on September 11, 2001 in the USA destroy this hope for peace, and a long lasting global war on terrorism begins. Also noteworthy are the strengthening of Russia and simultaneous expansion of the European Union, which grows by 10 countries in 2004 and experiences something totally unprecedented: With the Euro, the EU introduces a common European currency for the first time in history. For a long time afterwards, some Germans mourn for their beloved stable Deutschmark.

Type K3D-HP machine

With respect to machine building, the decade between 1995 and 2004 begins with a real boom in blow molding machine manufacturing. A plant is opened in southern China, and 3D blow molding undergoes systematic further development. In addition, the PET manufacturing process briefly becomes an area of focus within Kautex. The process for parison transport with robots is industrialized. In the second half of the decade, the market weakens, and homemade problems add to the trouble. The Krupp Kautex era ends in 2000 with the sale to the Swiss conglomerate SIG. After four difficult years for Kautex, shares are transferred to Adcuram. Many employees lose their jobs during these years. The rest hope that ownership and management will regain stability and continuity. Starting in 2004, they face the task of growing into a new team with colleagues from a former competitor in the industry.

1995-2004

Machine manufacturing in China

In 1995, Krupp Kautex Maschinenbau GmbH establishes the first German joint venture in the southern Chinese region of Guangdong, together with Chen Hsong (established in 1958, with 1,500 employees) and the Shunde Sunny Group. This cooperation with Chinese partners is intended to facilitate access to the Asian market. That same year, production of the KEB2 starts. Its production is replaced in 1996 by the KCC1. Besides this series, the KCM1 is also produced there in small quantities in 1996. It is intended as a simple variant for the Chinese market. In 2003, the joint venture ends with the departure of the Chinese partners, and in 2004 Krupp Chen is renamed as Shunde Kautex.

Type KCC1 machine

Signing of the joint venture contract (From left: Erich Wendling (Krupp Kautex), Mr. Chen (Chen Hsong), Mr. Fu (Sunny Group))

Notarized record of the joint venture contract from1995

Machine manufacturing in the USA

In 1997, in order to ensure shorter delivery times for customers in the USA, the CP series that was derived from the KBS2 series is manufactured in the USA, and is displayed for the first time at the NPE trade fair in Chicago. For its internal machine building operations, the US subsidiary moves from its previous location in Edison, New Jersey to a plant of its own in Branchburg, New Jersey. After only five years, there is a setback. Production of its own series is adjusted due to declining demand. The subsidiary has to downsize, and moves again in 2003. To this day, the US subsidiary is located in North Branch, New Jersey, and specializes in sales and service. Since 2004, it is operating there again under the name Kautex Machines, Inc.. For the past 10 years, it has once more been on a growth path. As of 2015, Kautex has been represented in the USA for 55 years, and is planning a move into a newly constructed building with a Technikum.

Kautex branch office in North Branch, New Jersey

3D technology: Low-waste blow molding

Since 1999, under the name KBS3, Kautex offers a new kind of machine that can be used above all to manufacture molded parts with a tubular cross section (called “3D parts”) more economically, and with improved quality. Such parts are increasingly used as fuel filling pipes, and to conduct intake air or charge air for internal combustion engines, but are also used as condensate tanks in dishwashers and for trap lines in the sanitary sector. Advances in cost effectiveness and part quality are due to the production method known as the “insertion technique”, which Kautex implemented for the first time in type KBS3 machines. In this production process, parisons with much smaller diameters are used than in the pinching process. The blow mold is horizontally divided, and when the blow mold is opened, a robot inserts the parison lengthwise into the upwardly opened mold cavity. Because the entire slender parison is within the mold cavity, pinching it out is unnecessary. In this way, the amount of flash is drastically reduced, which allows smaller

extruders to be used, and leads to considerable energy savings. In addition, this process achieves substantially more uniform wall thickness, and renders structure weakening pinch seams in load bearing component parts unnecessary.

Prior to the introduction of the variants of 3D blow molding, such molded parts were manufactured as so called “pinched” parts. Due to this process, manufacturing them constantly required a particularly large portion of the parison to be pinched together, and the excess flash fed back into the materials cycle as production waste. This conventional process is still used even after the introduction of the 3D technique; therefore parts manufactured in this way are called “2D parts”. Prior to the development of the fully automated insertion process, as used since 1999 in type KBS3 machines, there were a series of attachments for using hand operated tongs to insert long tube shaped parisons with small diameters into a horizontally arranged, upwardly opened blow mold half, so that waste pieces would only be produced at both ends of the tube shaped part. These attachments did not succeed industrially, because the degree of automation was too low and the insertion process could not be repeated with sufficient precision. The first attachments for automating the insertion process were already described at the end of the 1970s in patents from the Japanese company, Excell Corp.

3D air channel

The suction blow molding process, which was simultaneously realized for the first time in 1988 by the Japanese companies Sumitomo Tool Co. and Tahara Machinery Ltd., is well suited as an alternative to the insertion technique. In this process, the parison (which is once again characterized by a very small diameter) is sucked by means of vacuum into the mold cavity of a blow mold that is already closed. This process variant allows for less complex and therefore more cost effective blow molding tools than other 3D processes. The first European suction blow molding machines originate at Battenfeld-Fischer in 1992. In 1995, the company establishes this process in Europe and North America under a license assigned by Sumitomo.

3D molded automotive parts

Kautex was also active in developing other 3D techniques some years before the development of the insertion process. Thus, in the 1990s, the 3D process with multi-part blow molds had achieved a certain degree of success. In this process, robotic parison manipulation grippers and movable mold tools work together in a finely tuned sequence of steps, such that the slender parison is inserted into a complexly contoured, sequentially self-closing mold cavity. Regardless of the preferred process variant for molding, whether suction or insertion, Kautex Maschinenbau and Battenfeld-Fischer develop technology in the 1990s for sequential coextrusion (SeCo). In this process, a two layered parison is generated, in which the first layer is formed from a hard material, and the second layer is formed from a soft material. During ejection of the parison from the head, in chronological succession, first primarily hard material, then primarily soft material, and then primarily hard material is ejected, and

so forth. This results in parison segments in which first the hard layer and then the soft layer predominates. In this way, complex 3D parts can be manufactured, that have both rigid and elastic segments. This process is therefore often called the hard-soft-hard process. This results in various component part functions being integrated into a single blow molded part, so that the number of individual parts that must be installed is drastically reduced.

The merger of Kautex and Fischer under SIG in 2000 brings the various, previously often competing, process and machine variants for 3D blow molding together under one roof, and Kautex becomes the provider for a seamless portfolio of machines for manufacturing 3D parts. The demand for such parts increases in the following years, above all for automotive applications. Kautex further develops the 3D technologies, and the related machine technology. By the end of 2014, Kautex has delivered more than 160 machines for 3D blow molding. They include more than 80 suction blow molding machines, because the suction blow molding process has proven to be especially advantageous for processing rapidly crystallizing "engineering plastics" [e.g. polyamide (PA), PA with a fiberglass mixture, polyphenylene sulfide (PPS), and polyether ether ketone (PEEK)], and these technical plastics have been increasingly used in the automotive sector for a number of years.

Krupp changes course

Krupp expands its engagement with plastics machinery manufacturing until the second half of the 1990s. At the beginning of 1997, Krupp acquires the extrusion blow molding machine builder based in Troisdorf-Spich that had belonged to the Battenfeld group of companies, and subsequently manages it under the name Fischer-W. Müller Blasformtechnik. At first, Krupp hesitates to merge this competitor with Krupp Kautex Maschinenbau. Instead, the conglomerate pursues a two-market strategy. In order to advance its "new daughter", the conglomerate falls back on resources from Krupp Kautex. The noticeable feeling of hostility at Kautex, previously caused by the competitive situation, is not displaced with a new sense of collegial understanding. Instead, it grows more intense. With the acquisition of the steel company Hoesch AG in 1992, the Krupp conglomerate becomes the market leader in the consolidation of the German steel industry. A few years later, Krupp-Hoesch pursues the far larger merger with Thyssen AG.

The merger of Krupp-Hoesch and Thyssen leads to a new logo, that remains unchanged to this day.

After that succeeds, in the fall of 1999, ThyssenKrupp decides to focus the merged company on a few core businesses. For this purpose, a large number of holdings are sold, including the companies in the plastics machinery business sector. The Krupp Kunststofftechnik GmbH group, with its companies Krupp Corpoplast, Krupp Kautex and Fischer-W. Müller, as well as the sheet metal packaging technology division, is sold in the middle of 2000 to SIG (Schweizerische Industriegesellschaft AG), and managed from that time forward as "SIG plastics".

SIG and Kautex are a poor fit

The origins of the SIG group are in rail vehicle technology and personal weapons technology. In the second half of the 20th century, a diverse industrial conglomerate emerged from this background. To ensure profitability and improve growth opportunities, SIG decides at the end of the 1990s to focus the conglomerate on the packaging systems business sector. Due to the high growth rates for PET beverage bottles, it looks attractive at

Seite 30 / Mittwoch, 3. Mai 2000, Nr. 102 Frankfurter Allgemeine Zeitung

Schweizer Verpackungs-Gruppe kauft PET-Technik von Krupp

SIG zahlt 390 Millionen DM / Getränkekartons reichen nicht mehr / Besseres Ergebnis im ersten Quartal

SIG Schweizerische Industrie-Gesellschaft Holding AG, Neuhausen am Rheinfall. Der Schweizer Konzern, nach Tetrapak der zweitgrößte Anbieter von Kartons für Eistee oder Orangensaft, kann den Getränke-Abfüllern nun auch PET-Flaschen liefern. Wie SIG mitteilte, wurde jetzt die Krupp Kunststofftechnik (KKT) in Essen übernommen. Für das Unternehmen, das mit 1700 Beschäftigten einen Umsatz von 480 Millionen DM erzielt, zahlten die Schweizer einschließlich der übernommenen Schulden 390 Millionen DM. Der Thyssen-Krupp-Konzern verkaufte die Kunststofftechnik rückwirkend zum 1. Oktober 1999.

Das deutsche Unternehmen, das Blasform-Maschinen für PET-Flaschen, für Plastik-Verpackungen bei Lebensmitteln sowie Getränke-Dosen herstellt, wird in der SIG-Gruppe als neue, eigenständige Kunststoff-Division geführt und soll weiter ausgebaut werden. Ihr Leiter wird der bisherige KKT-Chef, Werner Fillmann. Die SIG-Gruppe hatte vor kurzem beschlossen, sich vom Waffengeschäft mit Pistolen und Jagdgewehren zu trennen (wozu auch die deutschen Firmen Sauer und Blaser gehören) und sich künftig vor allem auf die Verpackungstechnik zu konzentrieren. Sie bringt bereits 80 Prozent des SIG-Umsatzes von knapp 2 Milliarden Franken (2,5 Milliarden DM); davon entfällt der größte Teil auf Getränkekartons. Im Verpackungsgeschäft gab es 1999 einige Probleme, was zu einem Betriebsverlust führte und zum Abbau von Arbeitsplätzen. Davon sind auch deutsche Tochtergesellschaften, die Getränkekartons herstellen, betroffen. Die SIG versuchte schon seit längerer Zeit, ihrem Konkurrenten Tetrapak nachzueifern und das Sortiment um PET-Flaschen zu ergänzen. Denn Getränkekartons werden teilweise durch diesen Kunststoff verdrängt und auch bei Lebensmitteln wird diese Verpackung häufiger verwendet. Da ein Einstieg in das PET-Geschäft aus eigener Kraft unwahrscheinlich schien, war eine Übernahme erwartet worden. Die Zürcher Börse reagierte mit einem deutlichen Kursgewinn, weil die SIG nun diese Technik hinzukaufen konnte.

Die Gruppe teilte am Dienstag zugleich mit, dass der Umsatz in den ersten drei Monaten um 10 Prozent zunahm und auch das Ergebnis sich verbessert hat. 1999 machte die SIG wegen der Kosten für die Umstrukturierung einen Verlust von 43 Millionen Franken. km.

Press article in the Frankfurter Allgemeine newspaper, dated 5/3/2000

the beginning of 2000 to acquire Krupp Corpoplast, which is for sale. Without further ado, SIG decides to merge the simultaneously acquired companies, Krupp Kautex and Fischer-W. Müller. This hasty step is not understood by many customers, and is not supported by many employees. The merged company loses market share, and is subdivided at the beginning of 2002 into SIG Kautex and SIG Blowtec. When this arrangement does not bring the hoped for improvement in earning power, SIG decides in 2003 to sell both of these companies. Finally, the Munich investment company Adcuram acquires both companies in 2004. Shortly after this aquisition, Blowtec ceases operations.

Ecomax

For many years now, plastics have been taking the place of traditional raw materials like metal and glass. The same is true for the transparent plastic, polyethylene terephthalate (PET), which has been displacing traditional packaging for mineral water and soft drinks since the late 1980s. At the beginning of the 1990s, PET is also increasingly used for packages that had previously been made of polyethylene or polypropylene, such as dishwashing liquid bottles. Consequently, several Kautex customers are pushing for the development of a PET injection stretch molding machine (a so called single step machine). After an extremely short period of development, Kautex Maschinenbau shows the prototype for such a machine at the 1995 K Trade Fair, under the name KBS5-1500. The technology is very promising, but the machine is too expensive and too large. The Krupp group decides against further development. Instead, it encourages Krupp Kautex and Krupp Corpoplast to jointly tackle the new development of a modular system of building block system of single step machines. The first prototype is presented at the 1998 K Trade Fair under the name

Ecomax machine

Facts and figures 1995-2004

Company

- 1995 Establishment of Shunde Krupp Chen Plastics Technology Co., Ltd. as a joint venture
- 2000 Sale to the Swiss conglomerate, SIG Holding AG, and renaming of the company as SIG Blowtec GmbH
- 2000 The company has reached a global production capacity of 30 million fuel tanks per year
- 2002 Renaming as SIG Kautex GmbH & Co. KG
- 2003 The company establishes a subsidiary in the vicinity of Milan, Italy, and concentrates on sales and customer service
- 2004 Transfer of shares to Adcuram Beteiligungs AG and renaming as Kautex Maschinenbau GmbH
- 2004 Renaming of Krupp Chen as Shunde Kautex Plastics Technology Co., Ltd.

Ecomax 10/2. A number of Kautex and Corpoplast customers decide in favor of these machines. In the first few years of its industrial use, the design is improved in many respects. In order to foster further development and marketing of this series in a more focused way, and with more integrated management, SIG PETtec is founded in Troisdorf-Spich in the summer of 2000. Kautex and Corpoplast transfer their shares in the Ecomax business to this new company.

Machines

- 1995 Expansion of the KBS1 series for blow molded parts up to a volume of 35 liters
- 1995 Expansion of the KBS2 series for the entire blow molding range up to a volume of 1,000 liters
- 1995 Presentation of the prototype KBS5-1500
- 1996 Production of the KCC1 in China
- 1997 Presentation of the CP120 at the NPE in Chicago
- 1998 Presentation of the new single-step machine Ecomax 10/2
- 1999 Introduction of the KBS3 for 3D parts (later the K3D HP)
- 1999 Production of the KCM1 in China as a variant of the KCC for Chinese customers

Technology

- 1995 Single-step process for PET bottles
- 1996 Blow molding foam technology (BFT) for manufacturing transport pallets
- 1996 Robot based parison transfer process
- 1998 IMD process In-mold deflashing
- 2000 First use of an industrial PC instead of a PLC
- 2004 Process for manufacturing fuel filler pipes with an electrically conductive inner layer

Examples of packages produced from the Ecomax machine

Products

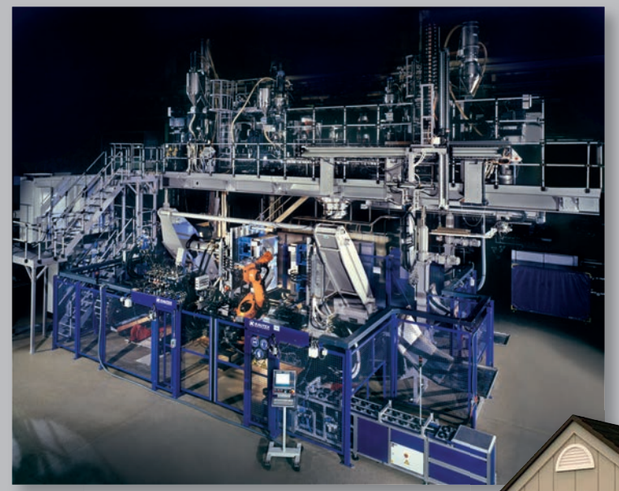
- 1995 PET bottles
- 1996 Transport pallets
- 1999 3D automotive parts

08 Under its own power, on a clear course

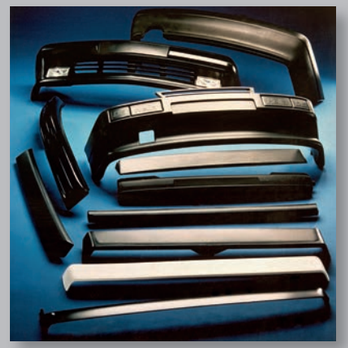
In 2005, for the first time in German history, a woman is elected Federal Chancellor: Germans set their hopes on Angela Merkel (CDU) and thus on new stimulus and stability. In fact, Germany emerges relatively unscathed from the global economic crisis that originated in the US banking and real estate market. Resource scarcity becomes an important topic. Around the world, prices for raw materials and energy rise. In addition, in Germany, the Fukushima nuclear disaster leads to far-ranging discussions and a change of direction in energy policy. Renewable energy and energy conservation become a concern for all industries in the economy. People are living in the information age, in which nearly all information can be effortlessly retrieved and forwarded thanks to smartphones and social media.

Around the world, demand grows for machines to manufacture plastic tanks. The plastic fuel tank has now largely replaced its predecessor, the sheet steel tank. Kautex Maschinenbau concentrates heavily on decisive market shares in the automotive segment. Its market share in tank machines is higher than that of any other competitor. But even in the packaging sector, Kautex Maschinenbau invests year on year in engineering, and presents new machines of the KLS series at plastics trade fairs in 2007 and 2010, followed by the all-electric KBB series in 2013. The KBB all-electric machines are the new standard for productivity and energy efficiency. In the “specialties” market segment for innovative applications, new products emerge such as composite pressure vessels or large flat parts for garden sheds. One of the great strengths of the global company from Bonn is to develop individualized solutions for the customers in all market segments, and to provide international customer service.

2005-2014



Type KBS241 machine



Blow molded spoiler

Garden shed made of plastic panels

At Kautex this decade also represents innovations in corporate organization, and a time of deliberate upheaval and courageously breaking new paths.
In this way, by its own efforts, Kautex Maschinenbau with its new management team regains a leading position among blow molding machine makers, and can particularly assert itself in the rapidly growing Asian market. In view of the increasing individualization of customer orders, Kautex Maschinenbau sets up a process focused organization.

Turning during a storm

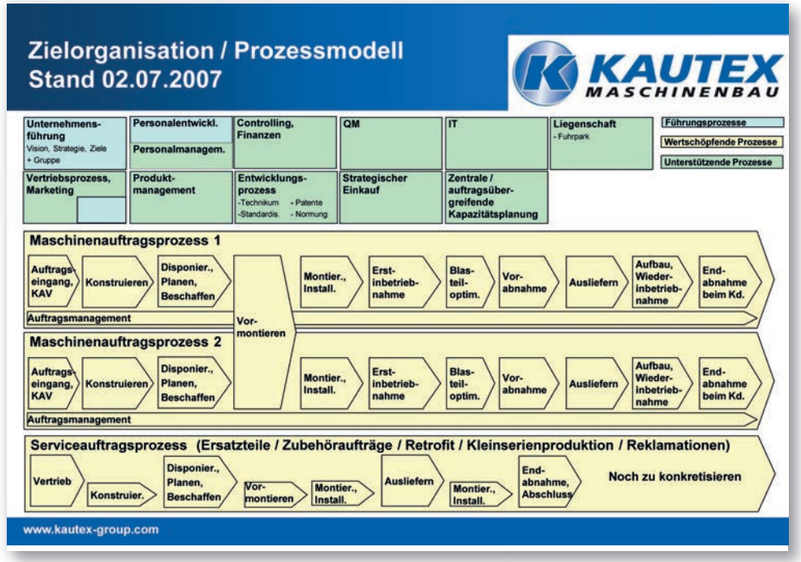
Adcuram's goal is to make the company profitable again in a short time. In doing so, the new shareholder's confidence is based both on the growing market potential, and on the experienced and engaged team. Kautex Maschinenbau leaves corporate hierarchies behind, and returns to being a medium sized company that devotes all of its attention to the customer. Starting in 2005, the management team is restructured, starting with senior management, which since that time has been comprised of Olaf Weiland and Andreas Lichtenauer. They are both engineers with extensive sales experience. Weiland had previously worked for Kautex Maschinenbau in the 1990s, before switching to its sister company in Hamburg, Krupp Corpoplast (now KHS Corpoplast), where he modernized and expanded sales and customer service. Until 2004, Lichtenauer was responsible for growing the Kautex business in China, and by now he has over 25 years of professional experience in blow molding machine building. Both embody a high degree of personal identification with Kautex Maschinenbau, as well as an approachable manner and a partnership oriented approach, both internally and externally. They have assembled an international management team, which today includes another ten executives in Bonn alone. In the time from 2005 to 2014, the company is able to more than double its revenue.

Andreas Lichtenauer

Olaf Weiland

Reorganization of company processes

In 2006, all processes within the company are reviewed in order to identify areas for possible improvement. This leads to numerous small changes that help to increase transparency and efficiency. Furthermore, over the course of 2007 it becomes clear that the inherited functional stratification of the company is often an obstacle to efficient, high quality, on time fulfillment of orders. This only becomes more clear as the customer orders become more complex and individualized. After widespread discussion within the company, the functional organization is replaced, starting in 2008 with a process focused organization. The most important units in the organization are now cross disciplinary, so that complex customer orders can be executed by manageable teams. Alongside the fixed organizational structure, the company now increasingly uses teams that are assembled around particular tasks. Many employees are gradually acquiring the required competency in project management



The process organization draft from 2007 is implemented by the beginning of 2008.

methods. The company supports this with comprehensive professional training. In addition, the prevailing understanding of leadership is reconsidered by the management team, and is further developed so that it more effectively supports the changes indicated.

Strengthening Shunde Kautex

After the departure of the Chinese joint venture partners, starting in 2005, Kautex Maschinenbau has the opportunity to integrate and strengthen the Shunde Kautex company in a step by step manner. This international collaboration begins in sales and customer service. In 2007, the local management team is reconstituted: Du GuoLiang, Andreas Krause, and Mark Lüddecke collectively take over responsibility. They improve management in all areas of the company, modernize production, build a solid circle of reliable suppliers, and strengthen employees' loyalty to the company. In 2010, the "KCC quality team" is formed at the international level, with the goal that products delivered from the Shunde plant will also help to confirm Kautex Maschinenbau's global leadership with respect to quality. Meanwhile, the group of satisfied customers is growing year after year, both in Asia and in the western world. At the beginning of 2013, in order to prepare for continued growth, Shunde Kautex opens a new, larger factory.

Plant in Shunde

Opening ceremony for the plant in Shunde, 2013

Demographic change and employee engagement

Kautex Maschinenbau's business success depends on the knowledge, skills, and commitment of its employees. The growth of the company requires building up the team. At the beginning of the decade, only about 200 employees are working in the home office in Bonn, of whom about 80 percent are already past the age of 40. Since then, every year Kautex recruits significantly more students for career training than are required to cover the short term need. The success speaks for itself: At the beginning of 2015, there are already 407 employees working in the Bonn location, of whom 43 percent are below 40 years of age. However, education doesn't end with career training. Therefore, in total, the company annually invests a seven figure sum in Euros for on-the-job training and continuing education for its employees. In addition, Kautex works closely with a number of technical universities to align their research with practical issues, and to help interest young engineers in blow molding machinery manufacturing. A considerable number of graduates are now working enthusiastically at Kautex. The company management is convinced that long term relationships with customers, other business partners, and its employees will also drive business success in the future. Most employees share this vision. At the beginning of 2013, when presented with the opportunity to do so, a total of 45 employees purchased stock in the company – on short notice, but for the long term. Since then, Kautex management and employees hold a majority of the company's share capital (50.1 percent).

Trainees from Kautex Maschinenbau GmbH in 2011

Large flat parts

Over the course of time, growing markets generate a growing diversity of products that are manufactured with the extrusion blow molding process. This also includes "large flat parts", which is to say, plate and panel shaped components. Plastic table

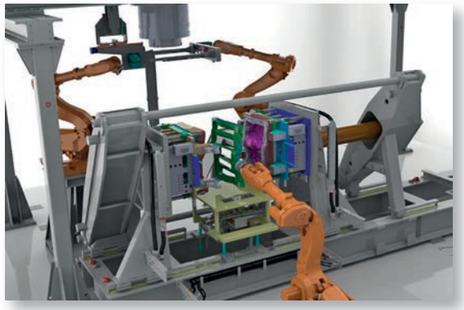
tops and engine compartment underbody coverings for automobiles are the first parts in this category to be produced on Kautex machines. The increasing interest in using the blow molding process to manufacture such parts is no accident. As compared to solid plate shaped plastic parts, such as can be manufactured with the injection molding and vacuum molding processes, blow molded double walled panels offer a number of advantages. Pound for pound, they are much more resistant to warping, and they are easier to keep clean due to their ribless outer shape. The investment required for molding tools is also usually considerably lower.

Detail of a garden shed made of plastic

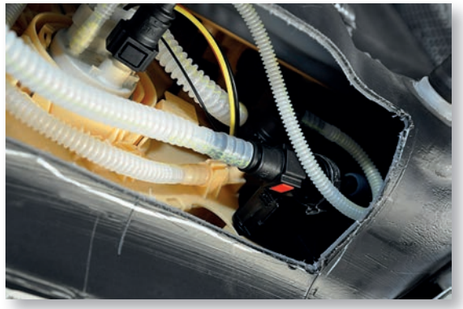
To manufacture large flat parts using the conventional blow molding process, the parison is “pre-inflated” before molding, in order to impart a sufficient diameter to it. Although the elongation caused by pre-inflation is necessary in the plane that is horizontal with respect to the mold parting line, it is undesirable in the vertical plane. In particular, it requires a very large closing stroke relative to the panel depth, and furthermore the pre-inflation air volume must be evacuated immediately before closing the mold. In order to overcome this limitation of the conventional process (and a few other limitations), the company develops a new process for blow molding large flat parts, which is patented in 2004. This novel process does not require pre-inflation, because the parison is mechanically stretched, and only in the same plane as the mold parting line. For this purpose Kautex develops specialized parison stretching pins that operate on the entire length of the parison. They are equipped with dynamic separating mechanisms, called “flying knives”, which allow the pins to be removed from the waste flash on the sides after molding is complete, without requiring space for a large vertical stroke below the closing mechanism. This novel process allows a considerably higher number of pieces to be produced per hour, is more energy efficient, and also permits more uniform wall thickness distribution than the conventional process. It is used for the first time in series production by the customer Fischer Mexico, which has manufactured covers for spare tire wells and station wagon trunk floors on a type KBS120 machine since 2006. In 2010, the good results from this production in Mexico convince the customer Suncast (USA) to use the same process – but on a considerably larger scale – to manufacture garden shed panels and deck box panels on a type KBS241 machine.

C3LS®-process

Environmental impacts from motor vehicles are being reduced step by step. These environmental impacts also include hydrocarbon emissions from gasoline vapor that escape from the fuel tank system. Although the six-layer wall of a CoEx tank provides an excellent vapor barrier, most fuel tanks have a number of functionally necessary openings, which can only be similarly well sealed with great difficulty. In addition, the fuel tank system includes some components that are outside the tank, and therefore require additional seals. In order to be prepared for even stricter limits in the future, some large fuel tank manufacturers in the 2000s are seeking solutions that will help to minimize the number of tank openings, and will also allow external components to be moved inside the fuel tank. Besides reducing emissions, these solutions aim to reduce the cost of tank production. Kautex Maschinenbau provides customized contributions to each of these solutions. At the same time, these tank manufacturers understandably place a high value on protecting their various



Excerpt from an animated film that shows the C3LS process



C3LS tank

technologies against competition. Consequently, in 2009 Kautex begins developing its own process for manufacturing fuel tanks that will meet the USA's "PZEV" (partial zero emissions vehicle) standard. In 2010, the fuel tank manufacturer VITEC, from Detroit, joins this effort as a development partner. In March 2013, the fuel tanks manufactured with the new, patented Kautex "C3LS®" process pass all of the end customer General Motors' test procedures.

KLS – Kautex Long Stroke

Starting in 2005, with the KLS series, Kautex Maschinenbau offers a range of high performance blow molding machines for manufacturing plastic bottles, and continuously develops this series. The top of the line KLS14-100D model, a true "long stroker", can produce up to 18,000 pieces per hour depending on the size of the bottles. This series has an interesting history. The first model was developed in Siegburg by Willi Müller (1937-2013), who was from Lohmar. It reached the market in 1991, and was used starting in that same year by the customer Sauer Polymertechnik in Neustadt bei Coburg. Müller sold his company in 1995 to the Battenfeld group, after which the long stroke machines were made, sold, and further developed by Battenfeld-Fischer (Troisdorf). After being taken over by the Krupp conglomerate in 1997, this company was renamed as Fischer-W. Müller Blasformtechnik (FMB). The long stroke machines were a new benchmark in the industry due to their high output, their flexibility, and the excellent bottle quality. Other machine builders copied this concept. Starting in 1998, the FMB team took a chance on replacing all of this machine's hydraulic drives with servoelectric drives. The aim was to reduce energy consumption, improve the repeatability of the movement sequences, reduce the noise burden from production, and exclude the risk of product contamination from oil leaks. However, in worldwide use, it was found in subsequent years that the new electrical drive solution was not yet mature. Customer complaints became more frequent, so that the company from Troisdorf – which meanwhile had been renamed as SIG Blowtec – was driven in 2003 to take the all-electric variants off the market. SIG Blowtec had to cease operations in 2004. At that time many experienced employees switched to Kautex Maschinenbau and continued their work on the long stroke machines unperturbed. Since then, all Blowtec customers are supported by Kautex. Starting in 2010, these sometimes painful, but still valuable experiences from the previous history of using servoelectric drives in blow molding machines contributed to the development of a completely new, now exclusively all-electric Kautex series for bottle manufacturing. This series is presented under the name "KBB" at the 2013 K Trade Fair in Düsseldorf, and since that time its introduction to the market has run smoothly.

Type KLS6-100 machine

KBB series

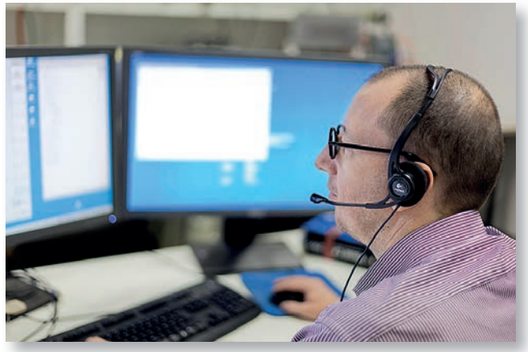
In past years, Kautex has devoted a great deal of energy and attention to expanding its technological and market leadership with respect to tank blow molding systems. This is increasingly a determining factor in the perception of the brand from outside. However, the company still sells high performance packaging machines. To make this clear, at the 2007 K Trade Fair, Kautex Maschinenbau presented a high performance machine for manufacturing HDPE bottles. The KLS6 on display has 12 cavities and produces 5,800 bottles per hour, and for the first time in three different colors at once. For the subsequent 2010 K Trade Fair, a KLS8 is presented, for the first time not as a single blow molding machine, but rather as an integral component of a complete and fully automated production line, including quality control, labeling, and palletizing. Although hydraulic systems are still used for the movement sequences in these machines, Kautex makes a decisive improvement for the 2013 K Trade Fair, and presents a machine from its new, all-electric KBB series. The KBB60 on display attracts interest, due not only to its classy appearance, but also to its smooth process movements. The machine radiates precision and perfection down to the smallest detail. Compact dimensions, extremely short cycle times, and a system for recovering energy make it a new benchmark in its market segment.

Type KBB60D machine

A new dimension of services

Customers expect responsive and helpful customer service from a modern machine building company. In the late 1990s, the consulting industry discovers this topic. Since then, it markets concepts that enable machine builders to improve their profits from the spare parts business and other segments of the customer service business.

Due to Kautex's origins, efficient customer service is in Kautex Maschinenbau's genes. The machine building division of Kautex Werke was not evaluated based on revenues from machine sales, but rather on the productivity of the Kautex plants where these machines were used. Consequently, "reliable support of the blow molders" has always been deeply and firmly fixed in the Kautex team's mentality. This takes more than just supplying spare parts. However, that by itself is already an enormous challenge: Even after decades of use in production, the necessary parts must be accurately identified and quickly delivered. This is made more difficult by the great variety of variants, technical changes made to machines after they were delivered, and the global distribution of the installation sites. In addition, methods and tools for technical documentation have been repeatedly modernized over the years, so that the replacement parts service must perform its rapid research in totally different documentation systems. Time has also not stood still for Kautex's suppliers, so that efficient replacement parts service requires good collaboration, and often creativity as well.



Remote maintenance by computer

If production is disrupted or interrupted by malfunctions or damage to the machines, high availability and a rapid response time are required. At Kautex Maschinenbau, particularly experienced technicians can be reached by day or night. When the cause is unknown, a remote diagnosis is immediately performed by the Kautex technician, who checks the machine controller via an internet connection. If a Kautex technician is needed on site to resolve the problem, he or she goes to the customer's plant as quickly as possible. To shorten travel time, the company has stationed well trained Kautex technicians in 15 different countries, and this decentralization of customer service is expanded year after year.

Kautex customers use their machines in production for several decades. With such long use times, it's worthwhile to modernize the machines from time to time. Such modernization projects require close collaboration with the customer, and first class project work on Kautex's part. The company has developed an especially qualified and experienced team for this purpose. Under the direction of outstanding "retrofit project managers", this team performs extremely diverse modernization projects, completely customized to the customer's particular requirements, and with the shortest possible interruption of production.

Technikum employee measuring a HDPE bottle

Further development of Kautex machines is always oriented towards customers' current and future production requirements. Consequently, knowledge of the end

Presentation of a virtual machine for customer training

products and the available raw materials have always been of vital importance to Kautex. To exploit and increase the potential of the production processes, Kautex Maschinenbau continuously performs tests at its Technikum in Bonn. Customers frequently commission such tests, and the customer's specialists often participate in this work. Raw materials manufacturers also take advantage of the opportunities for testing that are provided by the Kautex Technikum. In 2010, it becomes apparent that the production space available in Bonn-Holzlar is no longer sufficient to meet the increased demand for Kautex machines. The heavy equipment contractor Baumann has a new workshop available in Bonn-Hersel, which Kautex rents in summer 2010 for the following years in order to assemble large blow molding systems there, up to five systems at a time. Kautex also invests in a new Technikum, in order to expand process technical development there, and also in order to use the former Technikum's workshop for machine assembly. In March 2012, under the motto, "A New Dimension of Services", the new Technikum and the expanded customer service and development offerings are presented at an in-house exhibition to the international customer base.

In 2008, Kautex Maschinenbau decides to develop a blow molding system simulator that should make it possible to test and improve controller software with project specific settings, before commissioning the relevant real blow molding system. This should reduce commissioning times. In 2009, Kautex brings the University of Bonn/Rhein-Sieg and the Dr. Reinold Hagen Foundation on board as partners in collaboration. When the development team presents their progress in the summer of 2012, Kautex recognizes the potential for using such simulators for training purposes, both for customers' employees and its own employees. The simulators allow for hands on practice with machine settings, operation, monitoring, and troubleshooting at lower costs, with lower risks, and in a shorter time than before. In addition, customers' desired schedules can be better taken into account when planning the training project. At the 2013 K Trade Fair in Düsseldorf, a ready-to-use simulator – now called a "Kautex virtual machine" – is presented to customers for the first time. It meets with great interest, and some customers immediately declare their intention to order simulators for their own development and training purposes.

Composite pressure vessels

Over the years, blow molded plastic containers have replaced earlier glass and steel designs in many areas. The most important driver for this change is weight reduction. If the blow molded container has to withstand high internal pressure, as is the case with gas cylinders, it requires reinforcement. On behalf of the Norwegian customer Raufoss (now Hexagon Ragasco AS), in 1999, Kautex Maschinenbau had already developed and delivered a type KBS20 machine for producing a blow molded 25 liter inner container (also called a liner) for pressurized gas cylinders. In production, these liners are first cooled, provided with a unit for the cylinder valve connection, and then wrapped with resin-impregnated glass fibers, in order to achieve the required pressure resistance. Due to the increasing demand for these light, corrosion free cylinders, in 2006, Raufoss/Ragasco invests in another Kautex machine, this time of type KLS30D, with four times greater performance than the first blow molding machine.

Although in projects like this, the customer takes care of the additional process steps, Kautex Maschinenbau decides in 2006 to invest in the development of its own technology for such pressure vessels. In doing so, Kautex has its eye on the increasing demand for pressure vessels for liquefied petroleum gas (LPG) and compressed natural gas (CNG), as well as other use cases for pressure resistant plastic cylinders, for example for storing compressed air, nitrogen, water, and technical gases, or even as corrosion free housings for water filters. If extremely high pressures occur, carbon fibers are used for the reinforcing jacket. The first plastic pressure vessels have shown that, in addition to weight reduction and corrosion resistance, they also offer greater safety.

Portable gas cylinder for LPG

CNG pressure vessel

In 2010, India's leading plastic processor, Supreme Industries Ltd., orders a system from Kautex for manufacturing 400,000 gas cylinders per year (also called type IV containers) in six different sizes. This is the first project for composite cylinders, in which Kautex takes responsibility for the entire project. The Indian plant is brought into service in 2013, and handed over to Supreme as a turnkey solution.

In 2014, Kautex brings a system into service in the Bonn Technikum, with which such plastic pressure vessels can be developed and manufactured for test purposes from this time forward. Kautex now also has its own system available for the necessary burst pressure test and pressure change cycle test, so that the test results are available within a few days. In keeping with the longstanding tradition in the Kautex Technikum, these new installations are also jointly used with customers and raw materials manufacturers.

Preparing for the ninth decade

In the eighth decade, the company achieves growth that is far above the average. Between 2005 and 2011, Kautex Maschinenbau is able to more than double its revenue. In 2012, at 107 million Euros, it achieves the highest revenue figure in company history. These high volumes are achieved again in 2013 and 2014. As can be seen, the acquisition by private investors in 2004, the reconstitution of the management team in 2005, the stability that has been achieved since then in all aspects of management, and last but not least the reorganization of internal processes

Production system for composite vessels in the Technikum (detail)

in 2007-2008, have done the company good. Kautex Maschinenbau is now standing on a solid foundation for the future: Good, close relationships with customers, a highly capable team that identifies with the company and pulls together day after day for customer satisfaction, a well filled pipeline of technical innovations, an array of services that are unique in the industry, and last but not least a solid financial basis with a mortgageable equity ratio and high investor trust.

The past ten years have also been used to counteract the threat of an aging workforce. For this purpose the company has disproportionately invested in career training for junior staff, and established a new training workshop in 2015. In addition, step by step, Kautex Maschinenbau has initiated technical collaborations with various German universities. This has already led to a number of highly promising technical innovations. Additional young engineers have also found their way to Kautex along this path.

All Kautex employees share a strong interest in the success of Kautex customers, and in their own success, which depends on it. Reliability and a culture of trust are central values in the company's mission statement, which was formulated in 2012. These values form the core of the Kautex Maschinenbau

Employees in 2012

Facts and figures 2005-2014

Company

- 2005 Olaf Weiland and Andreas Lichtenauer become the senior management
- 2005 Shunde Kautex becomes a fully owned Kautex subsidiary
- 2005 Kautex conducts an in-house exhibition for the first time in years
- 2006 Renovation and expansion of the Technikum
- 2007 The first management buyout, in which five Kautex managers acquire a stake in the company, replacement of majority shareholder Adcuram (Munich) by Steadfast Capital (Frankfurt am Main)
- 2008 The process focused organization comes into force
- 2010 Kautex takes over international sales for Rikutec systems
- 2011 Opening of a sales office in Moscow, Russia
- 2012 Dedication of the new Technikum in Bonn
- 2013 Second management buyout with participation by a majority of management;

brand. Naturally Kautex management can't predict the future, and the company vision will therefore have to be repeatedly fine tuned. However, Kautex's people share the same values: The belief in technical feasibility, a sense of fun in solving problems, open and fair dealing with partners, the engagement of each individual, and good team work will continue to be the most important requirements for the company's further success. That we meet these requirements after eight decades of company history fills us with a sense of gratitude, and at the same time with a sense of obligation.

Capiton AG (Berlin) becomes new majority shareholder; the first ever participation of employees in shareholder's equity

- 2013 Dedication of the new plant in Shunde, China and opening of a sales office in Bangalore, India
- 2015 There are approximately 6,100 Kautex machines registered around the world

Machines

- 2010 Large blow molding systems for manufacturing garden shed panels
- 2010 First systems for PZEV fuel tanks: To reduce emissions values, components are installed inside the fuel tank during the blow molding process
- 2012 First suction blow molding machine with a two station design
- 2013 Introduction of the all-electric KBB series at the international plastics fair in Düsseldorf
- 2013 First seven layer CoEx fuel tank blow molding machine
- 2013 Production line for LPG composite cylinders in India (Supreme Industries Ltd.)

Technology

- 2006 "Flying Knives" as part of a process for manufacturing large flat parts
- 2010 C3LS® as a proprietary process for manufacturing PZEV fuel tanks in collaboration with the Vitec company (USA)
- 2013 Monitoring machines via smartphone or tablet with "BC Connect"
- 2013 Virtual machines for training purposes
- 2014 Prototype production of composite containers in the Technikum

Products

- 2006 Covers for trunk floors
- 2010 Deck box and garden shed panels
- 2013 Composite pressure vessels
- 2013 Seven layer CoEx fuel container

Appendix

Senior management 1976-2015

Ing. Dr. h. c.	**Reinold Hagen**	1976
Wirtsch.-Ing.	**Reinold Hagen jr.**	1976
Ing.	**Winfried Hagen**	1976
Dr.-Ing.	**Walter von der Ohe**	1976-1990
Dipl.-Kfm.	**Werner Schläder**	1977-1981
Dipl.-Ing.	**Michael Heimann**	1978-1981
Ing. (grad.)	**Arnold Hübecker**	1980-1986
Dipl.-Ök.	**Erich Wiartalla**	1981-1986
Dipl.-Kfm.	**Hartmut Kehler**	1986-1990
Dr.-Ing.	**Reiner Hegele**	1986-1988
Dr.-Ing.	**Manfred Kulik**	1986-1995
Dr.-Ing.	**Helmut Reichstein**	1988-1989
Prof. Dr.-Ing.	**Wilhelm Dalhoff**	1989-1991
Dipl.-Kfm.	**Erich Wendling**	1991-1994
Betriebsw. (grad.)	**Rudolf Tischer**	1992-1997
Dipl.-Ing.	**Werner Daubenbüchel**	1995-2000
Dipl.-Wirtsch.-Ing.	**Hans-Ludwig Dörfler**	1995
Dipl.-Ing.	**Andreas Kandt**	1997-2001
Dipl.-Ing.	**Jürgen Hagedorn**	2000-2002
Dr.-Ing.	**Roger Stehr**	2002-2004
Dipl.-Betriebsw.	**Bernhard Berger**	2004-2005
Dr.-Ing.	**Olaf Weiland**	seit 2005
Dipl.-Ing.	**Andreas Lichtenauer**	seit 2005

1947 Kautex

1950 until 1970

1979 KRUPP KAUTEX

2000 SIG BLOWTEC

2002 SIG Kautex

2004 KAUTEX MASCHINENBAU

2013 KAUTEX MASCHINENBAU

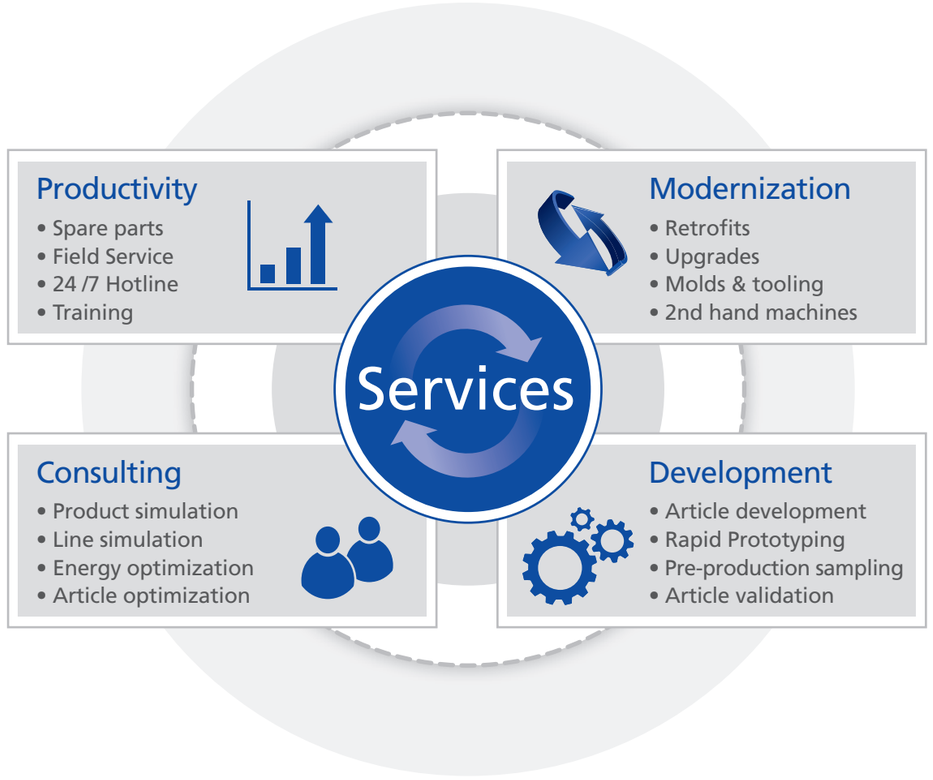
Kautex Maschinenbau - worldwide

Sales network in 83 countries

As at April 2015

Kautex Services

Local service in 15 countries



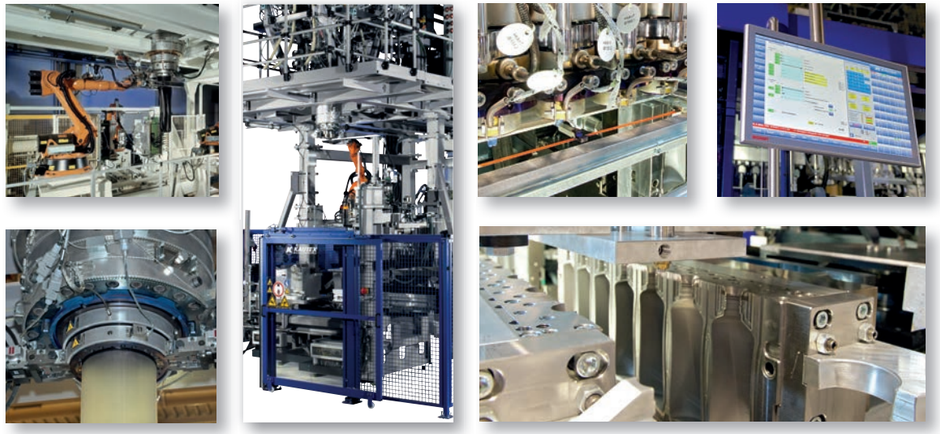
Range of products and services

Consumer Packaging — CP
KBB series
KLS series
KEB series
KCC series

Industrial Packaging — IP
KLS series
KEB series
KCC series
KBS series

Automotive — AM
KBS series
KCC series
K3D series

Specialties — SP
KBS series
KCC series
KLS series



Installed Kautex machinery

More than 6,100 active machines - worldwide

North America 9 %	
CP	244
IP	90
AM	85
SP	132
Total	551

Latin America 8 %	
CP	332
IP	113
AM	27
SP	26
Total	498

Western Europe 56 %	
CP	1.975
IP	832
AM	303
SP	277
Total	3.387

Eastern Europe 7 %	
CP	262
IP	111
AM	47
SP	25
Total	445

Asia 10 %	
CP	307
IP	129
AM	147
SP	19
Total	602

Middle East 4 %	
CP	156
IP	43
AM	11
SP	6
Total	216

Africa 5 %	
CP	258
IP	46
AM	6
SP	13
Total	323

Oceania 1 %	
CP	52
IP	25
AM	2
SP	6
Total	85

CP = Consumer Packaging
IP = Industrial Packaging
AM = Automotive
SP = Specialties

As at January 2015

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