Environment Report 1995

Contents

Henkel's contribution to the worldwide Responsible Care program

Principles and Objectives of Environmental Protection and Safety

(Concrete environmental aims make progress transparent)

As a leading company and Specialist in Applied Chemistry, Henkel accepts its responsibility to society. Henkel was one of the first companies to endorse the Business Charter for Sustainable Development of the International Chamber of Commerce. We are committed to its principles and to the chemical industry's international initiative Responsible Care.

In 1982 we published our "Principles on Environmental and Consumer Protection", in a version which was valid for the whole Henkel Group. The intervening years have seen considerable and dynamic progress in the scope, depth and success of our Eco Management System. A large number of practical examples are described in this Environment Report and its three predecessors.

We are committed to the Principles of Sustainable Development contained in the Charter of the International Chamber of Commerce. We participate in the Responsible Care program, a worldwide initiative by the chemical industry. The internationally consistent principles expressed there have been included in our corporate goals. We have therefore published an updated version of the Henkel Group's "Principles and Objectives of Environmental Protection and Safety", from which the following extracts are taken.

Our basic goal is to play a leading role in matters of environmental and consumer protection and safety; in short, we are aiming for "Eco Leadership".

The starting point is a sound understanding of our responsibility: "We are committed to developing and supplying products and systems that offer special benefits to our customers in all parts of the world. Along with this performance and quality leadership, we are committed to ecological leadership (Eco Leadership)."

Continuous improvement of environmental and health protection is a key part of the total concept. This means that Henkel supplies products and systems that are

recognized by acknowledged scientific criteria as environmentally compatible, and provides its customers with comprehensive advice on safe handling.
At the same time, the proper operation of our production processes should not represent any hazard to health or the environment. For this reason we apply uniform safety standards throughout the Group, which in some cases are stricter than current legislation.
Protecting employees from health hazards is ensured by a total occupational safety concept. The package of measures includes work organization, safety management and occupational health precautions.

Concrete environmental aims make progress transparent

We have therefore defined demanding and binding guidelines for products, production and occupational safety in our updated "Principles and Objectives of Environmental Protection and Safety". And, for the first time, we have defined concrete environmental objectives which we plan to realize in the short term. In this way we aim to increase the transparency of the process of continuous progress in environmental protection and safety, both internally and externally.
The corporate culture statements are also of great significance. Corporate culture is closely related to how employees identify with their jobs. Only motivated and creative employees will work efficiently. This is why we intend to systematically encourage and develop an understanding of environmental protection and safety. And it is therefore only logical for employees to be appraised for their contributions towards environmental protection and safety.
In the same way that we promote the systematic transfer of progressive technologies and methods throughout the Group, we also encourage our business partners and suppliers to aim for the same standards of environmental protection and safety.
Naturally we also engage in an intensive dialogue with the public. We inform the public regularly, candidly and fully: even when we have made mistakes. Questions and concerns on the part of the public are treated seriously and are responded to.
The new "Principles and Objectives of Environmental Protection and Safety" are a condensed yet nevertheless comprehensive formulation of our policy of responsible care. "Sustainable Development must give equal priority to economic, ecological and

social goals. Only economically successful companies will be able to contribute to effective environmental protection and social progress."

Dr. Wilfried Umbach

Executive Vice President

Research/Technology

Eco Management

(Principles and Objectives of Environmental Protection and Safety, New manual describes Eco Management System, Environmental policy and environmental protection organization)

Zeroing in on the target

(Feed pump switched itself on)

The goal is clear: the continuous improvement of Henkel's products and production processes. The more so when weaknesses are exposed. Henkel then needs to implement fast and appropriate measures. What happens then is illustrated with the help of five selected case histories from the Düsseldorf parent plant.

Minimization of the amounts of substances that can escape during an operational accident - irrespective of their hazard potential

During the incident in October 1994 (see Operational accident), an unexpected rise in pressure resulted in the escape of a mixture of substances through a safety relief valve. Until then, Henkel's engineers only inspected the safety relief valves and rupture disks of production lines where dangerous substances were used. These inspections have now been extended to all production lines. The substances and amounts that can escape into the atmosphere during an operational accident are registered (survey), and the possible effects are analyzed (assessment).

Depending on the result of the assessment, the next step is to install the necessary catching systems, separating devices, etc., or to implement other technical measures (realization).

Survey and assessment by the end of 1995.

Realization by the end of 1996.

Compilation of an AOX register for works wastewater

In 1993 the AOX load in the total wastewater increased (see diagram *Nickel and AOX loads in wastewater*). To allow the individual sources of AOX emissions to be determined in future, all wastewater sub-streams will now be regularly analyzed to determine their AOX content. The recorded data will serve as a basis for initiating specific measures to achieve a reduction in AOX.

Compilation of the register by the end of 1995.

Environmental protection courses for 1,600 employees each year

In a works agreement, Henkel has stipulated that not only production employees but also commercial and technical staff will undergo systematic and target-group oriented training on the subject of environmental protection by participating in basic and follow-up seminars. The number of participants has seesawed somewhat in recent years (see diagram *Environmental protection courses*). Bottlenecks have now been eliminated, so that a higher percentage of employees can successfully take part in these seminars each year.

Planned for 1995.

Construction of a new emergency management center

An emergency exercise in June, 1994, and the operational accident four months later showed that the work in the emergency staff and the cooperation with the emergency services on site could be considerably improved if sufficient accommodation and modern means of communication were available. It was therefore decided to construct a new emergency management center at the Henkel parent plant in Düsseldorf. The center will also accommodate the joint emergency headquarters of the Plant Fire Department and the Plant Security unit. The new building will enable the emergency staff to function more effectively.

Completion mid-1996.

Voluntary fire-protection inspections of 20 percent of all buildings each year

Past experience shows that fire-protection inspections considerably reduce the risk of fire. Henkel will carry out voluntary fire-protection inspections of 20 percent of all the buildings at the Düsseldorf site each year.

Inception planned for 1995.

Environment Manual: In black and white

"Work is now proceeding at speed at the Henkel site in Düsseldorf to translate the principles into practice. The Environment Manual for the parent plant should be ready at the end of 1994." When the last Environment Report was published in May, 1994, there was not much time left for the project team to meet the promised deadline. Nevertheless, the team of employees from Henkel subsidiary COGNIS GmbH and the Environmental Protection and Safety unit met their target: the Environment Manual was ready on time at the end of 1994.

New manual describes Eco Management System

The manual for the Düsseldorf site is not based on abstract considerations but is the result of close cooperation between the relevant specialist departments and the users. It describes the site's Eco Management System: the organizational structures, procedures and resources with which the requirements of environmental protection and safety are translated into operational practice.
The Environmental Protection Officers appointed by the Company for e.g. immission protection, water protection and waste play a key role. They are the central contact points for environmental protection matters, and their activities are one of the cornerstones of Eco Management at the Düsseldorf site.
As mentioned in the 1994 Environment Report, the structure of the manual is based on the DIN ISO 9001 quality standard.
This standard is subdivided into 20 elements which describe a quality management system. At the heart of the system is just one requirement: to satisfy the "customer". To achieve this, the "quality of products and services", which is often defined by means of "specifications", must be controlled and monitored by a Management System.
The parent plant's new Environment Manual makes use of this structure, although some terms are suitably modified. For instance, "Quality of products and services" has been amended to "Quality of operational environmental protection". This is largely dependent on how adverse environmental effects - from, for example, harmful substances, or the abnormal operating conditions of operational accidents - can be prevented or avoided, and how existing environmental impact can be gradually reduced.

The "specifications" for environmental protection are largely the environmental protection laws, the ordinances, the voluntary agreements with industry and the plant-internal regulations. They also include the expectations of employees and the neighbors of the plant. "Customers", in this context, are not only the buyers of a product but also the Company's neighbors and employees, as well as government agencies and political parties.

Environmental policy and environmental protection organization

A natural consequence of this extension of the meaning of the terms is that the elements of the standard must also be modified. In "Element 1", the responsibility of executive management for defining a quality policy and setting up an organization to translate this policy into practice becomes the "Responsibility for environmental policy and environmental protection organization". The Company's definition of its environmental policy, and its environmental protection organization in the Düsseldorf plant are therefore also described in Element 1 of the Environment Manual.
In the same way, other central environmental protection tasks, such as "proper and environmentally compatible operation of production lines" or measures to prevent emissions during operational accidents, can be integrated into the structure of DIN ISO 9001 and described in the Environment Manual.
Written "Environmental Procedure Instructions" form the basis for this, supplemented by work and procedure instructions from Quality Management.
The aim of the new manual is to document the Eco Management System and make it transparent, and to organize the plant-internal coordination of environmental protection activities more efficiently.
It also makes a contribution toward emphasizing employees' responsibilities with regard to environmental protection and encouraging them to consider the environmental aspects of their actions.
However, the manual is more than simply an opportunity to document systematic and modern environmental protection. It is also the basis for environmental auditing and for certification under the EU Eco Management and Audit Scheme regulation. In addition, it plays a role in gaining public acceptance of the site and therefore in securing the Company's long-term future.

Of course, the authors of the manual are well aware that its publication alone cannot guarantee the continual improvement of environmental protection in practice.
The Eco Management System must be explained at all levels of the Company, and each employee must be aware of his or her role and responsibility in translating it into practice. Only then will it be "lived" and become an accepted part of daily practice.

Enterprising employees: Rewarding ideas

At first sight it is just a simple drain stopper, but it fulfills a very important function. When liquids escape as a result of operational accidents and threaten to flow into the sewers, it can be mounted more easily and quickly than conventional stoppers. This simple change is one of many suggestions that Henkel employees have proposed with respect to environmental protection. Such suggestions, mostly based on practical experience, are of interest above all to Henkel's Suggestions unit. Over a period of many years the unit has repeatedly launched campaigns intended to stimulate and exploit the creative potential of the Company's work force. In 1980 ideas were invited on the subject of "Energy Saving", and in 1992 on "Everything Concerned with Packaging". In 1994 the campaign, during which the idea for the fast stopper was submitted, was entitled "Profitable Environmental Ideas".
The highest award ever paid by the Company for a suggestion concerned an improvement in the field of environmental protection: in 1985 Henkel paid 175,000 DM for a new template design for the manufacture of detergent boxes, because it resulted in considerable savings in board consumption.

The Suggestions unit and the Environmental Protection and Safety unit invited Henkel Group employees in Germany to submit entries to the "Profitable Environmental Ideas" campaign in the fall of last year. In particular, ideas for improvements in fields such as waste prevention and reductions in energy and water consumption were required, as were proposals that would benefit the environment by means of organizational improvements. A total of 1,344 employees, whose ideas were usually the result of a team effort, took the chance to help the environment and simultaneously win an attractive prize.

Company canteen: Serving up environmentally compatible solutions

According to a German proverb, food and drink keep body and soul together. They also give rise to good ideas, according to the Henkel employee facilities in Düsseldorf, which often receive interesting suggestions from their employees on the subject of improving environmental aspects within their department.
In a chemical company such as Henkel, in the context of environmental protection, attention is mainly focused on production and products. Nevertheless, employees in other departments are also able to point out exceptional opportunities for modifying set patterns of behavior to the benefit of the environment.

For example in the works canteen: In response to a suggestion by the customers, beverages are no longer served in plastic beakers but in glasses. Canteen employees receive regular schooling on the subject of environmental protection. They exhibit a high level of interest in making practical contributions, and they submit a large number of suggestions. Thanks to their many ideas, the volume of domestic and packaging waste has been considerably reduced during the last three years. The volume of domestic waste alone has declined from 2,470 to 910 cubic meters.
Coffee - exclusively from fair-trade projects - is supplied only in 10-liter returnable drums, cooking oil in 500-liter bulk containers, and meat and fish in returnable containers. As a result, the volume of packaging waste has been reduced by forty percent, from 1,640 to 980 cubic meters.
Employees use water and energy responsibly while preparing 7,000 meals daily. They use no more than is needed, although dishwashing alone requires 5,000 liters of drinking water each day. Waste is sorted for recycling, the use of disposable cutlery has been cut back, and environmental awareness weighs more heavily as a selection criterium in the choice of suppliers. Nowadays it is not necessarily the cheapest supplier who is chosen, but rather the one who can supply bulk containers and reusable packagings. If the supplier's place of business is nearby, this is also an advantage, because short journeys mean less gasoline consumption, and that reduces not only the pressure on resources but also emissions.

Products

Innovative ideas lead to environmentally compatible products

Natural esters: Striking oil

Without lubricants, everything would stop: no engine, hydraulic system or chain saw could run. Each year about a million metric tons of these indispensable aids ensure that everything runs smoothly. However, when they have done their job, only about two-thirds of them are properly disposed of as waste oil, or recycled. One third more than 330,000 metric tons - escapes into the environment. Lubricants seep into the soil as a result of leaks, or of spillages during filling and transfer. Or they evaporate when they become very hot - as during turning, milling and cutting operations. Conventional lubricants, which are formulated on the basis of mineral oil, degrade only slowly in the environment. This is why leading manufacturers now supply environmentally compatible products, which are used especially in sensitive sectors such as agriculture, forestry and the construction industry, when work has to be carried out near bodies of water and in water protection zones. Henkel, as the world's leading processor of natural oils and fats, supplies numerous biodegradable and toxicologically harmless basic chemicals or additives for such lubricants, for example fatty acid esters, fatty acids, emulsifiers and fatty alcohols.

Renewable raw materials as a basis for hydraulic oils

In this way, new and more environmentally compatible products are developed from renewable raw materials. Examples of such products are synthetic esters as basic liquids or additives for highly efficient hydraulic oils.

These products, which are already established in areas such as agriculture, the construction industry and the municipal sector, are subjected to practical studies by Henkel for industrial applications. In the context of a project with the German Federal Ministry of Agriculture, Henkel has been testing a readily biodegradable hydraulic oil - first of all in six forklift trucks at the Düsseldorf production facility where natural esters are manufactured as basic oils. During the next three years the oil will be subjected

to further practical tests in 17 municipalities in North Rhine Westphalia and Lower Saxony.

Practical tests in the Düsseldorf parent plant: Henkel rail employees using the new switch lubricant.

In a second practical test, Henkel is cooperating with the German Federal Ministry of Research and Education and Deutsche Bahn AG. An environmentally compatible heavy-duty lubricant for rail switches is tested, which has already been used successfully in Switzerland. The product is not affected by cold, heat or the passage of time. It can be metered easily and is very economical. The intervals between successive lubrications are two to three times as long as for conventional products. Henkel's Rail unit is testing the properties of the heavy-duty lubricant on its 41-kilometer-long rail network.
The new lubricants have already replaced some 30 percent of the conventional products used in the Federal Republic of Germany. The search for further possible applications for environmentally compatible lubricants and working fluids is being energetically pursued.

Soil decontamination: As snug as a bug

Microorganisms appreciate a warm climate, a balanced diet and well ventilated soil. When they find these conditions, they multiply much faster than usual. They also consume much more than usual, including the mineral oil with which the soil is contaminated at some locations. Although they break down the mineral oil into harmless components, this is a slow process and as many as 70 years can pass before the soil is clean again.
However, with the help of specially formulated nutrient solutions, which make the pollutants especially easy to digest for these tiny life forms, soil contaminated by hydrocarbons can be decontaminated very quickly and cost-effectively (see Environment Report 1994, *Soil decontamination*).

Soil under gasoline stations is often contaminated by oil

This process is of particular interest for operators of German gasoline stations. Legislation has been enacted under which they are obliged to convert their gasoline tanks into environmentally compatible gas recirculation filling stations by the year 2000. This will involve expensive earth-moving operations. In most cases the soil is heavily contaminated by gasoline and oil residues, and experts estimate that the affected 18,800 gasoline stations will yield some 1.9 million metric tons of soil which will have to be cleaned up. From 10 to 200 metric tons of soil have to be decontaminated per gasoline station.

Previously the usual practice was to restore the soil on-site in land farms, or off-site in treatment centers. For gasoline station owners, neither type of disposal option is satisfactory. The land farming methods are only economically feasible for large volumes. Treatment in stationary systems often involves long and costly transport routes. Thanks to a new system developed by Henkel subsidiary COGNIS, the restoration of these small volumes is no longer a problem. "Soil box" is the magic word.

This is the name given to a mobile container system, in which the microorganisms can restore the contaminated soil under optimal conditions. Each unit consists of up to twelve modified standard containers, joined by flexible tubing to a utility container, which forms the heart of the system. The utility container houses all the key systems needed by the process (electricity, ventilation, heating, measuring instruments, and an exhaust gas purification system for safety). In this way the cleaning up process is largely automated, and there is no need to carry out intensive supervision.

For the microorganisms to feel at home and function efficiently in the soil box, their surroundings must be just right, i.e. moist, warm and well ventilated. Above all, the microorganisms need nutrients and a balanced, moist environment. The bacteria are provided with either a COGNIS liquid nutrient product, which takes effect immediately (see Royal reward: Inventor prize for nutrient cocktail), or a granulated nutrient, which releases its active agents gradually.

In addition, external air is drawn into the soil box, so that the soil is well ventilated. During the cooler months of the year the air is heated.

If their surroundings are optimally adjusted, the microorganisms do their work rapidly. As an example, 140 metric tons of oil-contaminated soil from a gasoline station were treated in this way. In under six weeks the microorganisms reduced the proportion of hydrocarbons from the initial level of 3,000 - 6,000 milligrams per kilogram soil to just 500. In this case they excelled themselves; usually about three months are needed to clean up this volume of soil.
No transportation, faster degradation of pollutants, lower costs, simple handling - the advantages of the new system are obvious. Restorers of contaminated soil in Germany usually have to obtain approval for their treatment systems. However, under German pollution control legislation, mobile systems such as the soil box are exempted from this requirement, provided the restoration does not take more than 12 months.

Royal reward: Inventor prize for nutrient cocktail

(Soil under gasoline stations is often contaminated by oil)
At Christmas 1993 the Rhine overflowed its banks in Cologne and flooded parts of the city and the surrounding region. The water caused considerable damage. Domestic fuel tanks in flooded cellars developed leaks. Some of the oil seeped into gardens. The subsequent rapid cleanup of the soil was partly due to an ecologically harmless active agent concentrate for microorganisms, which was developed by Henkel subsidiary COGNIS GmbH. The product accelerated the biodegradation of pollutants - above all mineral oil in the soil (see Soil decontamination).

Prince Albert of Monaco presented inventor prize

The fact that COGNIS was awarded this special prize in December 1994 was due in no small measure to the unconventional application of the product. Prince Albert of Monaco honored the inventor of the active agent concentrate with the European inventor prize for the successful assimilation of the product in the market. A scientific committee, the Geneva "Salon International des Inventions", selected a total of three prize winners from 153 submitted patents from 15 countries, all of them relating to environmental protection.

New tanning process: KO for chromium

Leather is used everywhere: for shoes, clothing, furniture, shopping bags, etc. But despite its popularity with consumers, it does pose problems for the environment. This is because of the tanning process, or more specifically the chromium salts used in the production of leather. Residues of this heavy metals remain in the leather and in the wastewater. To ensure that neither skin nor water comes into contact with chromium in future, Henkel has developed its new wet-white tanning process. Today, pale shades of leather can also be produced in an environmentally compatible manner by tanning with zeolites. Versions of these sodium aluminum silicates with specially tailored properties are available for use in the production of leather.
During conventional tanning processes, chromium-containing substances accumulate in the skins and cross-link the skin fibers. This bonds the material of the skin, and improves its utility and wear properties. A durable leather is produced. The tanning process can now also be carried out with zeolites, and the results are good. The leather retains its shape, is colorneutral, and can be readily machine processed. Its ageing resistance has already been confirmed in long-term studies. Furthermore, products made from wet-white leathers contain much lower levels of residual tanning agent than conventional products.
This finds favor with customers, who are increasingly turning to leathers made by more environmentally compatible methods and marked with an "eco-leather" label. Visible proof of the increasing importance of not only the quality of a product but also the environmentally responsible method by which it was manufactured.
One secondary ecological effect: waste leather which has been tanned by the new process, and therefore does not contain any heavy metals, is suitable for use as, for example, a slow-acting nitrogen fertilizer.

Recovering copper: A mine of information

What do Henkel product developers and application technicians in the Mining department of the Organic Specialty Chemicals Division mean when they talk about "stripping"? Certainly not a barely clad dancer. They are referring to the primary extraction of copper from crude ores: stripping is one of the three stages of wet chemical processing. It follows selective extraction (stage 1), in which an impure copper-containing solution undergoes concentration, and converts the ore into an

acidic solution. In stage 3, electrolysis, metallic copper is extracted in a very pure quality from the concentrated pure copper solution. For many years Henkel has supplied tailor-made reagents for the extraction of this valuable metal. They are used in all three process stages as liquid ion exchangers, and guarantee a high yield. This type of copper extraction, which is referred to by specialists as hydrometallurgy, is carried out in closed cycles, in which the reagent is regenerated and reused. In this way copper can be extracted in an environmentally compatible and economical manner from crude ores that contain less than one percent of the metal. In the Western world there are some 30 facilities which use Henkel reagents in their extraction processes, producing about 800,000 metric tons of pure copper each year. This figure will increase considerably during the next four years.

However, these reagents are not only outstandingly successful in the extraction of copper from crude ores. They are also gaining in importance in connection with the recycling of useful materials. For instance, in the processing of the copper-containing scrap produced in the electrical, electronic and metal processing industries. Or in the recovery of copper from the ammoniacal etching solutions left over from the manufacture of printed circuit boards for the computer industry. Such solutions have a very high copper content of 150 grams per liter.

The recovery techniques which have been used until now consume large amounts of energy and deliver a poor quality end product. This contrasts with Henkel's liquid ion-exchanger, which easily removes almost all the copper from the used solutions and yields a very pure secondary raw material, without expending much energy.
The decoppered etching solution can be fed back into the process cycle, or used to digest other copper-containing sources of secondary raw materials.
All these successes have failed to satisfy the product developers. Even the best product and the best process can always be improved. Henkel specialists are now working on a project to improve the whole process even more, so that the already low level of energy consumption can be reduced still further. This will also open the way to using the extraction technique to recycle more valuable metals, thereby helping to conserve valuable raw material resources. Valuable metals with a variety of different origins, which can now only be processed with difficulty or not at all, will also become accessible to this method.

Newcomers: Environmentally compatible esterquats

Not the easiest of terms for a non-chemist! It can, however, be split up into its components to allow it to be read more easily: Di(stearoyl-oxethyl)-hydroxyethyl-methyl-ammonium-methosulfate. Henkel, as a manufacturer of hair conditioning rinses, hair conditioners and fabric softeners for laundry, rates this class of substances very highly. The quaternary ammonium compounds with an ester bond, which specialists refer to as esterquats for short, replace cationic, long-chain, quaternary ammonium compounds (QACs), which rinse just as soft but are harder on the environment.
Esterquats have two major ecological advantages over conventional QACs. Firstly, they are readily and completely biodegradable, even under anaerobic conditions. And secondly, they are less toxic to water organisms. This clearly gives them a much superior ecological profile.
And that is not all. Hair conditioners that contain esterquats exhibit better skin compatibility than conditioning preparations that contain conventional ammonium compounds.
The new products are manufactured by the Spanish subsidiary Pulcra in Barcelona, and are distributed worldwide by the Group's Cospha organization.

Prize for the best scientific documentation

The technical product brochure on esterquats won the Italian association of cosmetic chemists' "Premio Valentino Facchino" prize for the best scientific documentation on new cosmetic basic substances. This was the second time in succession that Henkel took this award, and it was a fitting recognition of the comprehensive studies on toxicology, dermatology, ecology and applicational safety, and their presentation in a readily understandable form.

Solvent-free contact adhesives: It was worth the effort

What attributes are needed by a developer of adhesive products? Specialist skills of course - but also a lot of patience. Sometimes a developer may even have to wait for years before all customer demands have been met and he can present his new

product. Henkel's new contact adhesive, which is completely free of solvents, is a good example of this. It took some ten years to develop.
High demands are made on contact adhesives. They have to bond the most widely varied materials as quickly and firmly as possible. Whether plastic and leather, or wood and iron. The solvent-free contact adhesive also exhibits the expected high initial and final strength. Of course, it cannot act as quickly as a solvent-based product. Whereas a solvent evaporates within ten minutes, the new water-based contact adhesive needs twice as long before it can be pressed together. On the other hand it can even bond Styropor, is odorless, and even gives good wet-adhesion results.

Disposing of disposal problems: Less packaging - more environmental protection

Visitors to the Henkel stand at the specialist paint fair Spectrum '94 in Erfurt (Thuringia) looked on with amazement as they were shown how 5,000 grams of ready-to-use dispersion adhesive for wall coverings can be conjured out of 1,000 grams of powder. This had nothing to do with magic, of course, but was the result of intensive research into how to achieve even greater reductions in the amount of packaging materials used. The result was a powdered concentrate which is supplied in folding boxes and is mixed with water to give the required volume just before it is needed.
The amount of adhesive that can be mixed from one box of concentrate is equivalent to several times its weight and volume of ready-to-use dispersion adhesive. Far fewer trips are needed to transport the concentrate compared with the ready-to-use adhesive, so less fuel is used. And there is less waste. The empty cardboard boxes can be disposed of as domestic waste.
Anyone who, for reasons of time or convenience, still wants to resort to the familiar ready-to-use dispersion adhesives in cans or buckets can now do this with a clear conscience. Not only the large buckets but also most smaller types of container are now made from recycled plastic, which means that the material has already gone through a previous life as, for example, a beer crate or some other form of plastic container.

Recycling of cans and buckets

The recyclate packagings can be fed back into the recycling circuit after use, and again processed into packaging materials. The jacket of an adhesive pen no longer needs to go through this cycle. The new generation of this solvent-free adhesive for paper and board will be supplied in a jacket that can be reloaded in a matter of seconds. That means a 70-percent saving in plastic. Plastic buckets and bottles for wood glue have also left the recycling carousel, because since recently they, too, can be refilled. Wood glue is now supplied in tubular bags for the purposes of refilling and direct processing. The tubular bags are much more environmentally compatible than the plastic containers, generating some 90 percent less packaging waste.
Special tubular bags have also helped Industrial Adhesives. Customers who used Henkel hotmelt adhesives had a major problem with the packaging. Hotmelt adhesives, which are used for applications such as attaching labels to a wide variety of materials, or bonding different layers in modern diapers, cannot be transported as granulates in paper sacks, because sooner or later they will fuse together. For this reason they were delivered in boxes, which were lined with silicone paper. The problem was: the silicone paper was difficult to recycle.
A new make-up and packaging method, developed by Henkel, solved this problem in a simple manner. A thin polyolefin sheet is welded together at the filling machine to form a tube, and this is filled with the hot, liquid adhesive. Ultimately nothing remains of the packaging because the customer can feed the tubular bag together with its contents into the melting tank, where the bag dissolves without leaving any residue.

Finely graduated cooling of the melt

Of course, the new method is not as simple as the above description makes it appear. In particular, the different melting temperatures taxed the ingenuity of the specialists from Process Technology, Product Development, Production and Plant Engineering. Because the melting temperature of the sheet is significantly lower than the temperature of the melted adhesive, a process had to be developed that would guarantee not only finely graduated cooling of the melt but also rapid heat dissipation to protect the sheet. In addition, the thermally and mechanically tubed bag needed a cooling system that would bring it to the correct temperature as gently as possible.

After twelve months of development work, in the spring of 1994 the experts were able to come up with a result that satisfied everyone. In April the first tubular bags with hotmelt adhesives were launched onto the market.
No painstaking development work but simply a lot of hard thought was needed to effect a considerable cutback in the amount of material in the packaging of dishwashing agents and hair-care preparations. A dishwashing agent was marketed in tablet form and as a compact powder in a refill pack made from paper (which, of course, was made from pulp bleached without chlorine). This reduced the amount of packaging by about 80 percent. The associated rinse aid is available in a plastic bottle, which is made from 30 percent less plastic.
Familiar manual dishwashing agents have also been available for quite a while in innovative refill boxes with enhanced environmental compatibility: the plastic bottles used in the home can be refilled and used again.

Plastic is not used at all in the transport packaging of small sales units of products such as hair dyes and hair waving agents. The trade takes both products, which are always packaged in folding boxes, in small units rather than cases. They were previously enclosed by plastic sheeting to facilitate their transport.
Today package bands, provided with sealing wax, hold the products together. In terms of weight there is little difference, but the disposal of 35 metric tons of paper and three metric tons of sealing wax is much simpler than the disposal of 39 metric tons of plastic.

Compact detergents: An even better second generation

Compact detergents are convenient in a number of respects. Much more can be achieved with very small amounts of detergent than with conventional products. This is more than a matter of simple detergent power. For the environment in particular, less means more. Each gram less detergent means less washing active agents in wastewater.
Packaging costs are also much lower. Consumers could see this clearly with their own eyes when the first compacts were launched onto the market in the early nineties: the normal detergents looked like Goliaths alongside the small compact David.

Despite this success, Henkel felt that it could still do more. Instead of resting on their laurels, the detergent specialists looked for ways to compact the compacts - the Supras - even further, and to achieve superior washing results with still less detergent.
Since July 1994, the result of Henkel's continued development work has been available in Germany: Persil Megaperls - a compact detergent with even better properties (see Environment Report 1994). The margin of superiority to its predecessors is so great that experts speak of a new generation of compact detergents.
The major difference to the Supras is in the recommended dosage. This has been reduced by 20 percent by weight and 40 percent by volume. Packet for packet, the performance of the new product is equivalent to that of the Supras, but it needs 27 percent less packaging material.

Less energy for compact packagings

Henkel has compiled eco balances for various packagings. A comparison of the amounts of energy needed to manufacture the packagings shows that there is one clear winner. The energy needed to produce a three-kilogram packet of a conventional detergent is 0.302 megajoules (MJ) per washing cycle; the equivalent figures for a two-kilogram packet of Supra and a 1.6-kilogram packet of Megaperls are, respectively, 0.216 MJ and 0.178 MJ. This latter figure is just over half of that for normal packets.
Smaller packets take up less shipping space. That is to say, they take up less space on transport pallets. In figures: whereas 192 packets of Supra could previously be shipped on one pallet, today 288 packets of Persil Megaperls can be accommodated. This means that each pallet of Persil Megaperls packets transports enough detergent for about 2,000 more washing cycles.

Ecological benefits in the field of transport

The comparison with conventional detergents is even more impressive. Persil Megaperls use 55 percent less packaging material while achieving a 74 percent higher pallet occupation. Of course, Henkel no longer delivers most of these pallets by road but rather, in accordance with the eco logistics concept, by rail (see

Environment Report 1994, *Environment Manual*). The eco balance data on energy consumption for transport from the production line to the trade also clearly underline the ecological benefits of Persil Megaperls. The energy required to ship conventional powdered detergents by rail is 0.024 MJ per washing cycle (the equivalent figure for transport by road was 0.039), whereas for Supras it is 0.016 (by road 0.027) and for the new generation of compact detergents 0.012 (by road 0.020). This means that the energy consumed within a transport system has been halved.
The amount of detergent savings is also impressive. In Germany, for instance, Henkel recommends a dosage of 80 grams Persil Megaperls per washing cycle (water hardness range III). To achieve the same result, 105 grams of Persil Supra and 151 grams of conventional Persil would be needed (see diagram *Detergent dosages, e.g. Persil*).

Lower loads in wastewater

Thanks to the smaller dosages, smaller amounts of detergent components find their way into wastewater (24 percent and 47 percent less in comparison with, respectively, Persil Supra and conventional Persil). Organic components (for example surfactants) are broken down or eliminated in sewage treatment plants, and are therefore never discharged into rivers, etc.

Although some anionic LAS surfactants (Anionic Surfactants), which are manufactured from petrochemicals are still used for some applications, this does not detract from this positive total balance. LAS, together with surfactants such as FAS, which are based on renewable raw materials, is one of the components of Persil Megaperls. It is included in the formulation for technical reasons. Internationally recognized studies have shown that LAS is biodegradable, although more slowly than FAS surfactants. Product developers already have their sights on the next target: a substitute for LAS.

Production

One thing is sure: safety will continue to take precedence

Saving energy: Teamwork is more effective

For more than a decade, with lots of energy - and a lot of detective work - Henkel has been tracing the "holes" through which, day by day, energy disappears.
After the second energy crisis of 1979/1980, the first energy teams took up the hunt for ways of cutting down on electricity, steam and water consumption at the Henkel site in Düsseldorf. Seven years later, in August 1987, the Henkel in-house magazine reported that "Plant energy teams were able to save seven-digit sums." Sometimes in small steps, but always successfully.
One of these small steps in the right direction led the team to the steam pipelines. At locations where repairs had often been carried out, the original insulation layer was usually missing. This was because it was difficult to remove, and when removed it was also difficult to put back into place. A more easily mountable heat insulation system solved this problem.

Changes to small devices with large effects

Really large savings were brought about by small changes to no less small devices, namely the steam traps, which collect hot water from the steam pipes and allow it to drain off in a controlled manner.
In 1983 there were almost 10,000 steam traps in the Düsseldorf site alone. The constant stress to which they were subjected meant that a quarter of them suffered defects during the course of the year. As a result some 50 metric tons of steam were lost per hour. A sophisticated maintenance and service system reduced the drop-out rate to less than four percent. The inspections revealed not only defective but also inefficient drains. These were gradually replaced by more suitable models.
This steam trap service has proved its worth elsewhere. Today such traps are inspected regularly in Genthin, Raciborz (Poland) and Gebze (Turkey).
The Düsseldorf energy team is proud of the waste-heat steam generator. They use the waste heat from production processes, which was previously dissipated into the

environment, to generate steam and electricity. One example is the water glass factory, where eleven metric tons of steam and 250 kilowatts of electricity are generated per hour. This is enough to provide 50 three-person households with power from the mains.

Steam consumption stationary, electricity consumption rising

Although production and administration have expanded, steam consumption has remained stationary in recent years, owing to the numerous efficiency measures which have been taken. Electricity consumption, on the other hand, has steadily increased. One of the reasons is that ever more machines have been purchased for administration, laboratories, and research and product development. These machines - computers, air conditioning systems, measuring instruments - use a lot of electricity.

Power consumption has increased in production processes as a result of increasing automation. And environmental protection also needs electricity, without which filters, fans and cooling towers would be unable to function.

The Henkel Group now has 14 energy teams, whose members include plant engineers, plant superintendents and occasionally managers. If even the smallest leak is to be traced, it is essential that a continuous dialog is maintained between all plants.

Genthin: The team was able to achieve a great deal by implementing a number of simple measures. Although many production lines had been taken out of operation as a consequence of restructuring (see *Environmental protection in Genthin*), the supply pipelines were still under steam. But only until the energy team came and closed them down.

No more useless hot air

Insulation of the remaining pipelines now prevents any further heat losses. Steam is also saved by more efficient recycling of condensate (increase from 25 to 43 percent). The hot exhaust gases (200 degrees Celsius) from the boiler unit are also recycled. Instead of dissipating uselessly into the atmosphere, they are used in the detergent production line.

Raciborz: About three years ago, Henkel acquired an 80-percent stake in the previously state-owned enterprise Pollena Raciborz in the south of Poland. Since then, Henkel Raciborz has been producing detergents and cleaning agents - using as little energy as possible. The Düsseldorf energy team helped the Poles to get started. Again, it was relatively simple measures which helped to reduce steam consumption by 23 percent, despite a 40-percent increase in production in 1993. Thermal insulation and the closing down of unused sections of steam pipelines reduced steam consumption peaks by 60 percent.
Gebze: Türk Henkel in Gebze has had its own energy team since late 1989. Its successes include the savings achieved in fuel oil consumption. Although production increased from 32,244 to 42,989 metric tons between 1989 and 1992, fuel oil consumption fell from 1,493 to 1,180 metric tons during the same period. The reasons: improved heat insulation, a reduction in the temperature level, and a cutoff temperature of ten degrees Celsius for the heating.

Optimized cleaning saves water in production

Izmir: The reduction in water consumption was a high spot in the story of the energy team established in 1993 at Turyag, Henkel's second Turkish subsidiary, located in Izmir. Piped water is often so scarce in Izmir that the waterworks cut off the connections in the hot summer months. For this reason the achievement of economies in water consumption in the production sector was a top priority in Izmir. Cleaning was optimized, and the detergent packing shop and the refinery use only cooling tower water instead of fresh water for their vacuum pumps and centrifuges. Turyag saved most water, however, by reducing its steam consumption. The measures taken to achieve this included heat recovery in the boiler unit, recycling of condensate throughout the whole facility, and the provision of heat insulation on the pipelines. Because well over half the fresh water consumed at the site is used to generate steam, the drop of 20 percent in steam consumption was largely responsible for the 30-percent reduction in water consumption.
Fino Mornasco: Together with specialists from Düsseldorf, the energy team of Henkel SpA developed a special energy-saving plan for the Italian chemical products facility in Fino Mornasco. A number of energy-saving measures have already been put into practice within the context of this program. Examples include improved heat recovery

in the ethylene oxide line, and the reduction in hot water consumption at the site. Among the other economy measures are improved heat insulation of the pipelines, and the use of efficient steam traps.
The successes, whether great or small, which have been scored in recent years act as a daily incentive for team members in Germany and other countries to achieve still more. They know that what counts above all in their work is continuity, persistent and methodical effort, and know-how. They intend to spread the message throughout the world. They know that large savings can be achieved in energy consumption in, for example, Mexico, China and Thailand. In this way the Group can not only reduce its production costs but also make an active contribution to manufacturing its products in an environmentally compatible and sustainable manner.

Water savings: Every drop counts

It requires a lot of imagination to be able to visualize the volume of potable water that is used at Henkel's Düsseldorf site each year: 800,000 cubic meters. This is equivalent to 80 million ten-liter buckets of water. An even greater volume of process water is used - almost six million cubic meters - for purposes such as cooling, cleaning, steam generation, and production. If all this water were put into ten-liter buckets and stood next to each other, there would be enough buckets to go four times round the earth.
No wonder Henkel wants to economize on more than one or two buckets of water. Consumption of potable water has currently settled at the 800,000 cubic meters given above, which is almost 48 percent less than 25 years ago. Nevertheless, further savings will be made.
In the early Seventies, water was used almost without thought. After all, it did not cost much to buy. Nor was it very expensive to dispose of. Today the Company has to dig deep into its pocket for both. Sewage costs alone have increased almost fourfold during the last two decades. This is why Henkel's experts - especially the energy teams - are looking for opportunities of cutting back on water consumption.
Appeals to employees to be economical in their use of the valuable resource water play an important part here, just as the development of new methods. For example with regard to the operation of air conditioning systems.

These are currently cooled with potable water. Process water cannot yet be used for this purpose because it does not have the high level of purity of potable water. When a long-term study is concluded at the end of 1995, it should be possible to solve this problem by installing upstream water filters, thus saving 20 percent potable water. The only other areas supplied with potable water are the hygiene and staff facilities, the canteens and the administration building.
Reductions in process water consumption are and were on a much larger scale. Despite increased production, during the last twenty-five years Henkel has been able to reduce its consumption to the level of 1960 - from almost 12 to less than 6 million cubic meters per year. A large part of this success is attributable to a process which is now a standard feature of new production lines, but had to be gradually introduced into older ones during past years: closed-circuit cycling of the water in cooling towers.

Process water flows in a closed circuit

Process water was previously used only once and then discharged into the drains. Today it is passed through a cooling tower and then recirculated to the production line. This has resulted in a dramatic cut in consumption, because only the water which is lost through evaporation has to be replaced. This is no more than two percent of the circulation volume.
Considerable successes have also been achieved in recent years with the recirculation of steam condensate. Most of the hot condensate formed from the steam used to flow into the drains after its passage through the production line, irrespective of whether it was clean or contaminated with oils, fats or soil.

Henkel saves considerable amounts of process water each year by recirculating water in the cooling tower and by recycling condensates.

Today, an analyzer decides the fate of the condensates. Those which are pure enough are recirculated, while those which are polluted, including some which have been used for cleaning, are discharged into the drains. In 1994, 42 percent of condensates were recirculated in this way. In 1995 this will increase to 46 percent. The target is a recirculation rate of 50 percent, equivalent to 900,000 cubic meters of process water.

Here too, the specialists in the power plants have continued to look for new ideas. Circulation water which is first used, for example, to cool production plant, may be reused for cleaning production plant the second time around. Or it may be collected for purification before being used again in production or for steam generation. In this way, circulation water can be used at least twice and in many cases three times. Energy specialists saw a considerable potential for achieving cuts in circulation water consumption. In 1994, 1.2 million cubic meters of water was recirculated; in 1995 this will be 1.5 million.

Power plant uses most water

Economy measures are of special significance for the experts who are responsible for the Düsseldorf site's own power plant. This is because more water is used during its operation than anywhere else in the whole facility: 2.8 million cubic meters per annum are treated there for the purpose of steam generation. The treatment consists of filtration, softening and deionization. Only 300,000 cubic meters of the deionized water are used for production; the larger proportion is converted to steam.

Subsidiaries also economize on potable water

The drive to economize on water consumption is not restricted to the Düsseldorf site. For example, the Henkel subsidiary Gerhard Collardin in Herborn-Schönbach/Hesse, Germany, has cut back on consumption of potable water by means of a simple but effective measure.
The small company in Westerwald produces surface-treatment chemicals. Heat is generated during the manufacturing processes. The mixing and reaction tanks were previously cooled with potable water, which was used only once before flowing into the municipal sewerage. Today the cooling water streams, which differ in volume and temperature, are collected in a buffer tank, purified to high quality, deionized water, and used again in production. The heat is also exploited. With the help of a heat exchanger, the initial feed temperature for the generation of hot water can be raised from 10 to 15 degrees. Thanks to the new process, the Henkel subsidiary has cut its annual consumption of potable water and fuel oil by, respectively, 7,500 cubic meters and 6,000 liters.

Water pollution control: Little things mean a lot

Henkel has steadily improved its facilities for the treatment of plant wastewater and aims to optimize them still further. For example, at the sulfur works at the main Düsseldorf site. In the fall of 1994 a wastewater equalizing tank was installed there, which protects not only the central wastewater safety plant at the main Düsseldorf site but also the municipal sewage treatment plant, where Henkel's wastewater is purified, from foam surges.

New equalizing tank collects wastewater

In the past, especially after strongly foaming surfactants had been processed, it was possible for foam to form suddenly in the works wastewater, even though the applicable concentration limits were not exceeded.
The cause: Although the concentration of anionic surfactants in the production wastewater was continuously measured, there was a delay before the analysis results were ready. Before the foam-generating surfactant components were detected, part of the wastewater had flowed from the production line into the works sewage network. All the wastewater is now collected in the new equalizing tank, so that this can no longer happen. If the analyzer sends an alarm signal, the outflow can be closed in good time and the more strongly polluted wastewater can be collected within the plant. The wastewater is then disposed of in an environmentally acceptable manner at a later stage.
Since 1990 the Henkel subsidiary Kepec, in the Rhenish town of Siegburg, has been able to accommodate polluted wastewater in collecting tanks when operational accidents occur. With the help of a new automatic TOC measuring instrument, it is now possible to determine whether the total organic carbon content of the wastewater is unacceptably high.

The instrument, which operates continuously day and night, analyzes the content of organic compounds in the interceptor collector before the wastewater leaves the works. If the limiting value is exceeded, the main sewer is closed off automatically and the wastewater is channeled into the collector tank. Thanks to the TOC instrument, uncontrolled leaks can now be detected much faster. In the event of a

fire, the contaminated firefighting water would be held in the collector tank until it could be cleanly disposed of.

Expansion of sewage treatment plant in France

Water pollution control is of great importance not only in Germany but also at the foreign subsidiaries.
Sidobre-Sinnova in Meaux, France: Production has increased during the last ten years - as, therefore, have wastewater loads. The capacity of the biological sewage treatment plant built in 1981 was no longer adequate. In 1994, it was considerably expanded. Far-reaching changes were undertaken in line with a total concept developed jointly by Henkel subsidiary COGNIS and Sidobre-Sinnova. The preliminary treatment stage was extended by a collector tank with a sieve system to remove solids, and by two homogenizing tanks and a buffer tank. In emergencies, one of these tanks can be used to hold strongly polluted wastewater.

Poorly degradable substances reduced to a greater extent

The biological pretreatment stages were doubled and fitted with highly efficient submersed aerators. A new, larger, final sedimentation tank separates the water from the activ sludge. Not only has this expanded plant reduced energy costs but, above all, it also reduces poorly degradable wastewater components more efficiently.

95 percent less organic substances

During the secondary treatment stage, a decanter lowers the water content of the excess biological sludge which is present. A new buffer tank was also constructed, which can accommodate some 1,200 cubic meters of firefighting water if necessary, as well as contaminated cooling water resulting from operational accidents. The operators of the biological sewage treatment plant expect that the expansion will result in a 95-percent reduction in the amount of organic substances in the wastewater. On the basis of the favorable results of a comprehensive expert opinion, the sewage sludge can now even be used as agricultural fertilizer.

More safety: Tank farms and filling sites

Not only Henkel's production lines are subject to strict safety inspections but also the associated tank farms and filling sites. At the main Düsseldorf site, filling operations involving potential water polluting liquids are only carried out over areas that are impermeable and resistant to these substances. Henkel's specialists cooperated with the experts from a company with wide experience in this field to develop a modular system of catch pots, large-area plates, channels and pits, which can be adapted to take account of the position of the filling site and the operational conditions.

Safe pumping in production

This safety system is part of a comprehensive modernization concept for tank farms and filling sites, which has been implemented since 1992. At filling sites, liquid raw materials are removed from tank trucks or rail tank cars and pumped into the production locations. Many of Henkel's finished products follow the reverse route.

The properties of some substances are such that they require special attention. For example, volatile organic solvents. All sites at which these substances are transferred must be fitted with a gas recirculation system. This prevents vapors from escaping during the filling and discharge operations. When substances with an intense odor are pumped, the displacement air is fed into the central exhaust gas incineration system. The responsible controlling body inspects all filling sites at the Henkel site. It is only satisfied if it can be proved that the drip trays are impermeable and resistant to all substances that can escape through leakage, and that they have a sufficiently large retention volume.
The modernization concept of the old tank farms sets priorities. Of a total of 29 tank farms, 16 have been assigned priority I. Most of these now conform to the latest safety requirements and have been approved by the controlling body in Düsseldorf. Official approval of the planned restructuring measures has yet to be obtained for some tank farms. Two priority II tank farms have already been brought into line with the latest requirements. The others will follow in the coming years.

New drum store: Investment in safety

When employees of the Rhenish subsidiary Kepec in Siegburg-Stallberg talk about the "Brandenburg Gate", they certainly do not mean the famous Berlin landmark. Their "Brandenburg Gate" is a new fireproof gate which, together with fireproof walls, provides a lot more safety on the plant site.
The gate and walls belong to a new drum store in which, since late October last year, flammable liquids and intermediate products have been stored in drums or fireproof containers in an area covering some 500 square meters.
The new outdoor store can hold up to 200 cubic meters of liquid in 1,000 drums. It can be sealed off within a few seconds. As soon as one of eight infrared sensors detects a fire, the sliding gate closes automatically. The Siegburg municipal fire department, with which the facility is linked round the clock by a fire monitoring and signalling system, is simultaneously alarmed.

New store provides double safety

Two gas alarm devices register even the smallest change in the composition of the air in the drum store, and sound the alarm immediately if flammable vapors escape. The new store is not only safe in cases of fire. Leaking drums cannot cause any harm, because they stand on a more than 25 cm thick floor of special concrete, which lets not the smallest drop through. If large amounts of liquid were to escape by accident, they could not seep into the environment. They would be collected in a pit with a capacity of 20,000 liters. Its sealed surface is resistant to acids and lyes.
The construction of the new store was simply one of the many environmental protection measures implemented by Kepec. The Henkel subsidiary has invested large sums during the last five years to prevent any pollution of air, water or soil. One example from earlier years is the bioscrubber, in which up to 30,000 cubic meters of exhaust gas are purified (Environment Report 1993, catchword *Microorganisms in the bioscrubber*).

Environmental protection in Ferentino: Ambitious aims for the future

Ferentino is a small town to the south of Rome. Henkel SpA has produced powdered detergents there since 1973. During recent years a fresh wind has blown through the company. The Ferentino production site was extended and made into the central storage and distribution center for powdered and liquid products in southern Italy.

Plant wastewater is doubly purified

The management of the Italian Henkel subsidiary took advantage of this extension and used it to improve safety. The major production lines were equipped with sprinkler systems, and a retention tank was constructed, with a capacity of 1,000 cubic meters, which can intercept and hold firefighting water until it can be purified in the facility's own sewage treatment plant.
The sewage treatment plant has both a chemical and a biological treatment stage. It purifies up to 40 cubic meters of production wastewater per hour. In 1994 this amounted to 93,802 cubic meters.
In Ferentino too, safety and environmental protection are key aspects of production. Considerable successes were achieved during the last ten years. Emissions were cut significantly. The switch from heavy fuel oil to natural gas in the power plant in 1986 enabled sulfur dioxide emissions to be cut by more than 98 percent, and nitrogen oxide emissions by 40 percent.

Henkel's Italian subsidiary also has ambitious plans for the near future in the field of plant environmental protection. Alongside the marketing of environmentally compatible products, it is now focusing more strongly on environmentally compatible production. This will be based on facility-wide balances for all energy and material streams: fuels, electricity, water, air, raw materials and packagings. These form the basis for the environmental aims of the management of Henkel SpA, which intends to achieve considerable reductions in energy consumption and therefore save resources.
This starts with targets for saving energy and water. Currently the annual consumption of water amounts to 181,615 cubic meters, of which 162,000 cubic meters come from the facility's own wells. It continues with improved methods of

measuring sulfur dioxide, carbon monoxide and dust, and ends with cuts in waste and wastewater.
In the period between 1993 and 1994 alone, efforts to reduce the volume of waste have brought about drops of 76, 21 and 10 percent in, respectively, domestic-type industrial waste, waste paper and sludge.
The Italians have also booked successes in cutting down on packaging materials. Detergent packets are currently manufactured making use of 80 percent used paper. Not content with this, they aim to reduce the consumption of packaging materials per metric ton of product still further in future.

Raising employees' awareness of environmental protection

At the same time, management is well aware that its ambitious aims can only be achieved if all employees are properly motivated and have a proper awareness of environmental protection. This is why a high priority is accorded to seminars, in which the subject of "Environmental awareness in the workplace" is consistently on the agenda.

Risk analysis: More safety for sure

Anyone who is involved in plant safety in a chemical company knows: the subject is endless. The state of the technology is in constant flux. Scientists gain new insights into the properties of substances, and practical experience enriches theory (see Environment Report 1993, catchword *Plant safety*). This is why those responsible for plant safety in the production units and specialist departments at Henkel must constantly revise and extend their safety concepts.
In Germany a large proportion of the facilities concerned are those for which a safety analysis is necessary according to the "Störfallverordnung", the German hazardous incidents order. About one third of the production facilities at the main Düsseldorf site are subject to the strict requirements of the hazardous incidents order.
The technical aspects of all facilities are monitored continuously by the plant engineers responsible. External specialists of TÜV, an officially approved German inspection agency, and the Company's own experts inspect the facilities at prescribed intervals. During the last two years, close attention was devoted to fittings

and flange couplings in plant components which work under high pressure or contain liquefied gases.
Recently, however, the legally prescribed inspections did not go far enough for Henkel. Starting in 1993, selected production facilities in Germany were subjected to an additional safety check. This "risk analysis study" was then extended worldwide to all critical production facilities of the Chemical Products business sector.

Production processes under high pressure

The special checks were performed above all in lines where ethoxylation, epoxidation, sulfation or hydrogenation are carried out. The production processes proceed under high pressures or at high temperatures, or generate heat during chemical reactions. In Germany, 35 facilities, and worldwide a further 21, were checked.

The experts looked for sources of danger which could cause undesired events, such as the release of hazardous substances, or fires or explosions. The inspection teams checked which possibilities to recognize dangerous situations and which precautions against these dangers are provided in the individual facilities. They apply the so-called Zurich Method to assess what incidents could occur in production lines, and whether, and if so what, safety precautions could be taken to eliminate the possibility of their occurrence in practice.
The results of this study show that the inspected facilities are characterized by a high standard of safety. In all cases only a number of minor measures, none of them involving any large investment, proved necessary to increase plant safety. Most of these measures have now been implemented.
Despite the intensive search for possible sources of danger, Henkel is not absolutely safe from operational accidents, as was demonstrated by the mishap on October 20, 1994. Largely as a result of this incident, it was decided to carry out a systematic check of the safety relief valves and rupture disks in all facilities by 1996, and if necessary to install, for example, improved retention systems or separation equipment.

Operational accident: Honesty is the best policy

When, shortly before 10 a.m. on October 20, 1994, a mixture of coconut methyl esters, coconut oil, glycerin, methanol and a small amount of zinc soap escaped through a safety relief valve of a line at the main Düsseldorf site, one thing was clear: no matter how many safety measures are taken, in a chemical company an operational accident can never be entirely excluded.
The incident, during which less than one metric ton of oleochemical detergent raw materials escaped into the atmosphere, was indirectly caused by a total power cut. For 13 minutes the facilities remained in the so-called safety mode. None of the employees can remember an occasion during recent decades when power was cut off for such a long period.

Feed pump switched itself on

When the facilities resumed operation almost simultaneously, problems occurred in the compressed air network (control air) which activates the switching devices in the production lines, opens valves, and actuates measuring instruments. As a result, a feed pump in the transesterification facility was wrongly switched on.
Normally it is switched off automatically as soon as the operating pressure is reached, but on this particular day the automatic system failed to react. The pump continued feeding, and the pressure rose. Finally the safety system which is intended to cope with such extreme operational conditions opened for a few seconds. There was no serious danger to employees or the people living in the vicinity of the site, nor was there any danger to the environment, although the facility does use methanol and is therefore subject to the requirements of the German "Störfallverordnung" (hazardous incidents order). The toxic alcohol caused no harm, however, because only very small amounts escaped and these evaporated immediately as a result of the high temperature of the reaction mixture. The other substances which escaped are not categorized as toxic.
The fact that the mixture had a brown-black color was later recognizable from the condition of streets and vehicles. Not for very long though, because Henkel initiated a large-scale cleanup operation.
The Company also reacted as quickly as possible with respect to the provision of information. Immediately after it became known that the scale of the accident

extended beyond the Company site, the Henkel emergency staff informed first the responsible official bodies and then the local residents by loudspeaker and by distributing leaflets.
A telephone line was set up to provide more information to those who required it, and an information stand was quickly set up.
The Company's employees were informed by means of leaflets and over the plant's internal electronic media systems. The local and national media were informed at first hand at a press conference which was jointly presented with the environment departments of the city of Düsseldorf, and subsequently praised Henkel's information policy as exemplary.
Immediately after the event, the measures which were to be taken to recover from the accident were agreed, and it was decided to have the facility inspected by an expert from the TÜV. Production was resumed after three days.
As a consequence of this incident, those responsible for safety within the Company - plant superintendents, plant engineers, environmental protection officers - have not only analyzed what went wrong in the facility in detail, but have also inspected other facilities. Moreover the site's power supply and the emergency power supply were thoroughly checked. Pressure-relief systems will shortly undergo comprehensive inspections to determine the extent to which emissions occur which could be unpleasant, a nuisance or dangerous. New technical devices should put a stop to such emissions in the near future.
This inspection is one of the Company's environmental aims for 1995/96. Another aim is the construction of a crisis management center - so that Henkel can react even faster in future (see Zeroing in on the target). Because it is certain that only fast, full and frank information will be trusted - especially in an emergency.

Teroson Emergency System: Winning valuable time

In the past, if a fire occurred at the site of the Henkel subsidiary Teroson, valuable minutes elapsed before the fire department was in possession of all the key information, for example on stored substances or possible emissions.

First of all the firefighters had to find out what was burning and which firefighting technique should be used. This took up valuable time. Today they only need to press a button. With the help of the Teroson Emergency System (TES), which was installed in summer, 1994, all key data are available in a matter of seconds. And not only in case of fire. The new system can also help when operational accidents occur, for example when products escape. Plant protection employees only need to specify the building number, and within seconds the computer sends all important data to the central plant protection office for the plant's own fire department, the external fire department and the emergency staff. These data include a description of the building, the types of substances stored in it, protective devices, special hazards, emissions in case of fire, protective measures for the personnel dealing with the event, and a list of the official bodies which have to be informed.

Fast and targeted response to emergencies

The TES not only gains valuable time for the company's emergency organization: a fast and targeted response helps to minimize human injury and environmental damage.

An end to nasal nuisance - Central exhaust gas system extended

The oleochemical production facilities and tank farms at Henkel's main Düsseldorf site have been connected to a central exhaust gas system for a number of years. The system draws off gases that would otherwise smell, and feeds them into the site's own power plant for incineration. Each hour, a total of about 25,000 cubic meters of exhaust gases from the oil facilities, the fatty alcohol facilities and a special fuel mixing facility are collected by means of a widely branching piping system. The introduction and steady extension of the central exhaust gas system have considerably improved the situation with respect to odor nuisance within the plant itself and in its immediate vicinity in recent years (see Environment Report 1992, catchword *Production - Waste gases*, and diagram *Odor emissions, 1994*). In the near future, the malodorous gases from the finishing facilities and from the new production line for alkyl polyglycosides (APG) will also be carried through the central exhaust gas system for incineration.

Up to 60,000 cubic meters of exhaust gas will then be incinerated each hour. Because the previous system could not handle this increase to more than twice the former volume, it had to be expanded. The distribution system in the power plant was also improved. In future the exhaust gas streams will undergo preliminary heating in the boiler unit. This will increase efficiency and save primary energy.

Exhaust gas incineration at Emery: No more turned-up noses

Henkel Corporation in the USA is now Henkel's largest subsidiary. In 1988 it started a Responsible Care initiative, and it is now showing the way in the field of clean air. Emery Corp., which has belonged to the Henkel Corporation since 1989, operates the Henkel Group's second largest oleochemical production facility after Düsseldorf, in Cincinnati, Ohio. The facility is one of industry's pace setters with respect to clean air and waste reduction (see Environment Report 1994, *Henkel Corporation USA*). Emery uses mainly vegetable oils and fats as raw materials, alongside beef tallow and lard. The animal fats are processed to yield fatty acids and glycerin, and one of the side effects is an unpleasantly rancid odor.

Odorous substances burn at 760 degrees Celsius

A new exhaust gas incinerator reduced emissions of these intensely malodorous but non-toxic organic compounds by more than 99.5 percent. This is no wonder, because the odorous substances are heated to temperatures of about 760 degrees Celsius in the new incinerator. About 425 cubic meters of exhaust gas can be purified each hour.
At the present time, three of the six production lines in which fats are hydrolyzed are connected to the incinerator. A suction blower draws the process gas, together with its load of organic substances, away from the production line and the associated tanks, and feeds them into the incineration furnace.
However, in order to ensure that the odorous substances are incinerated efficiently, it was necessary to modify the production process to reduce the amount of water vapor in the exhaust gas. Emery used to do this by means of direct condensation in open systems. A disadvantage of this was that the organic components in the exhaust gas - the potential cause of the unpleasant odors - could escape. Nowadays direct

condensation has been replaced by closed systems, so-called surface condensers, which prevent the cooling water from coming into contact with the process gas. The remaining three production lines will be connected to a second exhaust gas thermal treatment plant by the end of 1995. The exhaust gas streams of the neighboring glycerin cleaning system will then be connected to the planned incinerator. In 1996, it is expected that no one will have to turn up their noses at Emery.

Henkel Ireland: Burn rather than bury

The specialists of Henkel Ireland can always be relied upon to think up something new when it comes to solving difficult disposal problems. It started with the recovery of acetic acid from wastewater (Environment Report 1994, *Acetic acid recovery*). Now the Irish have found a way to utilize residues from TAED production. TAED (tetraacetylethylenediamine) is a component of detergents. It enables detergents to be effective at lower temperatures than those that prevail during the boiling cycle. In the past, Henkel Ireland tried repeatedly to utilize the residues of the TAED production process. Without success. The residues were therefore stored in the company's own landfill.

Special fuel with a high calorific value

The Irish refused to accept this state of affairs as a long-term solution. Together with colleagues from the Henkel Energy Consulting group in Düsseldorf they developed a sophisticated process to allow the nitrogenrich TAED residues to be pumped into the power plant as source of thermal energy. They can now be fired in the power plant as a special fuel with a high calorific value. But that is not all. The new boiler plant and a modified combustion process for the new burner ensure that the power plant emits far lower amounts of nitrogen oxides than before. The technology needed to remove the nitrogen was developed with the help of the experience gained by Henkel in Düsseldorf some years earlier with the so-called HERENOX process for nitrogen reduction (Environment Report 1992, Catchword *Energy production / Production*). This technology was also successful in Ireland: the nitrogen oxide emissions are

below the official limiting value and also comply with the requirements of the German technical regulations on air quality control.
Each year 1,100 metric tons of TAED residues are thermally utilized in this way and used to generate steam. The gross calorific value is far above the minimum value for the thermal utilization of wastes as defined in the future German "Kreislaufwirtschaftsgesetz" (act to regulate recycling). As a result, the company uses 600 metric tons less heavy fuel oil and does not need to pay high disposal costs. The new boiler plant will therefore soon pay its way. The skills of the engineers therefore benefit not only the environment but also Henkel Ireland.

Environmental protection in Genthin: Responsibility for tomorrow

When Henkel bought back the Genthin works in Saxony-Anhalt from the Treuhand Privatization Agency in December 1990, all concerned knew that there would be many changes in the coming years. The company, in which detergents for the whole of the GDR were produced, had to undergo a thorough restructuring in environmental as well as economic terms.
This decision was the death knell for some production departments. They were closed down because they were uneconomical and because they caused too much environmental pollution. This fate was suffered by the chemical plants, industrial cleaner production and above all the lignite-fired power plant.
In February 1992 the "all clear" was given to start the large-scale project "Complex ecological restoration of the redundant industrial site of the former detergent works Genthin and the development of territorial industrial zones". The project was supported by the German Federal Labor Office and the government of the Land of Saxony-Anhalt.
The works site is now largely free of redundant plant and buildings. Other old facilities, such as the tank farm and the drying tower used in the production of detergents, have been upgraded in recent years to conform with the latest technology. Environmental protection played a key role even during the planning stage of the new facilities: a factory for liquid cleaners and detergents, large parts of the detergent production plant, and a granulating plant. Ecologistics were also taken into account. More than 60 percent of the raw materials and finished products are

carried by rail to Genthin or regional depots in Germany. This proportion will increase in the coming years.

Noise level well below limiting values

Henkel's neighbors at its eastern German works have certainly noticed that the company accords high priority to human and environmental protection. Or rather, they do not notice it any longer, because the nuisance that used to be caused by the odor of rancid fat has now been eliminated. Moreover, the noise level has been lowered considerably: at 39 decibels it is well below the limiting value of the German technical regulations on noise protection. Compliance with the noise thresholds also extends to the works. The maximum noise level at a distance of one meter from the new boiler unit and from the compressor station is 70 decibels. There are no longer any noisy workplaces in production.

Progress has also been made in reducing wastewater volumes. Between 1991 and 1995 the amount of weakly polluted water was cut from 59,000 to 40,000 cubic meters, while the amount of strongly polluted wastewater fell from 280,000 to about 18,000 cubic meters.
The fact that less wastewater has to be disposed of today is attributable to a number of factors. On the one hand, production facilities have been closed down. On the other hand, cleaning and rinsing water and water that is polluted with washing active substances, is used again in production.

Clean air is the number one success

Of all the successes achieved in the reduction of environmental nuisance at the Genthin works, clean air is the number one. The examples of the new powdered detergent line and the steam boiler unit illustrate this clearly. Although the old powdered detergent production line discharged 275 metric tons of dust and 248 metric tons of organic compounds into the atmosphere each year, these values have now been reduced to, respectively, 40 and 63 metric tons. Measurements in the exhaust gas of the tower filter, the main emission source, gave a value of 6.16 milligrams per cubic meter, which is two-thirds lower than the permissible limiting value of the German technical regulations on air quality control (20 milligrams per

cubic meter). Emissions of sulfur dioxide, carbon monoxide and dust from the new steam boiler plant, which is fired with fuel oil, have been cut back to, respectively, 250, 170 and 20 milligrams per cubic meter exhaust gas. The respective equivalent emission values of the old lignite-fired power plant were 1,850, 1,225 and 150 milligrams per cubic meter. The energy of the flue gases produced in the new steam boiler plant is also utilized, in the drying stage of detergent production. In this way more energy is saved.

Environmental data

Research and development

1. Expertise in the field of renewable raw materials since the early years of the century (Back)
2. Start of ecological research (Back)
3. First toxicity analyses for water organisms (Back)
4. Start of environmental monitoring (Back)
5. Start of research to find a substitute for phosphate (Back)
6. Introduction of Coupled Units Test (Back)
7. Large-scale trial of the use of SASIL (Back)
8. Regular phosphate studies (Back)
9. Comparative study of biodegradation (Back)
10. In-vitro tests instead of animal experiments (Back)
11. Metabolite test (Back)
12. First "eco pack" (Back)
13. Concentrates (Back)
14. Eco lightweight bottle (Back)
15. Abandonment of measuring cup (Back)
16. Carrier straps and adhesive strips made from paper (Back)
17. Eco balances (Back)
18. Monitoring of the Elbe river and its tributaries (Back)
19. Abandonment of transport packaging (Back)
20. First refill packs (Back)
21. Environmental exposure analyses (Back)
22. River flow simulation model (Back)

Products and production

1. Ecological quality controls (Back)
2. Coordination Center for Environmental Safety and Consumer Protection (Back)
3. Patent application for SASIL (Back)

4. Solvent-free foil laminating adhesives (Back)
5. First brand-name detergent with reduced phosphate content (Back)
6. First phosphate-free, brandname, heavy-duty detergent (Back)
7. Introduction of HERENOX (Back)
8. Phosphate substitute in all powdered detergents (Back)
9. Biodegradable special fats and hydraulic oils (Back)
10. Cosmetic products without CFC (Back)
11. Organic emulsion breaking (Back)
12. Second generation of proteases (Back)
13. Pritt solvent-free (Back)
14. New type of surfactant class: APG (Back)
15. Cosmetic products with APG (Back)
16. "2 in 1" products (Back)
17. Pril with APG (Back)
18. Environmentally compatible drilling fluid emulsions (Back)
19. Used paper deinking (Back)
20. Flue gas desulfurization for the Henkel power plant (Back)
21. Substitution of chlorinated hydrocarbons by aqueous metal-cleaning systems (Back)
22. Extraction of water from used oil (Back)
23. First APG production facility in the USA (Back)
24. Bottle made from reclaim (Back)
25. Somat supra without phosphate (Back)
26. Heavy-duty oil for outboard engines (Back)
27. Environmentally compatible refrigerant (Back)
28. Biocrack (Back)
29. Risk potential study (Back)
30. PET bottle cleaning (Back)
31. Program "solvent-free" adhesives (Back)
32. Zinc phosphating of automobile bodies (Back)
33. Persil with FAS (Back)
34. Henkel residues center in Düsseldorf (Back)
35. Persil Megaperls (Back)
36. APG plant in Germany (Back)

Training and information

1. Washing compass (Back)
2. Stains table (Back)
3. Brochure "Textilien und Waschen" (Textiles And Laundering) (Back)
4. First brochure on environmental protection (Back)
5. Brochure "Verantwortung verpflichtet" (Responsibility Involves Obligations) (Back)
6. Brochure "Umweltschutz - Daten und Fakten" (Environmental Protection - Data And Facts) (Back)
7. Consumer information on the benefits of ecological products (Back)
8. Obligatory environmental protection training for all employees (Back)
9. Guideline "Umweltschutzinformation" (Environmental Protection Information) (Back)
10. First Henkel Environment Report (Back)
11. Symposium on eco logistics (Back)
12. Symposium on research and innovation at Henkel (Back)

Strategy and management

1. Statement by Dr. Konrad Henkel on the adoption of enviromental protection as an element of corporate policy (Back)
2. Principles of environmental and consumer protection (Back)
3. Environmental protection included in corporate guidelines (Back)
4. Works agreement on environmental protection (Back)
5. Worldwide eco audit (Back)
6. Eco program (Back)
7. Establishment of COGNIS Gesellschaft für Bio- und Umwelttechnologie mbH (Back)
8. Commitment to Business Charter for Sustainable Development (Back)
9. Claim to eco leadership (Back)
10. Coordination circle Eco leadership (Back)
11. New corporate guidelines (Back)
12. Responsible Care® concept (Back)
13. Environment Manual (Back)

14. Henkel quality initiative (Back)

Sulfur dioxide and nitrogen oxide emissions

Henkel parent plant, Düsseldorf

The emissions are largely caused by the power plant and the water glass factory (see diagrams Sulfur dioxide and nitrogen oxide emissions from the Henkel power plant, Düsseldorf and Dust and nitrogen oxide emissions from water glass production). The measures taken there to reduce sulfur dioxide and nitrogen oxides have lowered emissions considerably.

* Provisional values; at the time of going to press not all data had been finally evaluated.

Emissions of organic substances and dust

Henkel parent plant, Düsseldorf

During recent years it proved possible to achieve considerable reductions in emissions of organic substances by means of numerous individual measures. For example, local waste gas incineration units were installed for adhesives production and the printing shop. In other facilities, odor-intensive waste gases were collected with the help of pipeline systems and incinerated in the Henkel power plant. The reduction in dust emissions up to 1987 is mainly attributable to the dedusting of all water glass furnaces.

* Provisional values; at the time of going to press not all data had been finally evaluated.

Power and steam consumption

Henkel parent plant, Düsseldorf

The Henkel power plant works on the principle of heat-and-power cogeneration. Steam, after passing through the turbines to generate electricity, provides heat to the production lines. Cogeneration is much more efficient in terms of energy utilization

than simple power generation. Excess power produced by cogeneration can be fed into the public electricity supply. For the first time, this year's Environment Report shows the figures for power consumption, rather than power generation, at the Düsseldorf parent plant. We also show the steam consumption figures (for more details see *Saving energy - Steam consumption stationary, electricity consumption rising*).

Sulfur dioxide and nitrogen oxide emissions from the Henkel power plant, Düsseldorf

Switching to low-sulfur fuels has resulted in a considerable decrease in sulfur dioxide emissions since 1984. A further drastic reduction has been achieved since mid-1991, when the flue gas desulfurization plant came on line. The full benefits were first felt in 1992. Nitrogen oxide emissions have been reduced since 1985 by the step-by-step introduction of the HERENOX process. The special firing technology largely prevents the formation of nitrogen oxides, so that subsequent denitrification measures are unnecessary. The decommissioning of a coal-fired boiler plant also contributed to the reduction in sulfur dioxide emissions in 1992.
* Provisional value; at the time of going to press not all data had been finally evaluated.

Dust emissions from the Henkel power plant, Düsseldorf

The reduction in dust emissions in recent years is attributable to shutting down an old boiler unit and to dust separation in the flue gas desulfurization plant.

Wastewater

Henkel parent plant, Düsseldorf

Daily wastewater volume, excluding water from atmospheric precipitation. Henkel has a completely mixed sewage system. Atmospheric precipitation, cooling water, process water and water from nonindustrial activities are jointly discharged and fed

into the Düsseldorf-South municipal sewage treatment plant. Process water is generally used in the plant. Potable water is only used for non-industrial activities, and in the administration building and the employee facilities.

COD and sodium sulfate loads in wastewater

Because Henkel, as an indirect discharger, feeds its wastewater into the Düsseldorf-South municipal sewage treatment plant, the given COD loads do not find their way into the environment. Studies in model sewage treatment plants have demonstrated that some 90 percent of the COD load is eliminated. Sodium sulfate is formed when sulfuric acid is used, and this is followed by neutralization with sodium hydroxide. It is not critical from an environmental point of view, but in high concentrations it attacks concrete sewage pipes. However, such critical concentrations are not found in Henkel wastewater.

Nickel and AOX loads in wastewater

Henkel parent plant, Düsseldorf

Nickel is used as a catalyst in some production processes, and traces of it are transferred to wastewater during product treatment. As a result of specific process changes, nickel loads have been considerably reduced. A plant for purifying nickel-polluted wastewater streams has been in operation since 1993. This resulted in a considerable reduction of the nickel load in 1993. The slight increase in 1994 is attributable to increased production quantities. The increase in the AOX load in 1993 was reversed by initial operational measures. Further measures have been initiated to achieve more reductions.

* Data have only been recorded since 1986.

Copper and chromium loads in wastewater

Henkel parent plant, Düsseldorf

Copper is used as a solid catalyst in the hydrogenation of Fatty acid methyl esters. Traces of it are transferred to wastewater during product treatment. Another hydrogenation plant came on line in 1994, causing an increase in the copper load. Measures have been instigated to reduce copper emissions. Approval has now been ranted for the construction of a suitable wastewater treatment plant. The chromium load is largely attributable to unavoidable plant corrosion.
* No comparable chromium data available before 1989.

Other heavy metals - especially ecologically suspect cadmium and mercury - are not used or processed in the production facilities at the Henkel parent plant in Düsseldorf.

Waste balance, 1994

Henkel parent plant, Düsseldorf

Some newly defined terms are used in the Environment Report 1995 in the wake of newly introduced legislation in Germany. The term "residual substances" has been replaced by the term "waste".
* The soil excavated during the construction measures in 1994 resulted in a considerable increase in the quantity of waste. The excavated soil was utilized again as filling material on the Düsseldorf site.

Non-utilizable wastes, and methods of disposal

Henkel parent plant, Düsseldorf

A comparable waste statistic, distinguishing between wastes which are disposed of and wastes which are utilized, is not available for the years 1985, 1986 and 1988. The individual methods of disposal have been recorded since 1991.
From 1992 the waste figures include excavated soil and power plant ash, which are

disposed of by external contractors.

Noise immission trend

A comparison of the years 1987, 1992 and 1994 shows that noise-reduction measures in production units have improved the noise situation around the parent plant. The noise level of 50 decibels (A) is comparable with a normal conversation in a room.

Odor emissions, 1994

The number and location of measuring points depend on the built-up area around the plant.
In by far the most instances no odor was detected. Strong to extremely strong odors were not detected during any of the inspections.

Reportable occupational accidents

Henkel parent plant, Düsseldorf

Environmental protection and occupational safety are closely linked in the chemical industry. In the same way that facilities with a high standard of environmental protection have high safety standards, the environment-conscious and safety-conscious attitudes of employees result from the same positive approach to these themes.
* At the time of going to press, no figures were available from the Federation of Workers' Compensation Insurances and the Workers' Compensation Insurance of the Chemical Industry.

Environmental protection courses

Henkel parent plant, Düsseldorf

Since mid-1990 employees have undergone systematic target-group-specific training in plant-related environmental subjects in the context of a systematic program of seminars. In addition, discussions on environmental protection and safety are also held at least twice yearly. For many years, environmental protection seminars, which are open to all, have been held in the context of advanced training, and management personnel have been able to attend special advanced training courses on environmental subjects.

Dust and nitrogen oxide emissions from water glass production

Henkel parent plant, Düsseldorf

Dedusting equipment was installed between 1985 and 1987 for the purpose of reducing dust emissions from water glass production. The precipitated dust is not disposed of as waste but returned to the production cycle. Until now, it has only been possible to limit the nitrogen oxide emissions from the water glass furnace by improving the firing technology. It is planned to reduce the nitrogen oxide emissions from all water glass furnaces in future by means of non-catalytic secondary measures. Approval was granted in 1994 and the conversion started. The nitrogen oxide limitation system is expected to come on stream in the second half of 1995.
* Provisional values; at the time of going to press not all data had been finally evaluated.

Solvent consumption in adhesives production

Henkel parent plant,

Years of intensive efforts aimed at finding substitutes for organic solvents have brought about considerable savings, especially of the critically regarded aromatic and chlorinated solvents. Because not all adhesive systems can be switched to an aqueous basis, consumption of some of the less critical solvents has increased in certain instances.

Consumption of chlorinated hydrocarbons

Henkel Group worldwide

The increase outside Germany in 1990/91 is attributable to the acquisition of new companies, such as the largest British manufacturer of pickling agents, which previously contained chlorinated hydrocarbons. On European markets outside Germany, acceptance of alternative products without chlorinated hydrocarbons has not matched expectations. The increased consumption of chlorinated hydrocarbons in 1994 is attributable to stronger demand from picklers.

Environmental monitoring - surfactants in the Rhine

Since 1958 Henkel has carried out systematic analyses of the concentration of anionic surfactants in the Rhine and its major tributaries - long before government inspection bodies took up this theme. These analyses have impressively demonstrated the success of the switch, in 1964, from poorly degradable to readily biodegradable surfactants. Since that time the degradability of the surfactants has been steadily improved. After the introduction of nonionic surfactants on a large scale, in 1972 the analyses were also extended to include this product group.

Environmental monitoring - boron and phosphate in the Rhine

For many years, detergents used to contain phophates, which bonded with water hardness elements. Phosphates from this source made a major contribution to the phosphate pollution of bodies of water. Reduced-phosphate detergents came onto the market from 1980, and by 1989 Henkel had switched to phosphate-free formulations for all its detergents in Germany. These measures, together with the introduction of the third purification stage in sewage treatment plants, have considerably reduced the phosphate pollution of bodies of water. Boron is also included in detergents, in the form of the bleaching agent sodium perborate. The introduction of bleach activators improved the efficiency of the sodium perborate, so that lower amounts could be used.

Detergent dosages, e.g. Persil

By developing ever more efficient detergent formulations and dispensing with fillers and auxiliaries as far as possible, considerable reductions have been achieved in the recommended detergent dosage per wash cycle. This means that the chemical pollution of domestic wastewater has also been reduced. For technical reasons, in 1994 the recommended dosages for normal product and concentrate had to be increased slightly.

Glossary of chemical terms

Active sludge
: Sludge-like secretion of aerobic bacteria during biological wastewater purification.

Additives
: (Natural esters: Striking oil, Renewable raw materials as a basis for hydraulic oils)
Substances that are added for the purpose of imparting specific properties to a product.

Aerobic
: (Active sludge)
Conditions characterized by the presence of free oxygen.

Alcohols
: (Esters, Fatty acid esters, Fatty alcohols, Methanol, Transesterification)
Organic compounds whose molecules contain one or more OH-groups. This makes them more soluble in water than the hydrocarbons from which they are derived.

Alkyl polyglycosides (APG)
: (An end to nasal nuisance - Central exhaust gas system extended)
New type of surfactants, made only from natural raw materials such as starch, sugar and fatty alcohols.

Anaerobic
: (Newcomers: Environmentally compatible esterquats, Prize for the best scientific documentation)
Conditions characterized by the absence of free oxygen.

Anionic surfactants
: (Lower loads in wastewater, New equalizing tank collects wastewater, Sulfation)
Surfactants that break down into electrically charged ions in aqueous solutions, and whose special surfactant properties are attributable to the negatively charged anions.

Anions
: (Anionic surfactants)
Negatively charged ions.

AOX load
: (Zeroing in on the target)
Measure of the sum of the organic halogen (especially chlorine) compounds in wastewater.

Aromatics
: Class of organic compounds derived from benzene. The characteristic structural feature is the hexagonal benzene ring.

Biochemical oxygen demand (BOD)
: Measure of the sum of the biodegradable organic pollutants in wastewater. The BOD is the amount of oxygen consumed by microorganisms when they degrade these pollutants.

Carbon dioxide
: Gaseous combustion product of all organic substances that contain carbon. Carbon dioxide contributes considerably to the greenhouse effect. The most important source of carbon dioxide is the exploitation of fossil raw materials such as coal and mineral oil (mainly for energy production or vehicle traffic).

Carbon monoxide

(Plant wastewater is doubly purified, Clean air is the number one success)
Odorless, toxic gas, which is formed when fuels containing carbon undergo incomplete combustion in the absence of sufficient oxygen.

Catalyst
Special substance that accelerates a chemical reaction while itself remaining unchanged.

Cations
Positively charged ions.

Chemical oxygen demand (COD)
Measure of the sum of all organic substances in wastewater, including those which are poorly degradable. The COD serves to quantify the organic pollutants in wastewater. It indicates how much oxygen is needed to oxidize these substances completely.

Chlorinated hydrocarbons
Organic solvents with incorporated chlorine, as a result of which they are not flammable. This means that they are safe to handle, but this advantage is offset by disadvantages in the fields of health and environmental protection.

Condensation
(Odorous substances burn at 760 degrees Celsius, Steam trap)
1. Formation of liquid from the vapors formed during distillation.
2. Chemical reaction in which water is formed as a secondary product.

Decanter
(95 percent less organic substances)
Vessel in which settling solids are separated from a liquid.

DIN ISO 9001
(New manual describes Eco Management System, Environmental policy and environmental protection organization)
International standard that describes a universal and comprehensive quality assurance system covering all product stages from development through materials procurement and production to customer delivery.

Dispersion
(Disposing of disposal problems: Less packaging - more environmental protection, Recycling of cans and buckets, Emulsion)
Finely distributed undissolved particles in water.

Electrolysis
(Recovering copper: A mine of information)
Decomposition of dissolved and melted substances, especially salts, with the help of a direct current. Used, for example, to extract very pure copper from solutions of copper salts.

Emissions
(Zeroing in on the target, Environmental policy and environmental protection organization, Company canteen: Serving up environmentally compatible solutions, Plant wastewater is doubly purified, Feed pump switched itself on, Teroson Emergency System: Winning valuable time, An end to nasal nuisance - Central exhaust gas system extended, Odorous substances burn at 760 degrees Celsius, Special fuel with a high calorific value, Clean air is the number one success, Gas recirculation, Hazardous incident, Immissions)
Gaseous, liquid or solid substances that enter the atmosphere from industrial production plants, motor vehicles with internal combustion engines, domestic heating systems or during the course of other industrial processes.

Emulsifiers

(Natural esters: Striking oil)
Substances that support the formation of stable emulsions.

Emulsion
Dispersion of fine drops of a liquid in another liquid, for example water in oil.

Epoxidation
(Production processes under high pressure, Ethylene oxide)
Method of attaching oxygen to unsaturated organic compounds.

Esters
(Renewable raw materials as a basis for hydraulic oils, Fatty acid esters, Methyl esters)
Widely varied class of compounds formed by reactions between alcohols and acids. Esters are not only valuable intermediate products for chemical syntheses but are also used directly for a large number of purposes.

Ethoxylation
(Production processes under high pressure)
Reaction between fatty alcohols and ethylene oxide to form fatty acid polyglycol ethers (nonionic surfactants).

Ethylene oxide
(Optimized cleaning saves water in production, Ethoxylation)
Reaction product obtained by epoxidation of ethylene and used in the manufacture of nonionic surfactants.

EU Eco Management and Audit Scheme regulation
(Environmental policy and environmental protection organization)
Regulation adopted by the European Union (EU), providing for voluntary eco auditing and certification of companies.

Eutrophication
(Phosphates)
The introduction of excessive amounts of nutrients into bodies of water promotes increased growth of algae and aquatic plants. This can lead to temporary oversaturation of the water with oxygen. When the plants die, however, large amounts of oxygen are consumed during their decomposition in deeper layers of the body of water. This can lead to an acute shortage of oxygen in the water and bring about a massive disturbance of the biological equilibrium.

Extraction
(Recovering copper: A mine of information)
Method of obtaining a particular substance from a mixture of substances by dissolving it in a selective solvent.

FAS/Fatty alcohol sulfates
Important group of surfactants based on fatty alcohols.

Fatty acid esters
(Natural esters: Striking oil, Fatty acid methyl esters, Natural esters, Transesterification)
Products obtained when fatty acids react with alcohols. The best known fatty acid esters are the natural oils and fats. Other fatty acid esters are intermediate and end products in the widely branching field of oleochemistry.

Fatty acid methyl esters
(Fatty alcohols, Methyl esters)
Fatty acid esters with methanol; intermediate product in the manufacture of fatty alcohols.

Fatty acids

(Natural esters: Striking oil, Exhaust gas incineration at Emery: No more turned-up noses, Fatty acid esters, Fatty alcohols, Natural esters, Zinc soaps)
Class of substances that are found - bonded to glycerin - in all vegetable and animal fats and oils. Important starting materials for numerous oleochemical derivatives.

Fatty alcohols

(Natural esters: Striking oil, Alkyl polyglycosides (APG), Ethoxylation, FAS/Fatty alcohol sulfates, Fatty acid methyl esters)
Long-chain alcohols, which Henkel obtains from Fatty acid methyl esters or directly from fats by reacting them with hydrogen (hydrogenation). Fatty acids are important raw materials for the manufacture of surfactants.

Flange coupling

(Risk analysis: More safety for sure)
Plate-shaped piping attachment to facilitate connection to pipelines.

Flue gas desulfurization

(Sulfur dioxide)
Process for removing sulfur dioxide from the flue gases emitted by power and other firing plants.

Gas recirculation

(Soil under gasoline stations is often contaminated by oil, Safe pumping in production)
System that transfers the air dispelled while a tank is being filled into the emptied tank, so that no emissions escape into the atmosphere.

Glycerin

(Operational accident: Honesty is the best policy, Exhaust gas incineration at Emery: No more turned-up noses, Odorous substances burn at 760 degrees Celsius, Fatty acids)
One of the two main components of all oils and fats; serves as a solvent and as an intermediate product in the manufacture of numerous other substances.

Hazardous incident

(Risk analysis: More safety for sure, Feed pump switched itself on)
Disturbance of normal operations, as a consequence of which a specific substance can cause serious danger, either immediately or later, as a result of events such as major emissions, fires or explosions. (Definition in line with the German "Störfallverordnung" [Council Directive on the major-accident hazards of certain industrial activities])

Heavy metals

(New tanning process: KO for chromium)
Metals with a density greater than 4 grams per cubic centimeter. Because many heavy metals and their compounds are toxic and environmentally hazardous, they are the subject of critical attention. There are, for example, strict limits on the amounts of heavy metals in drinking water and food, arable soil, and wastewater discharged into sewage treatment plants or bodies of water.

HERENOX

(Special fuel with a high calorific value)
Name for a process developed by Henkel to reduce the amount of nitrogen oxides (NOx) in flue gas. The firing system of the power plant incorporates engineering features which prevent the oxidation of atmospheric nitrogen to nitrogen oxides. This makes downstream denitrification measures redundant.

Homogenization

Production of a consistent mixture from different components.

Hydrogenation

(Production processes under high pressure, Fatty alcohols)
Chemical reaction with hydrogen.

Hydrolysis
Chemical cleavage involving reaction with water.

Immissions
Effects of atmospheric pollution, noise, vibration or radiation on humans, animals, plants or objects. In the context of clean air legislation it refers to the emissions absorbed by the atmosphere and distributed up to a certain concentration.

Inorganic compounds
Substances that, in contrast to organic compounds, are not based on the key elements carbon and hydrogen. Inorganic compounds include, for example, minerals, acids and salts.

Ions
(Anionic surfactants, Anions, Cations, Nonionic surfactants, Zeolites)
Electrically charged particles.

LAS / Linear alkylbenzenesulfonate
Important group of surfactants based on petrochemicals. The basic aliphatic/aromatic hydrocarbon incorporates unbranched, i.e. linear, alkyl groups.

Megajoule
The joule is a physical unit of measure for heat and energy. 1 megajoule is the same as 1 million joules. About 4.2 joules are equivalent to 1 calorie.

Methanol
(Operational accident: Honesty is the best policy, Feed pump switched itself on, Fatty acid methyl esters, Methyl esters)
Simplest compound in the group of substances known as alcohols. Toxic, flammable, readily biodegradable liquid, which is miscible with water.

Methyl esters
(Operational accident: Honesty is the best policy)
Esters that contain methanol as their alcohol component (Fatty acid methyl esters)

Microorganisms
(Soil decontamination: As snug as a bug, Soil under gasoline stations is often contaminated by oil, Royal reward: Inventor prize for nutrient cocktail, New store provides double safety, Biochemical oxygen demand (BOD))
Microscopically small organisms, e.g. bacteria.

Natural esters
(Renewable raw materials as a basis for hydraulic oils)
Fatty acid esters that are manufactured from the fatty acids of vegetable oils or animal fats.

Nitrogen oxides
(Special fuel with a high calorific value, HERENOX)
Compounds of nitrogen and oxygen, formed for example from atmospheric nitrogen during all combustion processes. In order to keep the atmosphere clean, the permissible concentration of nitrogen oxides in exhaust gas is limited.

Nonionic surfactants
(Ethoxylation, Ethylene oxide)
Group of surfactants that do not form ions in aqueous solutions and are surface-active in both acid and alkaline environments.

Oleochemicals
By analogy to petrochemicals, collective term for industrial chemicals based on natural oils and fats.

Organic substances

(95 percent less organic substances, Odorous substances burn at 760 degrees Celsius, Carbon dioxide, Chemical oxygen demand (COD), TOC)
Substances whose characteristic main elements are carbon and hydrogen. Organic substances occur naturally, but can also be manufactured synthetically, for example from coal or mineral oil.

Petrochemical products
Collective name for substances that are obtained from mineral oil or natural gas by chemical synthesis.

Phosphates
Salts of phosphoric acid. They are essential plant nutrients, but their presence in too high concentrations in bodies of water can cause overfertilization (eutrophication). The main sources of phosphates in bodies of water are faeces and fertilizers. The phosphates that were previously present in detergents can now be replaced.

Polyolefin
(Recycling of cans and buckets)
Polymer plastics for packaging materials made from unsaturated hydrocarbons.

Precipitator
Plant where impurities are precipitated out of wastewater. Special chemicals are added to the wastewater to convert impurities into an insoluble form so that they separate out.

Reaction product
(Ethylene oxide)
Product created by a chemical transformation.

Responsible Care®
A worldwide initiative developed by the chemical industry. It stands for commitment to continuous improvement in safety and the protection of health and the environment, going beyond the relevant legal requirements. The program is identified worldwide by the same logo. Responsible Care® is a registered trademark.

Sodium sulfate
Sodium salt of sulfuric acid.

Solvents
(Solvent-free contact adhesives: It was worth the effort, Safe pumping in production, Chlorinated hydrocarbons)
Substances in which high concentrations of other substances can be dissolved. Often understood to refer only to organic solvents, although water is frequently used as a solvent.

Steam trap
(Changes to small devices with large effects, Optimized cleaning saves water in production)
Device for draining water formed by condensation when steam is used in production processes.

Stripping
(Recovering copper: A mine of information)
Expulsion of volatile components from liquids.

Sulfation
(Production processes under high pressure)
Process for manufacturing anionic surfactants that contain sulfate groups (for example fatty alcohol sulfates).

Sulfur dioxide
(Plant wastewater is doubly purified, Clean air is the number one success, Flue gas desulfurization)

Gaseous combustion product of sulfur and its compounds. Because sulfur is present in coal and fuel oil, sulfur dioxide is present in the flue gases of these products. In order to keep the atmosphere clean, this sulfur dioxide must be removed in flue gas desulfurization plants.

Surfactants

(Lower loads in wastewater, New equalizing tank collects wastewater, Alkyl polyglycosides (APG), Anionic surfactants, FAS/Fatty alcohol sulfates, Fatty alcohols, LAS / Linear alkylbenzenesulfonate, Nonionic surfactants)

Surface-active substances that reduce the surface tension of water.

TAED (Tetraacetylethylenediamine)

(Henkel Ireland: Burn rather than bury, Special fuel with a high calorific value)

Detergent component that activates bleaching agents at low washing temperatures.

Thermal utilization

(Special fuel with a high calorific value)

Utilization of the energy content of residual materials by burning them.

TOC

(New equalizing tank collects wastewater)

Total organic carbon. Measure of the total load of organic substances in wastewater.

Transesterification

(Feed pump switched itself on)

Conversion of fats and oils to fatty acid esters with the help of alcohols.

Water glass

(Changes to small devices with large effects)

Alkaline silicon compound that is soluble in water. Important intermediate product in inorganic chemistry, but also a corrosion-inhibiting component of detergents.

Zeolites

(New tanning process: KO for chromium)

Sodium aluminum silicates whose three-dimensional structure contains cavities, enabling them to combine with ions of hardness elements in water.

Zinc soaps

Zinc salts of fatty acids.

Zurich Method

(Production processes under high pressure)

Method developed by the Zurich Insurance Group for analyzing and evaluating the potential hazards and risks of industrial activities.