





Ideas for waste management

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COMMITTED TO HUMANITY AND THE ENVIRONMENT

For Trienekens, bespoke waste-management concepts imply far more than the mere removal of refuse. Above and beyond the issues of technical feasibility and the solutions' cost-effectiveness, there is ultimately a firm conviction at the heart of every project: anyone who takes a conscientious approach to the elimination of unwanted materials makes a special commitment to both the human race and the environment.

And it is precisely this commitment that has always been at the foundation of Trienekens's endeavours. **No matter in which country we have planned and implemented a remedial action, our company employs the same high standards** – and deploys the available state-of-the-art technologies.

It goes without saying that sustainability and resource conservation are generally implicit in today's waste-management efforts. Unfortunately, in many situations they are only addressed with lip service and fall by the wayside. This is never the case at Trienekens: sustainability and resource conservation are at the forefront of every measure we undertake, and the relevant principles are adhered to and applied assiduously.

As a result, the highest possible recycling rate is attained for every type of waste-management effort. Reusable materials are separated and recycled, and non-recyclables are efficiently used or relegated to landfill.

Already in the planning stage, Trienekens ensures that all facilities meet the highest possible environmental standards vis-à-vis problematic substances such as gaseous emissions and leachate from landfills. Wherever necessary, these materials are treated - and re-treated separately – before being released into the environment.

Behind our approach is the conviction that the best solution is always the one that produces the greatest benefit for humanity, the environment, and, of course, the client. However, no matter how noble the intention, the implementation cost must ultimately fall within the client's budget. Trienekens's work epitomises modern, affordable solutions for every type of waste-management requirement.

➔ Experience – the basis

Experience is a component of any rational waste-management endeavour – on par with technology, concepts, commitment, and know-how; nothing can replace it. **Trienekens's experience in waste management dates back to 1923.** For decades, our pioneering activities in the German refuse-disposal sector contributed to the development of new business areas involving innovative concepts and the consistent evolution of exemplary disposal projects. The advent of the new millennium has been accompanied by increasing international demand. When applied in the context individualized customer requirements, our expertise has resulted in a recipe for success. An essential aspect of this success is the intensive consultation we provide our clients – especially regarding compliance with their specific legal requirements. **Our experience clearly demonstrates that standard solutions seldom result in optimal results. Nothing can replace individualized concepts worked out in a responsible manner and close coordination with all stakeholders.** Employing this process, Trienekens has achieved remarkable results. Across the board, it has produced positive outcomes for everyone involved.

➔ Quality German solutions

Trienekens's headquarters, from which all of our international subsidiaries are overseen, is located in Viersen, a small town near Düsseldorf. **From this venue, our experienced engineers, who beneficially blend up-to-date know-how and long-term experience, work on the planning and realisation of complex waste-treatment facilities.** This combination puts them in a position to constantly provide appropriate answers to the urgent questions of the present, and to come up with solutions whose effectiveness will continue to manifest itself in the foreseeable future.

The company is co-managed by Rebecca Trienekens-Domrös and Joachim Domrös. Both attach the very highest importance to the development of solutions that are conceptually attractive and economically viable – and which help ensure the sustainability of life on our planet for future generations.

➔ Our core competences

Formulating and implementing world-class waste-management concepts comprises a variety of tasks and activities. Trienekens's core competences lie in the following areas:

- engineering
- waste-management concept
- mechanic-biological treatment
- landfill technologies
- treatment of hazardous wastes
- converting waste into energy
- leachate and landfill gas
- landfill recultivation
- logistics
- recycling of organic and green waste
- waste separation and recycling
- paper recycling
- disposal of commercial waste

Alongside the operational functions, waste-management data is collected, waste statistics collected, and charges calculated. Furthermore, thoroughly accurate knowledge of the relevant legal framework provides our clients with absolute legal certainty.

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Optimal solutions for maximal benefit

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1 | ENGINEERING

Trienekens has decades of experience in the construction of waste-treatment facilities. All meet three specific requirements: **the systems must offer the highest degree safety during the entire disposal process, they must be cost effective; and they have to fulfil the demands of the environmental service sector.** In the process, our engineers' long-term practical expertise has repeatedly proven itself, covering needs-based planning, efficient implementation, and operational support of the relevant facilities.

2 | WASTE-MANAGEMENT CONCEPTS

Waste-disposal security and the reduction of environmental impact underlie all of Trienekens's considerations. Accordingly, we develop sustainable and holistic waste concepts for our clients in the commercial, industrial, and service sectors. **The result is a system for management of the individual material flows that extends from collection, through recycling, to the disposal of non-recyclable substances.** This produces particular benefit for municipalities with whom Trienekens collaborates in the formulation, implementation and operation of holistic solutions.

3 | MECHANIC-BIOLOGICAL TREATMENT

Household refuse contains many organic elements, permitting the use of special technologies that are the foundation of the facilities that **Trienekens designs for the mechanical-biological pre-treatment of waste.** In the first step of the process, valuable materials such as glass, metal, plastic and paper are mechanically sorted out. In the next phase, the volume of waste is further drastically reduced by utilising its biological reactivity. From the enriched lightweight fraction, a substitute energy source can be produced for use in the cement and lime industries, as well as in power plants.

4 | LANDFILL TECHNOLOGIES

As a leader in the development of landfill technologies, Trienekens offers a comprehensive package of services, ranging from geo-morphological surveys and geological studies to the complete planning and construction of landfill sites. **The confidence we have in our own planning is underscored by our eagerness to enter into long-term operational management agreements.** We are also prepared to invest in modern landfill facilities developed over a period of time, systematically filled and optimally compacted. This guarantees the ability to maintain their capacities for more than 30 years.

5 | TREATMENT OF HAZARDOUS WASTES

The incessant increase of hazardous wastes and substances constantly poses new challenges to the waste-management sector. **First and foremost is the need to guarantee absolute security, commencing with the collection of the materials and continuing through to their final processing.** This necessitates management concepts that are ecologically sensitive, sustainable and economically viable.

Trienekens has been refining these concepts with great success for years. Our service palette also includes analysis, coordination with

governmental agencies and obtaining the required authorisations. This means that we offer a comprehensive service package in the area of hazardous wastes: collection, transport, storage, recovery, and disposal.

When possible, even hazardous waste is recycled. What is not reusable is relegated to specially designed landfill sites or incineration facilities. **The combustion process and waste-gas purification, of course, employ only state-of-the-art technologies,** and regulatory authorities have permanent access in order to perform inspections at any time.



→ Containers for waste disposal



→ Top-quality bottom sealings for landfills

6 | CONVERTING WASTE INTO ENERGY

The recovery of raw materials is undoubtedly one of Trienekens's primary goals. **Today, however, the transformation of waste into an energy source also plays an important role.** For example, in appropriately fitted facilities, the waste's biogenic energy is used through the production of

biogas prior to the processing of the residues into substitute fuels. Biogas is a further source of energy that over time has come to play a substantial role. This type of integrated treatment leads to the saving of primary resources.



Economical solutions offer maximal benefit



Waste paper waiting to be recycled ←



Trienekens's staff: competent and friendly ←

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7 | LEACHATE AND LANDFILL GAS

Planning, construction and operation of a landfill require forward-looking expertise with regard to leachate and landfill gas, which must be collected and recycled in order to use them. **Against this backdrop, Trienekens works with regional regulatory and permit-granting agencies to develop a facility configuration that not only complies with all legal regulations, but also, at a later stage, will always pass technical inspections.** This affords our clients a disposal channel that is secure in the long term. State-of-the-art technology, a high degree of professional competence, and conservation-minded resource management ultimately mean that the landfilling process does no damage to the environment.

8 | LANDFILL RECULTIVATION

Responsibility for waste-management safety does not end when the landfill has reached its capacity. For this reason, Trienekens plans and operates landfill sites so that individual areas within them are recultivated and returned to nature during the course of operation. **The company views recultivation as active follow-up care to protect the environment.** This elaborate and sustainable measure involves collecting and cleaning the leachate using appropriate precautions. Furthermore, the landfill gas is collected and exploited until the waste is no longer reactive.

9 | LOGISTICS

Collecting and transporting waste demand sophisticated logistics. Trienekens's employees ensure that the company fulfils this demand: They are on the road every day to collect household refuse. Extensive training of drivers and employees guarantees that waste is handled responsibly – and, of course, the company is in possession of all relevant training certification. **The result is that clients can rest assured that all legal requirements are met – even those related to collection and transportation.**

10 | RECYCLING OF ORGANIC AND GREEN WASTE

Organic wastes that are collected separately can be processed into composting products through the deployment of bespoke recycling plants. Trienekens plans facilities of this type, which produce substances suitable for use in gardening, landscaping, and similar contexts. **By fermenting biogenic waste, it is also possible to produce biogas, which in turn can be converted into heat and electricity, contributing to the sustainable reduction of CO₂.**

11 | WASTE SEPARATION AND RECYCLING

Closed-loop recycling management is the embodiment of resource conservation, which is why recycling plays a central role in clients' wishes for comprehensive solutions. The secondary raw materials, though, have to meet the highest specifications. The quality is decisive, and this is precisely the point at which Trienekens steps in, using value-added-oriented and efficient processing to ensure that recycled products are increasingly able to replace primary raw materials. The same applies to the processing of packaging wastes collected from households. State-of-the-art technology assures that metals, plastics, Tetra Pak containers, and other potential resources can be sorted out and become part of the recycling loop.

12 | PAPER RECYCLING

Recovering, recycling and marketing waste paper is a business area in which Trienekens has over 70 years of experience. Its goal is supplying the paper industry with high-quality secondary raw materials. To achieve this, the largest quantities of available paper are collected and sorted in the Trienekens's facilities, making the production of various grades of recycled paper possible. **Single-variety recycled paper benefits the company as well as the environment, thanks to a 60% savings of energy and water compared to the production of fresh-fibre paper.** Furthermore, this allows the waste paper, an important resource, to be used up to eight times in the production process.

→ “Environmental protection is our top priority.”

Rebecca Trienekens-Domrös, Managing Director, Trienekens GmbH

13 | DISPOSAL OF COMMERCIAL WASTE

Here, too, the goal is a collection process that results in the highest possible degree of varietal homogeneity. To help reach this goal, Trienekens provides commercial and industrial customers with appropriate containers, making it possible to accumulate the very broadest variety of resources. **After appropriate sorting and preparation, these are returned to the materials cycle.** Trienekens's range of services comprises the compiling of waste statistics, as well as helping fulfil all regulatory requirements related to verification and documentation.



Malaysia

SARAWAK: A SYSTEMATIC APPROACH TO WASTE DISPOSAL

Sarawak, on the island of Borneo, is Malaysia's largest state. The recent past has witnessed rapid growth in Sarawak's economy, industrialisation, and urbanisation - and with it, concomitant increases in both the quantity and diversity in the contents of waste from households, business, and industry. This has rendered the entire waste-management issue more complex. **In order to ensure an adequate disposal system, the government formulated a clear goal about twenty years ago: the development of a sustainable, integrated, and dedicated infrastructure based on the Western model.**

Trienekens was granted responsibility for this task, and on the basis of a joint-venture contract signed with the state government in 1998, the company formulated a bespoke concept. Two years later, Trienekens signed a long-term concession agreement with the government that resulted in the foundation of several companies.

Today, the Kuching Integrated Waste Management Park (KIWMP) is the centrepiece and most visible result of the sophisticated concept. The waste-disposal centre, housed on an area of 112 hectares, is regarded a model project in this region and a prime example of how the most diverse types of refuse can be sorted, treated, and recycled or disposed of with the help of an integrated waste-management system.

Tasks and their fulfilment

In the Kuching Integrated Waste Management Park, the household waste of Kuching's 700,000 inhabitants and the refuse from numerous industrial enterprises are disposed of. To date, the Trienekens-run facility has handled more than 1.5 million tonnes of waste safely and sustainably.

Among the features of the integrated approach are

- a mature logistics concept that involves proving refuse containers to all households and commercial enterprises; a modern vehicle fleet guarantees safe transport into the KIWMP
- one landfill for hazardous waste, another for municipal waste (landfill class IV).

A feature of both landfills is the high level of the security measures in place. **Trienekens employs special watertight sealing materials to protect the groundwater and soil.** In the household-waste disposal section, a ten-centimetre-thick Trisoplast® layer protected by a geotextile is used, over which a 50cm-thick gravel layer provides

drainage. In the hazardous-waste landfill, special safeguards are deployed: A 20cm-thick Trisoplast® layer and a 2.5mm-thick film composed of HDPE plastic with a particularly high density protect soil and water. **When rainfall is particularly heavy, a plastic sealing membrane supplies an additional protective cover over large areas of the landfill.**

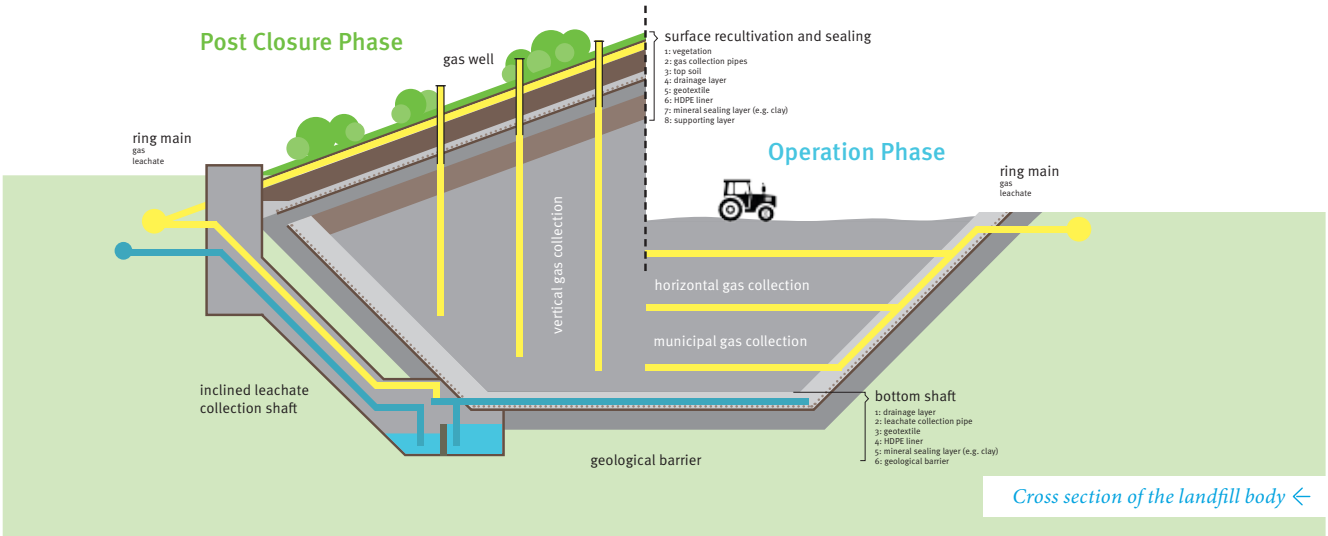
- Gas generated from fermenting waste is gathered and processed by a branching pipe system in the landfill body.
- Two facilities for treating the leachate collected in a complex pipeline system can handle up to 2,000m³ of the solution in the facilities daily.
- In two other facilities, up to 40,000 tonnes of various special wastes from the local oil and gas industry, other industries, and hospitals are controlled and eliminated at 1,200°C in a fully automated process. Constant monitoring of emissions ensures protection of the environment. Electrical energy for the facilities is supplied by gas from the landfill.

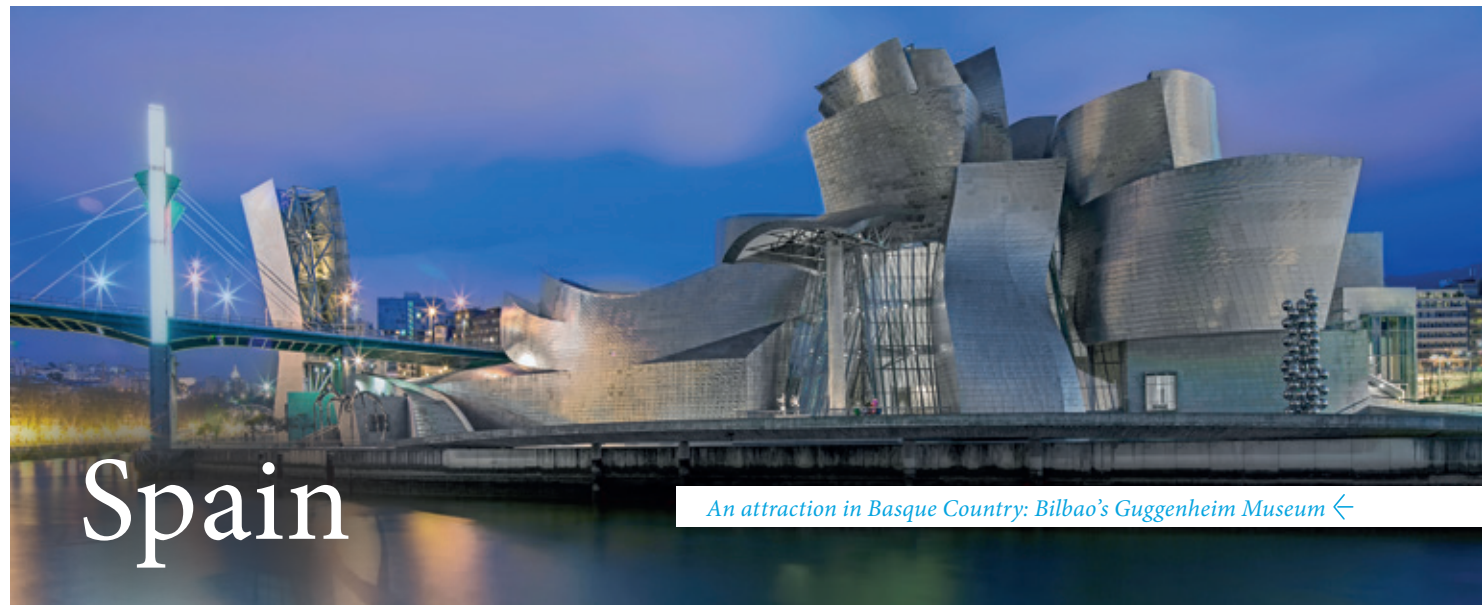
- At the end of their lifespan, when the capacity of landfill bodies has been reached, great effort is expended to recultivate them. As is done when a landfill site is constructed, various protective layers of gravel, bentonite, tiling, and soil are also put in place. Afterwards, the terrain is re-vegetated.

Other Trienekens projects in Sarawak

A gigantic industrial park is being built in the state constituency of Samalaju, 60km northeast of the northern Sarawak city of Bintulu. **Trienekens has signed a long-term concession agreement with the Sarawak state government to serve as the exclusive waste-management provider and will plan, construct and operate the Samalaju Waste Management Center.**

In this facility, Trienekens will process, recycle, or dispose of large amounts of slag, sludge, powders, hazardous waste and other commercial refuse. There will also be a new site for the disposal of household waste from the City of Bintulu, including transshipment facilities.





Spain

An attraction in Basque Country: Bilbao's Guggenheim Museum ←

BASQUE COUNTRY: COLLABORATION FOR SUSTAINABLE SUCCESS

Trienekens's involvement on the Iberian Peninsula began in 1994 with the acquisition of a wastepaper processing plant. The facility was in - and has remained in - Amorebieta in northern Spain's Basque province of Bizkaia. In the meantime, one of our Spanish subsidiaries, Trienekens País Vasco, has expanded the range of activities in the process of developing and implementing various solutions for waste disposal. Its endeavours are always undertaken in close collaboration with government agencies and local companies - and most important, all have achieved sustainable success.

→ Recycling old into new

Putting waste paper into the recovery loop is still one of Trienekens País Vasco's core businesses. The company deals with a broad range of paper and cardboard waste from industry, business and households.

One of its subsidiaries, Beotibar Recycling, collects more than 75,000 tonnes of paper annually and returns it to the paper industry after the appropriate pre-treatment and sorting. Thanks to this extensive expertise, the company's services cover the

entire realm of paper recycling. It collects assortments of used paper, paperboard, cardboard cartons, and specialty paper and sorts them carefully and accurately, making it possible to deliver products to the paper industry whose quality is clearly defined and precise. This, in turn, affords the purchasers trouble-free use of this raw material in production.

The hard-and-fast quality criteria agreed upon with the clients present no problem for Beotibar Recycling.

Thanks to the company's experience, it is able to adjust the sorting of the recovered paper to meet the individual specifications and requirements very precisely and maintain consistent quality in all shipments.

Destroying files and documents is yet another service that has been part of Beotibar Recycling's product palette for many years. In this process, the company guarantees its customers strict adherence to all statutory secrecy regulations.



→ Recyclables: waste-based resources

→ Resources from refuse

In Northern Spain, waste is usually disposed of via bring systems. The waste, which is sorted at home, is deposited in colour-coded accumulation bins, e.g. yellow containers are for light packaging. Until a few years ago, municipalities from the provinces of Bizkaia and Gipuzkoa would landfill this type of packaging waste. **Today, well over 30,000 tonnes from various districts in the region are collected annually in Trienekens País Vasco's sorting facilities in Amorebieta and Urnieta.**

Waste from the yellow accumulation containers consists largely of various types of plastic, but metal, bottles, and textiles also find their way into the mixture. Sophisticated sorting technology ensures that uniform aggregates of resources such as aluminium, iron, foil, paper, mixed plastics, Tetra Pak, polyethylene (PE), and polyethylene terephthalate (PET) plastics are the end products of the process. Initially, the various materials are separated by size and weight, and the larger pieces are filtered out. Magnetic separators pick metal out of the waste stream, and eddy-current separators isolate the aluminium. A key feature of the facility is AutoSort devices that deploy infrared technology to recognize different types of plastic. Various airstreams, for example, are used to separate PET bottles and yoghurt containers into individual hoppers. **The most important step, however, is taken with no technology whatsoever: Quality assurance testing is always carried out by the employees.** The planning, construction and operation of this type of light-packaging sorting systems is a component of the company's core business.

→ From conception to construction

Our broad knowledge in the areas of environmental engineering and facility construction has also encountered particular interest in Spain, for example in the Bizkaia Province in the Basque Country. In close co-operation with the regional government and a local public company, Trienekens planned the construction of a mechanic-biological treatment plant for household waste; its annual capacity is 180,000 tonnes.

After the facility went into operation, Trienekens assumed the role of operational consultant for the local political institutions that owned it. This will make the improvement of efficiency sustainable and secure. **This effort also resulted in the construction of a pre-treatment**

plant next to the existing waste-incineration facility that meets the very latest standards. All components of domestic refuse are optimally used. In the mechanical section, metals, plastics and other reusable materials are sorted out and recycled. In the biological section, the waste's bioreactivity is used to reduce its quantity, while also producing fuel that serves as a substitute energy supply, e.g. in the cement industry. This reduces the quantity of primary energy and turns waste into an economic asset.

The great advantage of the MBP is obvious: valuable materials are obtained and the amount of waste is reduced. This results in less waste to be incinerated or landfilled.



→ Urban residents up the refuse level

→ “The best solution is always the one that produces the greatest benefit for the environment, and, of course, the client.”

Joachim Domrös, Managing Director, Trienekens GmbH