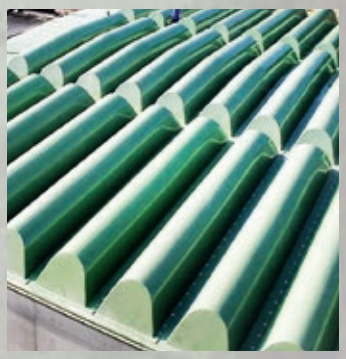
c·f·maier EUROPLAST

Report 27

Covering systems



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wortundform: 3, 6, 7 left, 8 top right and bottom, 9 top left, 20 bottom right

Editorial

Dear Readers,

More than thirty years ago, C. F. Maier began to manufacture sewage treatment plant covers, and it started with a major project – the covering of the BASF factory's sewage treatment plant of 60,000 square meters in size. Since then, we have developed a complete modular system with designs for every conceivable covering job, plus the tools to match. That made us the market leader in Germany and its neighboring countries. Projects not connected to sewage treatment – for example relating to water reservoirs or building construction – were also handled, but remained the exception.

There were always competitors who tried to chip away at our market shares by low prices. Later on, we were often asked to repair or replace those "cheap" covers. These days, however, clients have realized that we offer unbeatable advantages, thanks to interesting and economical designs, reliable structural analyses, inexpensive production precisely matching the specification, and invaluable assistance during assembly.

Project planning, design, structural analysis and coordination of order processing are at home in Königsbronn, while production of glass fiber reinforced polyester resin elements is concentrated at ITAP, C. F. Maier's company in Tunisia. For the important Gulf market, the C. F. Maier Shairco KSA joint venture was created in Saudi Arabia as a further production location.

In this report we will be familiarizing you with more recent and technically interesting applications and also with current design trends for our covering systems, and we hope you will benefit from them for your field of activity.

Dipl.-Ing. (FH) Gerhard Lettl,
Managing Director, C. F. Maier Europlast

A solution for everything

Type L, spiral pump station in Cottbus

The C. F. Maier modular system

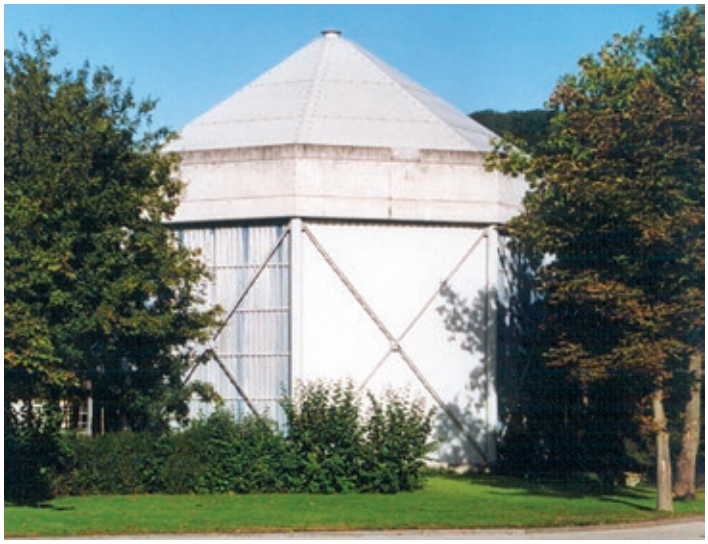
It would be going too far to list and illustrate here every model of our covering systems that we designed and delivered. There's a separate brochure with a systematic description of our engineering concepts ("Covering Systems – Technical Concept"), which we would be happy to send you on request. Just this much: we'd like to demonstrate clearly the sheer range of what we can do with a few pictures – and they're mainly of more recent projects: for circular tanks of almost any span, with and without central support or walkway, for rectangular tanks, channels, spiral pump stations, special designs and so on and so forth …

Type Af, rectangular tank in Bratislava

Type G5, circular tanks with 37 m diameter in Crossness/London

Type E2, dome in Hückelhoven, 20 m diameter

Type C, polygonal tower cover in Warstein



Type AB, channel in Augsburg

Type Af, rectangular tank in Colbitz

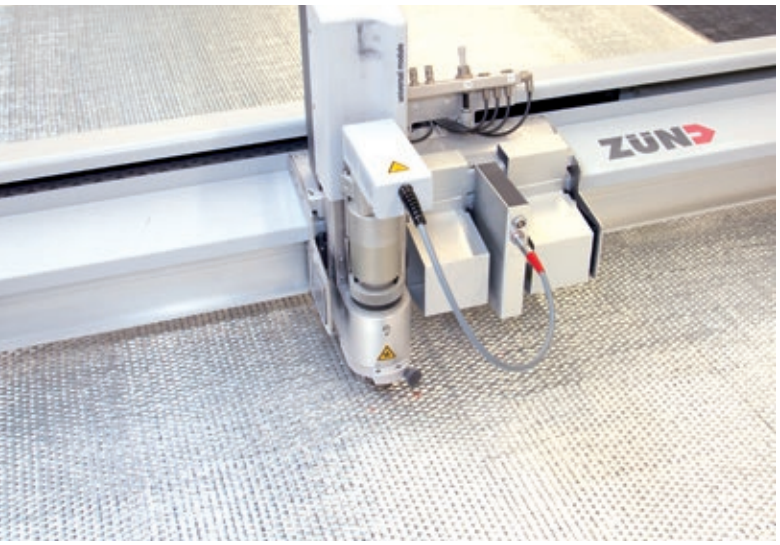
Type D1, circular tanks in Wiehl

Sturdy and economical

GRP as a material

Our covering systems are made almost exclusively from glass-fiber reinforced plastic resins (GRP). These materials and their advantages have been well known for many years: high strength, low weight, chemical resistance, good colorability and UV resistance, maximum options for shaping. Extreme resistance to weathering and ageing – covers we supplied more than thirty years ago are still in use today.

We incorporate the glass fiber component in the form of mats, fabrics and non-wovens, with strict adherence to the structural analysis and with appropriate safety margins. Stainless steel is used for connecting elements. Cut edges, drilled holes and the like are carefully sealed for dependable prevention of moisture penetration into the laminate.



Glass fiber fabric on a CNC cutting system

Competent and experienced

How we approach a project

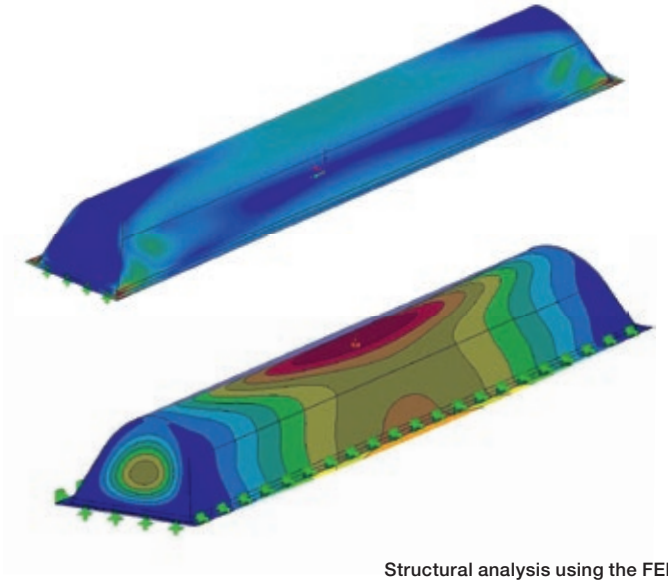
When we receive an inquiry, we are able, thanks to many years of experience and a wealth of available designs, to provide in a very short time a fully valid quotation for the most economical solution in the specific case. We don't need to make compromises, because we can draw on our extensive engineering skills.

For major projects, we visit to get a personal impression of the local situation. We can also as a rule cater to special requirements in the visual or engineering respect thanks to our extensive capabilities.

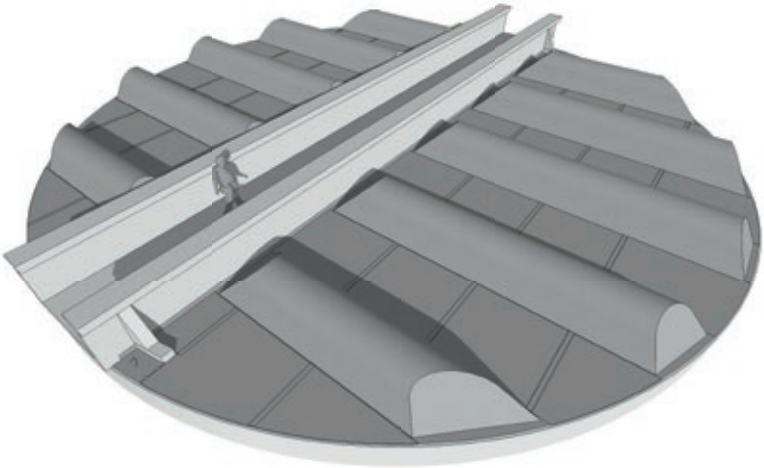
CAD design

Structural analyses are already available for all the variants of our modular system, so only the dimensions relating to the specific case and perhaps specific loads, such as high wind or snow loads, have to be inserted. That makes our quotations dependable and binding from the very start – the client doesn't have to fear subsequent demands.

We use 2-D and 3-D CAD systems for our design work. The latter are useful for more complex designs, when the client has to be provided with a clearer idea of the solution found by means of computer animations.

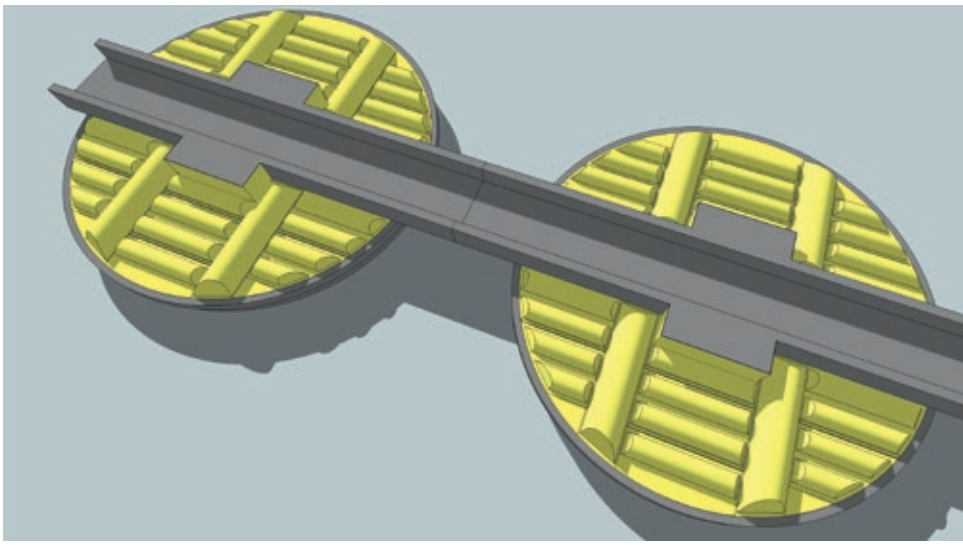


Structural analysis using the FEM method



3-D animation of a circular tank with walkway

Strength testing in our own laboratory as part of our quality monitoring



3-D animation of two circular tanks

European standards

Our production capabilities

C. F. Maier's Tunisian plant ITAP, with some 300 employees, has enough capacity to cope with major projects too. This up-to-date company is under German management and is certified to European standards.

The new C. F. Maier Shairco KSA joint venture in the Kingdom of Saudi Arabia is also headed by a German plant manager.

Laminating of flat elements at ITAP

Partial view of the C. F. Maier plant ITAP in Tunisia

Production of covering elements at ITAP

Markings for supporting ribs / metal inserts

Laminating of flat elements at ITAP

C. F. Maier Shairco KSA in Saudi Arabia

Material warehouse at C. F. Maier Shairco KSA

Part production at C. F. Maier Shairco KSA

Assembly without problems

Installation made easy

Until a few years ago, we maintained our own assembly teams. Sending them off to distant assembly locations inevitably made the projects more expensive. We have now long since gone over to commissioning a contractor and our partners on the spot with the assembly work. We make their work easier by

- supplying precisely dimensioned and ready-made parts that only need to be bolted together;
- including self-explanatory plans;
- writing an assembly manual for every project and, if necessary,
- adding instructions for building auxiliary equipment.
- offering an assembly supervisor from our own factory, although our excellent prior information often means he is not called upon.
- being present at the final inspection if this is required.

The following pictures show the most important assembly aids that we specify or even make ourselves, such as

- mobile cranes
- gantry cranes for emplacement (according to our drawings and adapted to the respective project)
- assembly towers (according to our drawings, custom-built for the application)

Our experience in many international projects proves that there are no assembly problems, anywhere in the world, when our method is used.

Assembly tower inside tank

Movable gantry crane

Positioning a preassembled dome using a mobile crane

Inserting the secondary support elements following assembly of the main support members in type G5

Lattice beams make things possible

Large spans crossed at low expense

In very large circular tanks – of about 40 meters diameter and up – and also in particularly wide rectangular tanks, self-supporting GRP elements come up against their limits – not because the material is limited, but because of the excessive length of the individual parts and the problems this causes for shaping, handling, transport and costs.

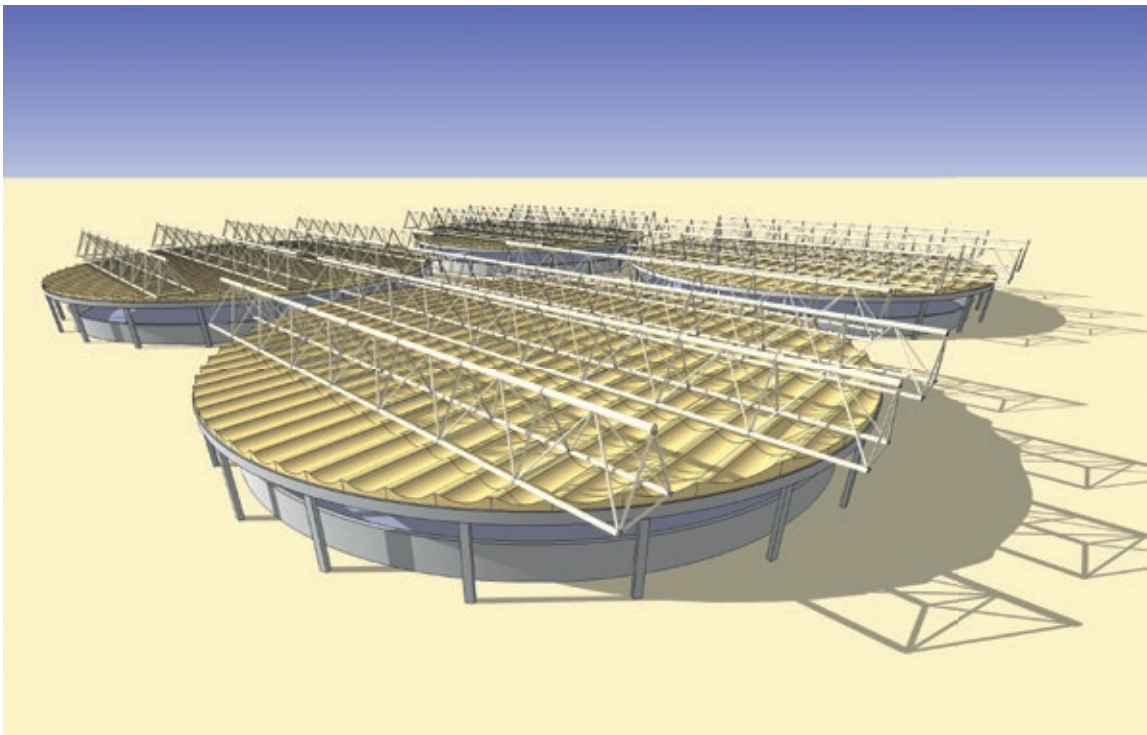
For cases like this, we have had solutions to hand for ten years now, in which parallel steel lattice beams span the tanks with a spacing of about 8 meters. The plastic elements are suspended from these beams.

Aerial view of Stuttgart-Mühlhausen plant
(© 2012 Google, image © 2008 GeoBasis-DE / BKG)

Infraserv, Wiesbaden, chord span 25 m,
element span up to 8 m

Stuttgart-Mühlhausen, 3 tanks, area 3 × 2700 sq. m, chord span up to 60 m,
element span up to 8.4 m

Computer animation of 4 tanks of the Jeddah North plant (KSA)



Jeddah North, KSA, 8 tanks, area 8 × 2500 sq. m, chord span up to 56 m, element span up to 7.8 m

Domes – yes and no

Covers for 18 – 40 meter tank diameters

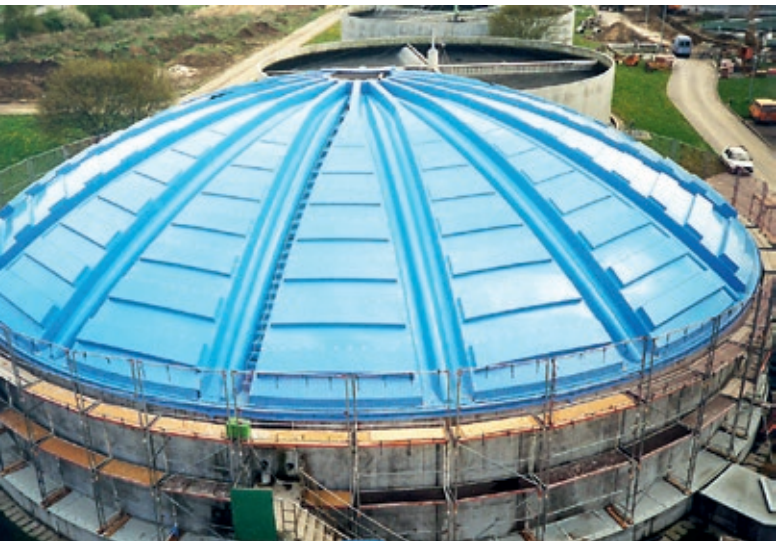
As a rule, we use dome covers with profiled elements in the case of circular tanks of up to 40 meters diameter – three examples are shown below and right. But for this size range too it may be that a dome isn't the optimum solution, such as when

- there is no preassembly space next to the tank;
- built-in parts like hatches are specified, which are hard to access on a curving dome surface;
- no auxiliary frame can be placed inside the tank because the latter can't be taken out of service;
- the air volume underneath the cover has to be kept small on account of the waste air treatment.

In cases like this, steel beam superstructures are a low-cost alternative. Preassembly requires only a narrow strip next to the tank. After assembly of the steel beam superstructure, the plastic elements can be fitted using a crane and without an internal frame. The steel structure stays outside the corrosive atmosphere, so expensive stainless steel is not necessary. The steel superstructure can also be used as an access walkway, and if required can support additional loads, for example from mounting of an agitator.

The principle of combining a load-bearing steel superstructure with suspended GRP elements has proved to be so economical that in recent years we have applied it even to smaller tanks – down to only 18 meters diameter – usually in combination with barrel shells and flat elements.

Schönwohld, 13 m diameter



Mergelstetten, 2 tanks of 33 m diameter

Greding, 19 m diameter

Alicante (Spain), 2 tanks with 32 m diameter

(© 2012 Google, image © 2007 GeoEye)

Lich, 27 m diameter

Lucerne (Switzerland), 18 m diameter

Heilsbrunn, 20 m diameter

Barrel shells: high load capacity

Inexpensive solution for small tanks

For circular and rectangular tanks with spans between 8 and 17 meters too, there may be local circumstances which rule out a dome solution: lack of space for preassembly, shutdown of the tank not possible, hatches at awkward points, requirement for partial dismantling for inspection purposes, requirement for lowest possible air space above the sewage.

In this diameter range, no load-bearing steel structure is needed, and instead GRP barrel shells are used as self-supporting beams (main support elements), with walk-on flat elements (for secondary support) between them – an unusually inexpensive and variable solution. Usually the barrel shells are slightly angled in the center to improve rainwater drain-off. We used to design the main support elements as sandwich beams with a hard foam core; today's barrel shells are considerably more advantageous.

Compared with dome solutions, which can be quite handsome as shown in the examples on pages 14 and 15, structures with barrel shells are as a rule less expensive and so are frequently preferred even when a dome solution would be just as feasible from the engineering viewpoint.

Plattling, 13.6 m diameter

Perl Besch, 17.8 m diameter

Warstein, 15 m diameter

Flexible sealing

The idea: plastic lips

The task: in the sand-trap tank, solids on the tank floor must be scraped or drawn off in the longitudinal direction. To do so, the tanks have an electrically driven scraper bridge from which the scraper devices pass down to the tank bottom.

The problem: the tank has to remain sealed and odor-tight.

The solution: Obliquely arranged plastic lips are integrated into the flat elements of the GRP cover, and are sealed until the moment that the link rods of a scraping tool on the bridge pass through. Then they close again.

This solution has now proved its worth in many instances. It does require plenty of knowhow, not least in respect of the material used for the lips.

Easily discerned: the lips open only where the link rods pass through

Still like new

24 years on: GRP water tower roof

The following example shows that GRP covers aren't limited to sewage treatment plants: more than twenty years ago, the dilapidated roof of a water tower in Essen, a protected monument, had to be replaced by a modern structure, but with the new roof outwardly matching the old one in every detail in respect of its shape and color. Our solution was a sandwich / segment structure with 40 supporting ribs on its underside and an 80 mm thick thermal insulation layer of polyurethane foam. Due to the extremely out-of-round nature of the tower, every segment together with its ribs had to be made individually. A ten-sided lantern mounting and an all-round fascia had to be made to match the original.

The dome of 19.5 meter diameter and weighing 13.5 tons was completely assembled next to the water tower and then precisely positioned using a truck crane.

The building and the cast-iron inner tank are now due for another general renovation – but its GRP roof isn't. It has lasted 24 years unscathed!

Mounting of the preassembled dome in Essen

Air sealing problem

Covers with special seal

In denitrification tanks, no oxygen can be allowed to get into the vessel's interior – the cover has to be absolutely airtight. We have met that requirement with our system F2. The so-called main support members rest on the tank rim; lightly profiled secondary support elements are provided in the spandrels between them. All connecting lines are sealed with special soft plastic sections. The image shows at the back a tank with 22.5 meters diameter.

The same basic design was also selected for the sake of visual uniformity for the biological filter in the foreground, where however airtightness is not crucial – quite the contrary: this is an open tank; the cover only has the job of protecting the fine nozzles of a rotary sprinkler from freezing up in winter. This is assured by the circular cover along the tank rim, which is the area particularly at risk.

Nessingen

Large flap

Bunker covering with electric drive

A large-sized cover (4.5 × 2.5 meters) that had to be able to open completely was needed for several sludge bunkers. The solution: a swing-up and air-tight flap with cable hoist and electric winch. It was designed and built completely by C. F. Maier.

Munich – Gut Großlappen

Hazardous gases

Explosion prevention for sedimentation tanks

Inflammable gas mixes can form in sewage tanks. GRP as a material is not in principle electrically conductive, so explosions might result in the event of electrostatic charging. To prevent that, graphite or soot used to be admixed with the synthetic resin. Today, we achieve good conductivity with a special resin sealant on the inner surface of the covers. To do so, the elements are also connected to a grounding system.

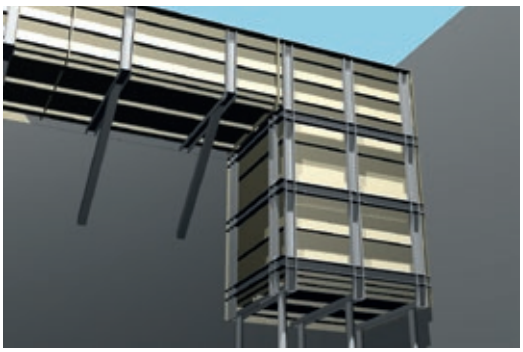
The cover shown in the picture was inspected and approved by TÜV.

Grounding elements

Better than stainless steel

Fe(III) precipitation in a drainage channel

There are special cases in sewage treatment where even expensive stainless steel fails and GRP is the best choice, for example in Fe(III) precipitation. Stainless steel corrodes under continuous contact with the medium. For this case, C. F. Maier has built a GRP drainage channel together with drainage shaft. The weight of the sewage flowing through called for a strong supporting structure that could be made of stainless steel, as it does not come into direct contact with the medium.



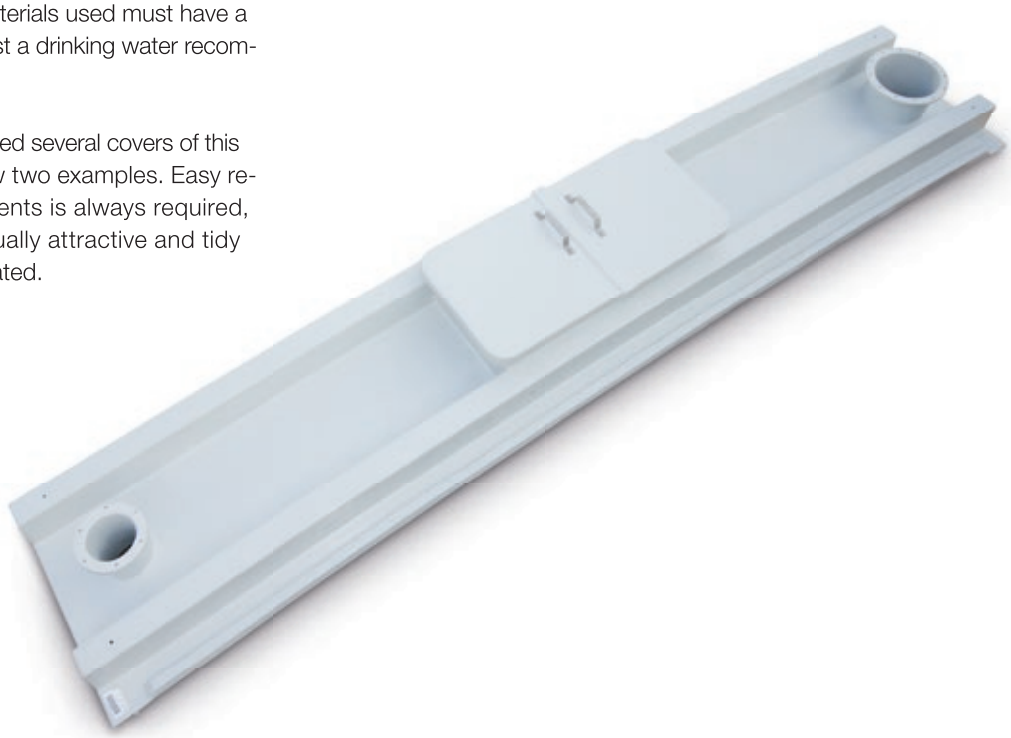
Channel with drainage shaft

Protection of drinking water

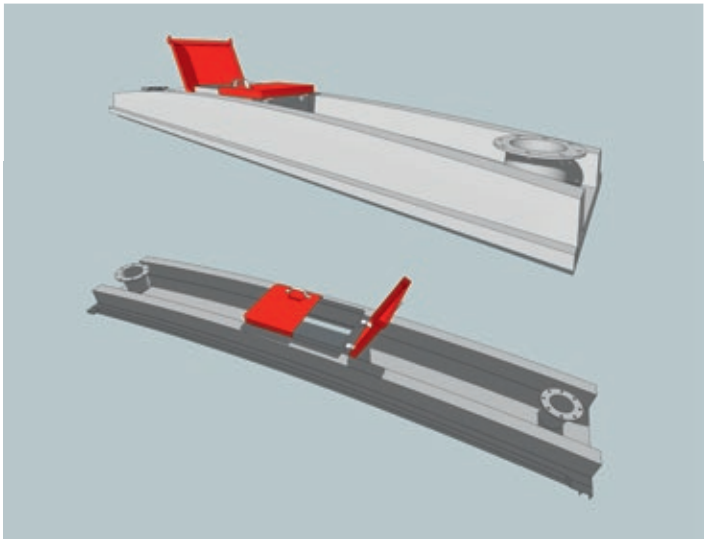
Covers for waterworks

To prevent both water contamination and high humidity above the open water surfaces inside the building, the filter cells in waterworks need to be covered up. The materials used must have a KTW approval or at least a drinking water recommendation.

We have already designed several covers of this type. The images show two examples. Easy removability of the elements is always required, and furthermore a visually attractive and tidy appearance is appreciated.



Colbitz



Computer animations for Oeversee

Minor but necessary

Special requirements

Sloping surfaces and stairway accesses, exits and boxes, walls and superstructures – all that might have to be built or covered as part of a major project. With our range of molds that has grown over the years, we can cater to almost all these special requirements practically straight away. The images show three examples: An enclosed stairway into the tank interior, a cover with sloping connection to a building, and a 3.5 meter high GRP annular wall as impact apron – considerably less expensive than the otherwise usual stainless steel structures.

GRP annular wall

Stairway access into tank interior

Sloping connection to building; flat part with inspection flaps and carrier shells

Architectonically ambitious

Color and shape

Sewage treatment plants don't have to be just dull and functional. Modern architects often use powerful colors, with simple and clear forms dominating the structures. The covers of the sedimentation tanks have to match the architecture in their shape and color – a wish we're happy to grant. In the first picture, the cover for the spiral pump stations had to be matched to the color and shape of the colorful trapezoidal sheet metal facades. We used the pale gray color found in the adjacent walls and designed the reinforcing ribs of the cover elements in trapezoidal form. In this way the plastic structure is ideally integrated into the whole.

In the next picture, a GRP trapezoidal sheet metal wall with the same color was placed on the steel tank underneath it. The roof is a barrel shell with flat elements in the same dark blue as the adjoining building.

Göttingen

Göttingen

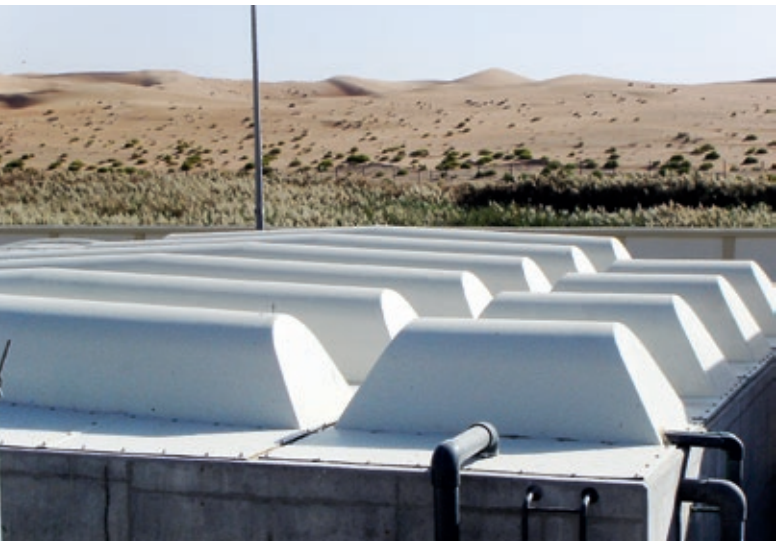
Lanxess, La Wantzenau (France)

Trust is crucial

Successful in the Gulf region

In Arab countries, trust is perhaps an even more important factor than elsewhere in the world. So a lot of preparatory work was needed before the first order was placed with C. F. Maier in 2005. It came from Bahrain. Numerous other projects followed in Dubai, Abu Dhabi, Saudi Arabia and Oman. The economic benefits of our designs, the quality of workmanship and the dependable compliance with agreed deadlines have become our most important references, while our joint venture in Saudi Arabia helps us to ensure the mandatory local content.

Elements for Raysut (Oman)



Al Quaa (United Arab Emirates)

Yas Island (Abu Dhabi)

A major system in the making

The Jeddah North Project (KSA)

Jeddah Airport in the Kingdom of Saudi Arabia is becoming more and more important not least due to the enormous and steadily increasing number of pilgrims to Mecca arriving and departing by plane. At the same time, the requirements placed on the infrastructure in the airport region are growing, which is why a large-scale sewage treatment plant near the airport is needed.

It was clear right from the start that the sedimentation tanks had to be covered: open water surfaces attract birds which can endanger air traffic, and above all the sight of an open sewage treatment plant was not desirable as the first impression that incoming passengers should receive.

A total of some 60,000 square meters had to be covered, spread over many tanks with different shapes and functions. When the order was placed, the preliminary building work on the tanks was already far advanced, so the existing structures had to be taken into account during planning work on the covers. A further requirement was to keep the air volume underneath the covers of tanks where waste air had to be treated as small as possible. Finally, the construction concept had to be economically viable and feasible with existing designs and with our range of molds.

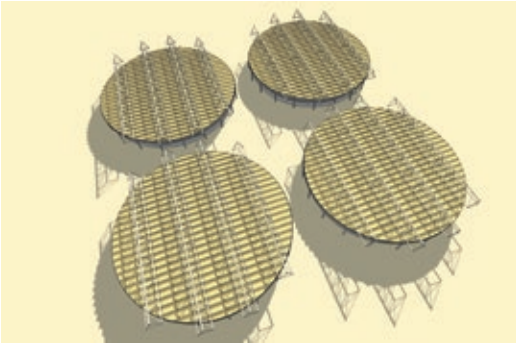
The overall layout (picture right) shows the solution arrived at and accepted by the client. For the eight large circular tanks with over 50 meters diameter, steel lattice beams cross the structure, and underneath GRP wave elements are suspended. The result was a quite filigree structure which was preferred over the originally considered dome solution.

The large rectangular areas are all covered with barrel shells as the main beams with plate elements between them. This results in a visual breaking up of the enormous areas. For the semi-round closures and also for the circular tanks on the right, we have again achieved a uniform appearance with centrally arranged barrel shells.

The contractually specified production and delivery deadline of one year was kept.

Further images show partial sections of the plant during assembly.

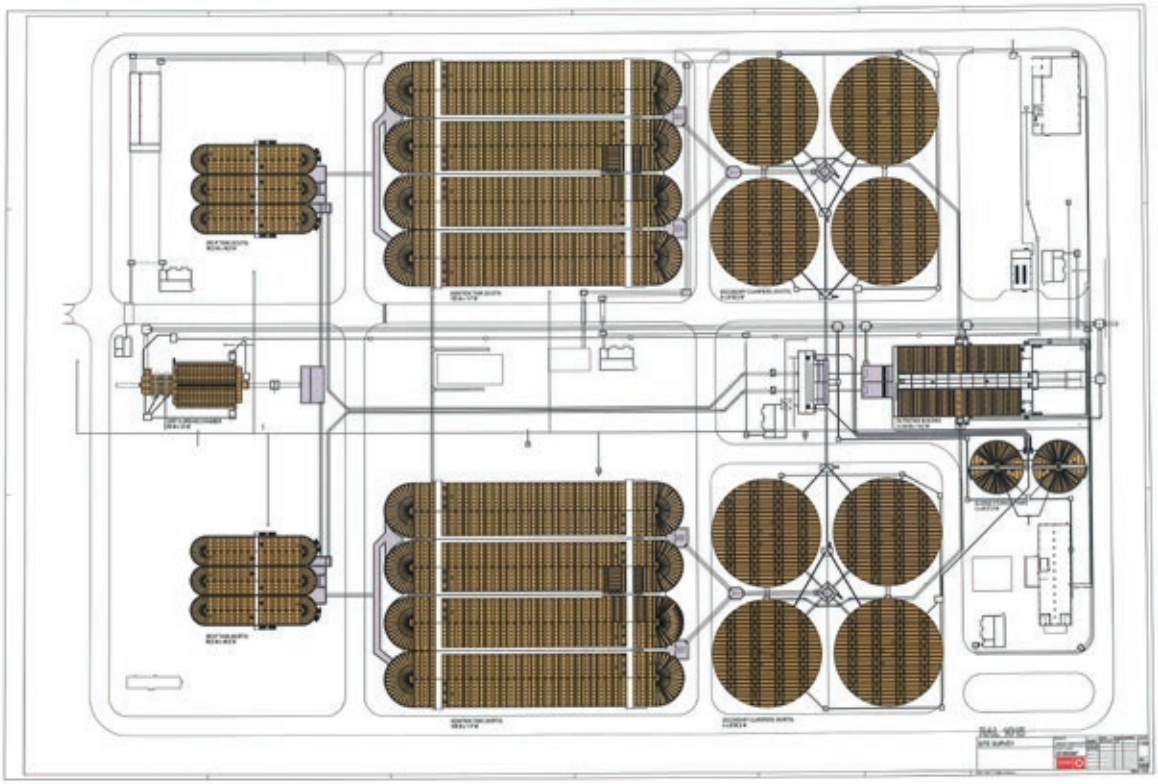
All images of this row: covers for 8 aeration tanks (155 x 30 m) during assembly



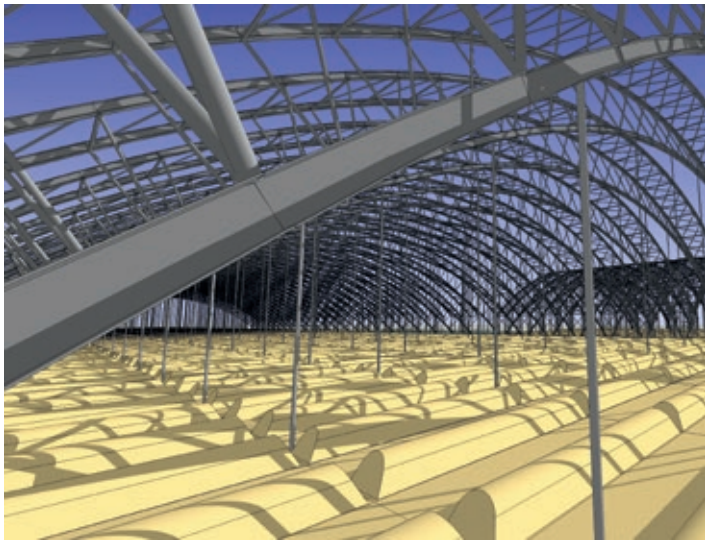
Computer animation of 4 of the 8 secondary sedimentation tanks, 56.5 m diameter

Satellite image at the start of assembly (© 2012 Google, image © 2010 GeoEye)

General view of plant



Impressive dimensions



Lagoon Covers – visionary project in the tender stage

The situation: In a coastal region of the Kingdom of Saudi Arabia, a collecting tank is to be built for treated sewage that has to be piped up to 150 kilometers into the interior for irrigating agricultural crop areas.

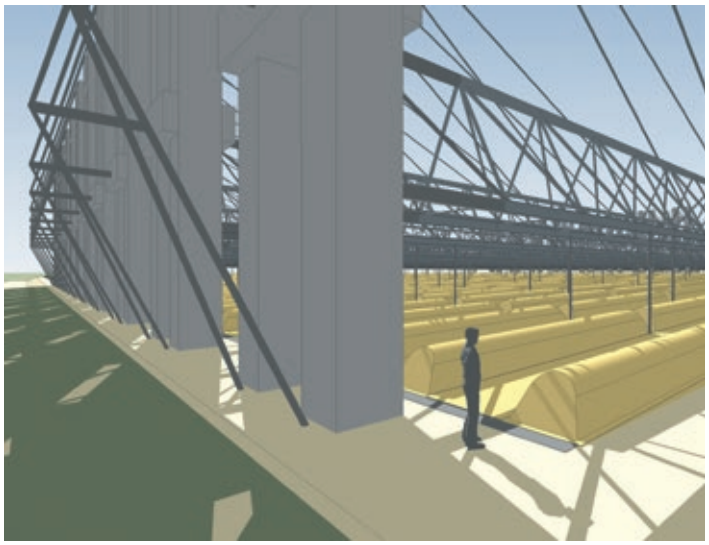
The task: A total of 100,000 square meters of tank area should be covered without the use of supports. The span is more than 150 meters.

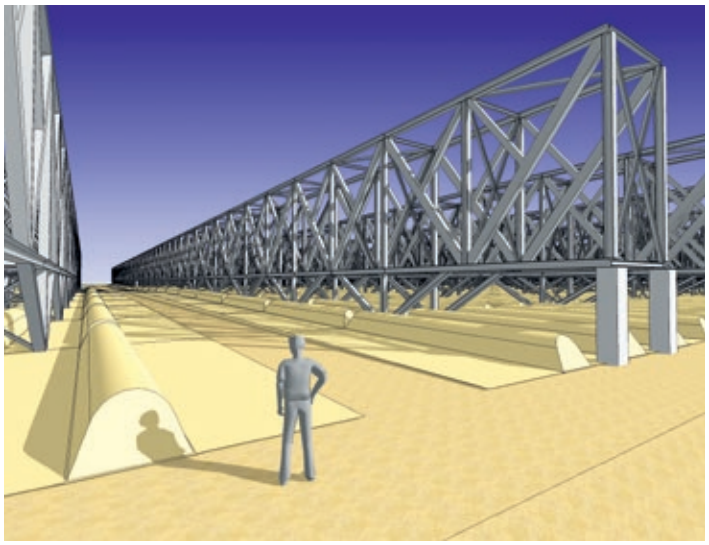
Our three approaches each with several variations: in any event a steel superstructure with suspended GRP elements which then have spans of up to 13 meters.

As the computer animations show, the steel superstructure comprises optionally

- an arched structure,
- lattice beams with cable bracing or
- 150 meter long conventional lattice beams.

In cooperation with a steel construction company, the drafts were thoroughly planned up to the assembly manual stage and are technically feasible.





Looking ahead: Europlast Report 28

SMC – material for medium-sized and large runs

The next Report will be about SMC (Sheet Molding Compound) – a classic GRP material that's playing an increasing role at C. F. Maier.

Our debut in SMC processing took place in a niche, i.e. with low-pressure SMC used only by a few GRP companies. It manages with lower specific pressures than classic SMC and with aluminum instead of steel tools, making it economical also for small annual requirements as are usual in bus, coach and truck production. Low-pressure SMC remains an important field for C. F. Maier – in addition to the classic SMC which is growing in importance. We will be reporting on our extensive experience with this material and on its potential in Report 28.

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