Aiming for perfection in technical solutions

When we caught up with Peter Heise of GFC (GFC AntriebsSysteme GmbH) in the last issue, the talk was mostly about the company’s wider commercial opportunities and solutions. Today, our conversation turns to the technical excellence that the company is known for…

PES: Welcome back to PES. For the benefit of new readers, would you like to introduce the company and explain a little about how you serve the CSP industry?

Peter Heise: GFC has specialised in worm gear manufacturing since 1896. We focus on five market segments:

- Actuator drives
- Worm gear sets
- Escalator drives
- High precision tracking drives for CSP applications
- Slewing drives for construction, forest and farming machinery

But we also use our longstanding traditional knowledge for developing customised drives on demand, especially for difficult environmental and special technical conditions as for example offshore and harbour applications.

For CSP industry we developed highly precise and long lasting maintenance free worm gears for tracking systems of heliostats at power tower plants.

PES: How much importance does the company as a whole place on your renewables business?

PH: Drive systems for CSP applications are one of the five market segments that GFC focuses on. This shows the importance we put at the renewable business. And for this market segment we preserve significant resources for R&D to keep us up to date.

PES: Where in the world are you currently doing business? Do you have any plans to move into new territories?

PH: GFC has its own facilities in China, Tianjin (established in 2010) and in India, Bangalore. Here we produce gears for
customers in the local market. We also use these facilities for sourcing local material and components in these countries.

GFC is a member of the AUMA group and if required we can count on our world-wide service and distribution net. So actually we don’t have special plans for that.

**PES:** What sort of testing do you carry out to ensure the durability of your products?

**PH:** Especially for our CSP products we developed a special test to simulate 25 years in a test period of around two months – a so-called ‘shortened life time test’. As a result we found the right material composition of the components in combination with the proper lubrication and sealing. So we can really guarantee – and not just calculate – characteristics such as wear, backlash, stiffness and back drive (self-locking) for a period of at least 25 years, maintenance free.

**PES:** What’s your strategy for staying one step ahead of the competition?

**PH:** We permanently improve our manufacturing process, check our supply chain and put resources into developing a new generation of worm drives for CSP applications. In parallel with this, we use our long experience to optimise our cylindrical worm gear drive in terms of stiffness, back drive and efficiency.

**PES:** And what about other principles of toothing besides cylindrical worm gears that are on the market for tracking gears, particularly Globoid gears (also called Double Enveloping or Hour Glass worm drives)?

**PH:** The biggest advantage of real globoid drives is an increased loading capacity. Since there are more teeth in contact to transmit power it is possible to use smaller teeth and therefore it is possible to decrease the size of the gear and save costs on materials. But to achieve this advantage it requires precise contact of all the involved teeth – this is what I mean with real globoid drives.

For manufacturing such real globoid gears some things are required:

1. A very high precision in toothing – manufacturing of worm wheel and worm shaft to the base of the bearing seats of wheel and shaft
2. High precision in manufacturing the axle bearing seats for wheel and shaft at the housing
3. Specific measuring equipment to check these required qualities during manufacturing
4. Carefully assembly and adjusting the axles of the components.

To make these requirements a little easier to understand I will try a comparison with a three legged table.

The three-legged table always stays stable even on an un-plane surface. If we imagine more legs on the table, we have to make sure that all the involved components are exactly manufactured in terms of length of the legs, interfaces table to legs, assembly and adjusting the legs to the table and on the end in terms of the very plane surface where the table can stay without tilting.

After solving all these preconditions, it is possible to put the calculated load on the table, without risk of over-bending or putting uncontrolled torsions in the system. To realise all these requirements in a constantly repeatable and stable mass production environment it is a bit of a challenge.

**PES:** Don’t GFC like to face these challenges?

**PH:** To answer this, let us take a short trip in the past. GFC was founded in 1896 by Mr. Pekrun. He teaches as a professor at Germany’s oldest technical university Dresden. He was researching gear technology and developed a manufacturing principle to produce globoid toothing under industrial conditions. To materialise his inventions he founded his own factory in Coswig near Dresden – nowadays GFC. His idea was to transmit more power with more teeth involved in transmission for mass production.

At the end of the 1980s, GFC was facing high price pressure on our worm gear market with relatively small numbers of gears and a wide range of different ratios. So we try to reduce the costs for the extensive manufacturing of globoid worm gears with high cost consuming tools, machinery, manufacturing- and assembly-time if you compare it to manufacture cylindrical worm drives.

Using computing systems and material science we can now improve design (geometry) and material combination for cylindrical worm gears so that we can compensate the disadvantage in using slightly more material but saving high manufacturing costs.
As part of our design studies we also find that all other characteristics such as efficiency and back drive (self-locking) are only related to the tooth geometry. If we use the same tooth geometry for a cylindrical worm gear as for a globoid worm gear, then there will be no difference for those parameters. So our decision was to move more into cylindrical worm drives.

**PES:** Times are changing and CSP-tracking-applications seem to be a mass market product. Do you still believe in cylindrical worm drives for this special market?

**PH:** Right now we think that we can meet our customers’ needs with our highly developed and proven cylindrical worm gear version. We are sure that we can control and ensure a stable and reliable quality, delivered on time. But of course the only thing that is stable is that the world is changing.

As for mass production, the cost proportion will shift from cost for manufacturing more to the cost side for material. So we do again investigations in globoid versions using our long term experiences in manufacturing and our knowledge of the weak and tricky points of this technology. Besides other issues for manufacturing, we do investigations to find a method to control and measure that all planned teeth will really be in contact.

In the beginning the gear will perform perfectly in terms of backlash. But if only one tooth is in contact and during operation wear starts, the backlash increase is uncontrollable. We have to consider that the gear should perform its promised characteristics for 25 years without maintenance. All this needs some serious investigation. And as you know our German tradition, we try to be perfect before we offer a technical solution. Therefore we offer in the meantime our cylindrical worm gear version.

**PES:** How much pressure are you under to adhere to lean manufacturing principles? How does this benefit your clients?

**PH:** At least since 2006 we start to implement lean manufacturing principles. Starting with arranging the machinery at the work shop according to the work flow, manufacturing lot sizes on real demand, improving tool setting time and cutting down stock. We also installed the full quality management system with all its components. 100% traceability of all components (forward and backward) is common praxis at GFC.

A first test for our lean manufacturing processes was the delivery of 4700 gears to track mirrors at the Chevron project Coalinga California. Our customer Bright Source benefits from delivery on time in stable and repeatable high quality. After continuously improving the principles we could face the next big challenge to deliver 78,000 gears for the IVANPAH project. 200 gears a day, 1000 gears per week we manufactured again on time without any delay and quality problems.

We could achieve these results not only by lean manufacturing. A stable supply chain is also required and needs to be installed. We permanently work together and do improvements with our suppliers who deliver castings, bearings, sealing gaskets and other pre-fabricated components.

On time delivery with 100% quality performance of the tracking gears is a real benefit for the people on the construction side. Especially at such large scale projects with complicate and tight logistic schedules, our customers are happy to count on such suppliers.

**PES:** Do you have any plans to expand your product portfolio in the PV arena?

**PH:** We already sell slewing gear applications for the PV market, especially for large panel sizes. Gears tracking normal PV panels do not necessarily need such high precision in tracking as the mirrors for CSP power tower plants. But there are also some interesting PV solutions that need very precise tracking – so called concentrated photovoltaic panels. They work with focused sunlight on the PV-elements. Here we face similar requirements as for CSP applications. This is the market that we feel positive about.

**PES:** What are your predictions for the coming year both as a company and for the market as a whole?

**PH:** We are optimistic and it looks like in China some large projects for CSP power tower technology will be starting in earnest.