

# INSIDER

Customer Magazine of Lindauer DORNIER GmbH

No. 18



## **THE “GREEN” WOOL**

Successori Reda S.p.A., Italy

## **A REVOLUTION “RELOADED”**

From silk pictures to carbon fiber turbine blades

## **DORNIER COMPOSITE SYSTEMS®**

Innovative solutions and systems for the fiber composite industry



Wolfgang Schöffl, Head of Business Unit Weaving Machines and Bernhard Wandinger, Head of Sales Film Stretching Machines combine both tradition and modernity.

New technologies and cross-segment synergies from the sectors weaving machines and plant engineering characterise the innovative power of Lindauer DORNIER GmbH.

Wolfgang Schöffl

Bernhard Wandinger

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Jacquard machines: From silk pictures to carbon fiber turbine blades

## **A REVOLUTION “RELOADED”**

Today everyone talks about the “digital age” or “industry 4.0”. However very few people know, how the basis has been laid for these developments 200 years ago in the French silk weaving metropolis Lyon.

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Jingjin Environmental Protection Inc., Dezhou/PR China

## **SEWAGE AND SLUDGE BECOMES WATER AND RAW MATERIAL**

The growing world population and industrialization of the developing countries inevitably lead to a rising pollution of our environment. To counter this negative side of progress and to ensure clean air and clear water in a world with an increased focus on sustainability, high-quality, precise filter fabrics are of vital importance.

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Apprenticeship at Lindauer DORNIER GmbH

## **READY FOR THE FUTURE**

For DORNIER – since its foundation in 1950 – vocational education is very important, because only well-trained and motivated staff members create the basis to meet future challenges. Even some of our international customers now show a keen interest in this concept of German style apprenticeship.

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Polyplex Corporation Ltd., Khatima/India

## **AN ULTRA-LIGHT HEAVY WEIGHT**

Modern logistics and packaging technology, especially for perishable goods, permit today that a greater amount of people are more safely supplied with food than ever before in the history of mankind. Polyester films are perfectly suited for this task.

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Innovative solutions and systems for the fiber composite industry

## **DORNIER COMPOSITE SYSTEMS®**

Fiber-reinforced plastics (FRP) are a material class with very high technological and economical potential. Under the newly formed brand “DORNIER Composite Systems®”, Lindauer DORNIER GmbH offers machines and installations for the production of textile reinforced preforms serving the fiber composite industry.

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Successori Reda S.p.A., Italy

## **THE “GREEN” WOOL**

It all started with the water coming from the Alps and cutting its way through the mountains of the province Biella in direction to the river Po. The clear water is ideal for fully integrated wool businesses, which have to wash their raw materials several times during production.

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# “The Green Machine” – DORNIER’s motto for the ITMA 2015

Dear customers and friends of  
Lindauer DORNIER GmbH,

This year our DORNIER rigid rapier weaving machine celebrates its 50th birthday. In 1965, when my father presented the new weaving machine to our American customers at the trade fair in Atlantic City, it wore – in contrast to its predecessors, the dark grey DORNIER shuttle looms – a warm and promising green varnish. This RAL colour 6021, known to us as “SULZER green”, adorned also the most modern and successful weaving machine worldwide at that time: The SULZER projectile weaving machine, which was for us THE admired shining example: No more a “loom”, but a real machine that in precision and technology resembled more a machine tool, than a classical textile machine. The aim of my father and his development team, headed by the ingenious Greek inventor Nikolaus Kokkinis, was to give this highly successful and productive, but in flexibility and application range limited, projectile concept a pendant, that suited shorter metrages, more complex applications and higher quality requirements.

Since he knew perfectly well, that a large number of green SULZER machines would be present in the weaving shed of the prospective customers, my father wanted to spare the company’s owner or production manager from looking at different colours and thus at least lower the “aesthetic purchase barrier.”

25 years ago, when Lindauer DORNIER GmbH decided to develop a new air-jet weaving machine on the platform of our rapier technology, it was no question which colour it would have – RAL 6021 of course. For the DORNIER air-jet weaving machine, this time invented by the equally creative Syrian engineer Dr. Adnan Wahhoud and his team, the aspiration was

to push the application variety of air-jet technology into domains that appealed to experts as technically and economically unthinkable – providing customers of projectile and negative rapier weaving machines a more efficient alternative.

Until today, we have delivered more than 65,000 of these “Green Machines” to our customers, proving that the promising green varnish has brought luck and success!

What my father could not foresee fifty years ago was, that in 1972 the “Club of Rome” would approach the public with its theses and subsequently create a worldwide political and social initiative which we today call “green movement”.

Its aim – preservation and protection of the environment through sustainable management – is more relevant than ever. In the last 20 years, the CO<sub>2</sub> topic and related consequences, especially on the population of rapidly growing developing countries, have strongly moved into focus and demand immediate action. “Green Technologies” for the protection of people and environment are booming.

Lindauer DORNIER’s contribution to this development lies in the wide application range and variety of our weaving machines. Whether for finest filters to purify water or air, for airbags and antiballistic structures to protect against death and injuries, for glass and carbon fiber composites to reduce moving masses and consequently CO<sub>2</sub> emissions – in all those sectors our “Green Machines” have become essential tools for the production of high-precision fabrics that accomplish such tasks better and more reliably than non-digital “nonwovens”.



Peter D. Dornier, Peter Dornier (1917 - 2002)

Another argument for the sustainability of the DORNIER philosophy is the fact that our “Green Machines” have an average lifetime of several decades and therefore are, by no means, disposable products. The platform strategy and the modular design concept of our DORNIER weaving machine system family, as well as the worldwide support, from which even 30 year-old DORNIER machines reliably benefit, create a permanent added value for our customers.

My father would have liked this development, as he has left us far more other things besides the green machine colour. The many old and young trees, which will welcome you, dear customer, on our factory premises, if you visit us in Lindau, are only one but an important example.

We are looking forward to see you!

With best regards and wishes,

Peter D. Dornier

## A REVOLUTION “RELOADED”

Today everyone talks about the “digital age” or “industry 4.0”. However very few people know, how the basis has been laid for these developments 200 years ago in the French silk weaving metropolis Lyon.



Jacquard woven silk picture of Joseph-Marie Jacquard (early 19<sup>th</sup> century)

The Jacquard weaving machine is considered undoubtedly a milestone in computer history, since for the first time, the punched card was used to control an industrial production. Its creator, Joseph-Marie Jacquard (1752 - 1834), contributed with this ingenious invention decisively to the industrial revolution.

### Poor childhood

Jacquard was born in Lyon as son of a weaver. He was the fifth out of nine children of Jean Charles Jacquard and Antoinette Rive. His father owned several looms and his mother entered patterns in a silk manufacture. Like most of the children, he did not go to school, as he had to help his father in the workshop. Only at the age of 13, he learnt to read. From earliest childhood he stood in his father's atelier in Lyon actuating at the top of the loom the vertical strings that lifted and lowered the warp ends just as required by the weaving pattern.

Joseph-Marie hated this monotonous work and decided to leave home as soon as possible in order to make an apprenticeship as a bookbinder.

### Supported by Napoleon

After the death of his parents, 20-year old Jacquard inherited the manufacture and attempted to improve the looms technically, yet without success, leaving him increasingly impoverished. When Lyon became a focus of the French Revolution in 1789, he had to flee from the town. Six years later he returned and again set about automating the loom. Wealthy textile manufacturers recognized the value of his work and started to support him financially. Important improvements of the production process and the looms brought him fame. Finally, even emperor Napoleon began to notice him and helped him to get an appointment at the “Conservatoire des arts et métiers” in 1804. Here, Jacquard found remains of a

mechanical pattern loom which the engineer Jacques de Vaucanson had constructed half a century earlier.

It was Vaucanson, the most famous machine constructor of the 18th century, who had the idea of the steered loom first. Primarily, he designed gadgets like automatic music boxes for the rococo society but he also engaged himself in more serious tasks. Already in 1745, the first prototype of a loom designed by him had been manufactured, which made the production of patterned fabrics possible with the help of a subsequently installed mechanism. He resorted to a cam roller that had already been used in Austria before, that directly lifted the single harness threads by means of small hooks. The pattern size was, however, very limited due to the size and diameter of the roller. Jacquard developed this control further and, around the year 1805, he succeeded with the invention which became a base for the industrial revolution in textile production: The loom operated by punched cards.

The time-consuming and monotonous manual labour of moving the warp ends was finally over.

### Father of the binary system ...

Thanks to the punched card, which contained all information about the pattern that had to be woven, endless weaves of any complexity could be mechanically produced. This “Jacquard loom” was the first programmable machine devoted to “image processing” and laid a cornerstone for today's automation.

Jacquard already separated software from hardware. He also was the first to introduce the binary system in machinery, until today the basic architecture of all data processing machines and computers.

His punched card, that, depending on the pattern, looked more or less like a long punched tape, was an early application of the binary or digital

technology, that is, zero or one. Napoleon, thrilled by Jacquard's invention, granted him a life-long pension as reward. In 1806, the emperor tried to impose the new looms per government decree, but encountered fierce resistance from the guilds, feeling threatened by the gradual automation in textile industry. Nevertheless, the technical progress of Jacquard's looms prevailed.

In the year 1810, he was awarded the cross of the Legion of Honour. Two years later already some 18,000 Jacquard looms were operating in France.

### ... and of the computer

Joseph-Marie Jacquard was 82 years old when he died on 7th August 1834. Half a decade later, the American inventor, Herman Hollerith, introduced Jacquard's punched cards in data processing and thus paved the way for binary computer programming. In 1924, another enterprise developed from the company originally founded by Hollerith: The "International Business Machines Corporation", shortly named IBM. Today in turn, Jacquard weavers benefit from the rapid advancement of computer technology, which came back to its origins after more than 200 years, opening up new possibilities for the production of these fabrics. Jacquard patterns are now read by scan and further processed by computer technology.

### Weaving without limits

There is a long way with various improvements between the first Jacquard machine and the nowadays electronically controlled weaving machines.

Joseph-Marie Jacquard would have presumably liked the latest development: The patented drive concept, DORNIER SyncroDrive®, enriching his invention with an additional degree of freedom, enables weaving without limits.

With DORNIER SyncroDrive®, the shedding device and the mechanical equipment are accelerated using a flywheel. At the same time, the weave of the following weft is read-in and maintained during acceleration. The weaving machine is started as soon as the shedding device has reached the pre-set speed.

Then it is synchronized with the shedding device and the reading of the fabric pattern continues. In that way there are no start or stop marks anymore. When the machine stops, the last beat-up impact is perfectly performed and the last weft memorized. The Jacquard machine then disconnects from the weaving machine and can "slow down" calmly.

### Modern enhancements

How the intelligent drive concept, DORNIER SyncroDrive® improves Jacquard's invention by using the most modern technology also becomes apparent in the significantly reduced vibrations and the extremely low speed fluctuations compared to conventional direct drives. With DORNIER SyncroDrive®, the weaving and Jacquard machine have separate servomotors and linking is accomplished by an 'electronic shaft'. The previous mechanical cardan shaft is eliminated, which has very positive effects on the system: The higher the speed of the cardan shaft during production, the higher the total forces and the larger the machine, the greater the distance between the Jacquard and the weaving machine. Consequently, the vibrations in the framework of the Jacquard machine as well as the floor vibrations are minimized and the harness runs very smoothly with DORNIER SyncroDrive®. Shed closing can be electronically set on DORNIER ErgoWeave® during full speed and different shed closing times are programmable. These settings can be archived together with

the article data making them reproducible. Lower costs, highest operational reliability and outstanding fabric quality put Jacquard weaving once again on a higher level.

### Into the 3rd dimension

If one is looking for a constant in Jacquard weaving, it is to be found in continuous progress. Since lately, this development is entering a new dimension: Technical multi-layer fabrics, (better known as 3D fabrics) are becoming increasingly interesting for various applications. The finished components, produced on the basis of these fabrics, have to fulfill highest mechanical standards in terms of vibration and shock resistance. The defined arrangement of warp threads, in the different layers of a woven grid, determines decisively the quality of preforms for composite parts due to its influence on rigidity and stability. Aerospace and automobile industries, for example, have highest requirements, since traceability and reproducibility are important factors for specification compliance. The latest Jacquard machine technologies permit an efficient production of near-net shaped 3D fabric structures of highest quality in only one working step on DORNIER weaving machines.

For Joseph-Marie Jacquard such a product would have been a new dimension also in the figurative sense as it is still based on his digitalized manufacturing process of 1805.



LEAP A – Jet engine with Jacquard 3D woven turbine blades (2015), © SAFRAN Group

# SEWAGE AND SLUDGE BECOMES WATER AND RAW MATERIAL

The growing world population and industrialization of the developing countries inevitably lead to a rising pollution of our environment. To counter this negative side of progress and to ensure clean air and clear water in a world with an increased focus on sustainability, high-quality, precise filter fabrics are of vital importance. With their help, through filtration and separation techniques, smallest particles (such as solids, droplets or microorganisms) are removed from gases and fluids.



Jingjin's DORNIER rapier weaving machines producing high-precision filter fabrics for wet, solid matter and air filtration

Filter fabrics are used for solid-fluid separation in the areas of environmental protection, the automotive, medical and chemical industry, the domestic sector, acoustic and food industry as well as metallurgy, general and coal mining.

The choice of the right product depends considerably on the later use and the resulting requirements. Besides the material composition, surface weight, mesh size, thread diameter, filter fineness and airflow rate, some other selection parameters such as mechanical, chemical and thermic characteristics of the substance to be filtered play a role. Woven fabrics can be used as the filter itself (fluid filtration) or as carrier for the filter substrate, e. g. of "nonwoven" materials for the filtration of gases.

## Jingjin Environmental Protection Inc.

Already in 1988, the founders of the company foresaw that China would develop into an industry and service community faster than expected thereby massively burdening the environment. In the city of Dezhou, province of Shandong, Jingjin began with the construction of complete filter presses, vibratory centrifuges, conveyor belts and crushers for press cakes, completed by purchased filter fabrics. At an early stage, Jingjin became aware that environmental precautions and also the treatment and recovery of waste in closed circles would gain more and more importance for the economies of states and the world in general. Consequently the company started its expansion abroad, building subsidiaries as well as representa-

tions in 123 countries with a competent support and service team. Furthermore, China's rapid development and increasingly serious environmental problems have brought its government to adopt stricter legislation in the last years with respect to the protection of the environment. This opened up great business opportunities for Jingjin on the local market.

Today, the company with 3,500 employees is the biggest filter press producer in China. In obtaining the certificates ISO 9002 for quality and ISO 14001 for protection of the environment, the company has established itself as one of the best 500 machinery producers in China, which was honoured by the government with the visit of Chinese Prime Minister,

Li Keqiang, on 24th July 2014. One year earlier, Mr. GuiTing Jiang, Jingjin's president, had decided to start producing filter fabrics, which until then, had been purchased from other manufacturers.

This specific requirement also calls for special technical machinery features. In the last 35 years, DORNIER has continually refined its rapier weaving machine for the production of filter fabrics becoming the

A secure and gentle weft insertion is very important for the processing of multifilaments. Lost or overstretched filament wefts would influence the quality negatively in a decisive way. The DORNIER rapier weaving machines offer the right concept featuring positive clamping of all single capillaries during weft take-up and transfer, low weft take-up speed, fine adjustment of weft tensioners and the open shed weft insertion. In addition, multiple weft insertion makes it possible to increase the production significantly without an increase of energy consumption or wear.

In order to weave monofilament screen fabrics of coarser diameters, total warp forces of up to 3.7 tons (37 kN) and more can be realized on the weaving machine. Thanks to the robust construction with gearboxes on both sides and torsion-resistant, toothed rack driven rapier rods, the DORNIER machine has proved itself to be especially suited for these applications.

In addition to DORNIER, Jingjin has also bought other European machines for weaving preparation and finishing. The management places its trust in this modern equipment to reach a leading position on the global market as supplier for high-quality filter presses.

“Convert sewage into drinking water and sewage sludge into raw material” – is the motto of Jingjin Environmental Protection Inc. serving thereby the welfare of every single human being.



Visit of Chinese Prime Minister, Li Keqiang with President, GuiTing Jiang, at Jingjin

His goal was to further enhance the process engineering potential, to increase the level of automation and also the production output of the separation units for a sustainable, future-compatible development.

### The weaving mill

Jingjin's attention to DORNIER was drawn by its filter fabric suppliers providing a reference. In 2013 the first rapier weaving machines were purchased. Shortly afterwards, however, the amount of machines ordered proved to be not enough in light of their business success.

For that reason, additional machines were installed in two stages. Today, Jingjin runs more than 100 DORNIER weaving machines and is one of the biggest Chinese producers of filter fabrics. Mr. Jiang told a DORNIER sales engineer: “I'm very satisfied with the DORNIER machines. They weave excellent filter fabrics which are very important for the quality and functionality of the filter presses.” Jingjin produces the required filter fabrics for this application mainly out of multifilament and monofilament yarns in a fineness range of 350 to 1,000 dtex.

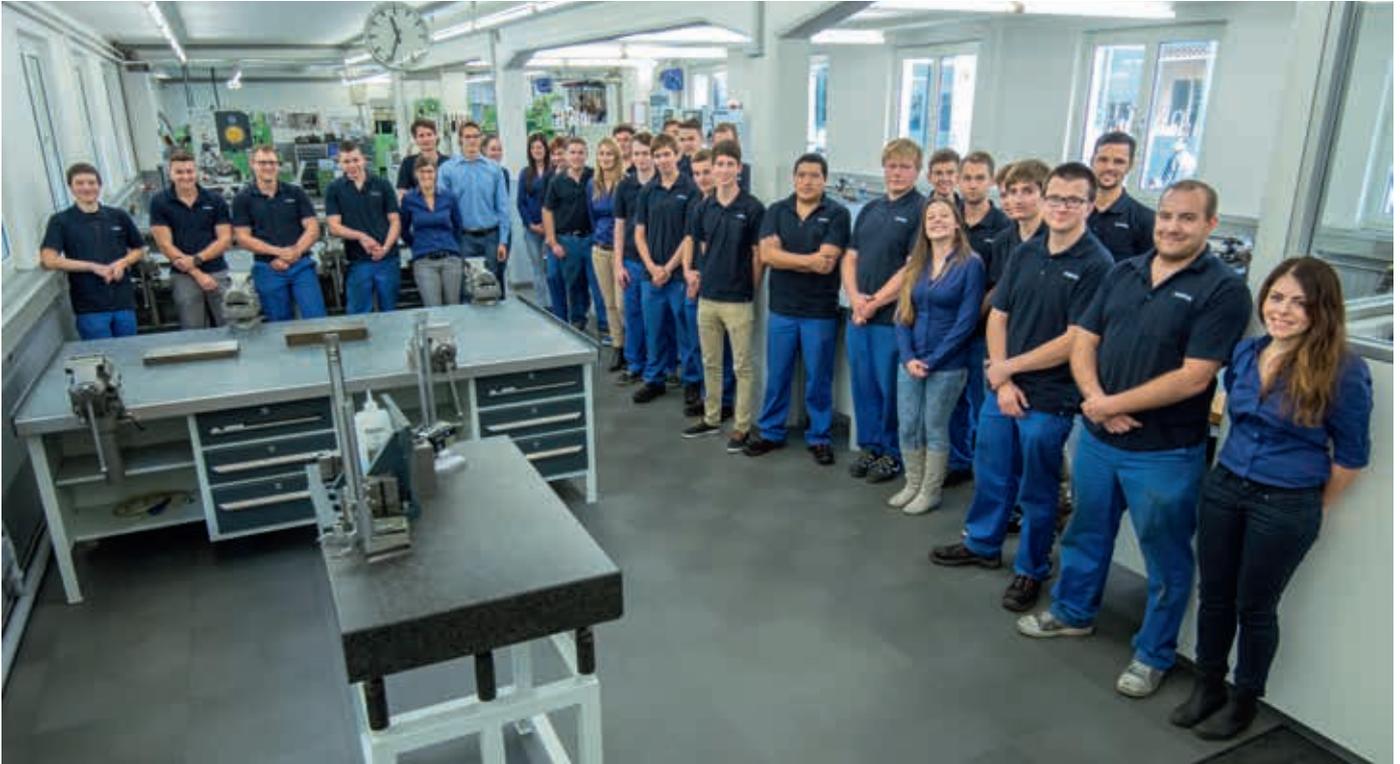
benchmark in this sector. With the heavy duty version of this weaving machine it keeps all options open for future filter fabric developments. In order to achieve the different characteristics of filter cloth such as air permeability, strength and stretching, DORNIER weaving machines feature highest sensibility and flexibility – at the same time providing remarkable power with regards to warp tension and weft insertion. For screen fabrics with defined mesh size, the electronic warp let-off and fabric take-up motion offer highest precision.



Jingjin's high-performance filter press equipped with filter fabric produced on DORNIER machines

# READY FOR THE FUTURE

For DORNIER – since its foundation in 1950 – vocational education is very important, because only well-trained and motivated staff members create the basis to meet future challenges. Even some of our international customers now show a keen interest in this concept of German style apprenticeship.



60 young people currently complete their education in the trainee workshop of Lindauer DORNIER newly renovated in 2014

## State of the art facilities

To ensure the best education for industrial mechanics and mechatronics technicians, DORNIER features two modern trainee workshops, which are equipped with a comprehensive machine park and all kinds of tools. One shop serves for the basic education, the other for the education at electronically controlled machine tools. The basic education comprises manual and conventional metal cutting as well as the acquirement of electric and pneumatic skills. Afterwards, the apprentices learn and work at the most modern CNC turning and milling machines. The technical vocational education starts at a simulator, followed by a practical training until the trainees have turned into autonomous system operators of modern machining centers.

A training room equipped with CAD/CAM workplaces, simulation tools for memory-programmable control systems, industrial robots and, since recently, a 3D printer are also available.

Consequently projects with schools for professional education and universities can be realized faster and better. Moreover, components that have been conceived in the CAD system can be printed into plastic right away. Thus the trainee workshop indirectly becomes a forerunner for prototyping and at a later stage for new production technology in the factory.

## Flexibility and high performance

The German industrial apprenticeship system is split in technical and commercial fields. Furthermore, a distinction is made between dual studies and vocational education. These two dual systems offer great advantages. The apprenticeship comprises a practical part in the company and an academic part at a school or college.

Depending on the type of the chosen apprenticeship, the theory lessons take place in a public trade school or a dual college. Besides technical and eco-

nomical know-how, foreign languages are also part of the curriculum.

During vocational education, the academic part in school takes place simultaneously to the practical part in the company. This means, on determined weekdays, the apprentices attend lessons at the trade school. During dual studies, rotation between theory and practice every three or six months ensures, that the acquired skills are put into practice at an early stage. The company and the school maintain close contact, whereby an efficiency oriented apprenticeship is made possible.

The standard duration of a vocational education is 3 to 3.5 years (depending on achievements and educational background). The apprentices have the possibility to reduce the length to 2.5 years. Dual studies normally last for a standard period of 6 semesters.



DORNIER apprentices working on their project tasks

### Apprenticeship at DORNIER

The company offers vocational education as well as the possibility of dual studies in both sectors: commercial and technical. The apprentices/students pass through various commercial or technical departments in the practical phases. Commercial trainees attend “technical training” in the workshop to acquire a certain technical basic understanding. In return, working in selected commercial departments is an inherent part of the training plan for technical apprentices. Attention is paid to theory and practice coinciding as best as possible. The theoretical knowledge acquired at the dual college can subsequently be applied in the following practical phase in the departments on current company projects. The students are responsible for carrying out special tasks or projects, serving as a practical base for the required project reports or a bachelor thesis. During apprenticeship, interprofessional projects take place, such as the construction of a go-kart with combustion engine or electric drive. Furthermore, on a CNC milling machine which adopts the image data from a scanner online, a 3D figure can be created directly. The apprentices have to plan, organize and carry out the ideas for such projects in teamwork self-reliantly. DORNIER encourages its apprentices to employ solution-oriented working methods, which help them not only during their career, but also get them the feeling and fascination for technology. During the apprenticeship, an intensive cooperation between the apprentices/students and DORNIER creates a strong

relationship. Almost every graduate is employed by the company after completion of their training.

### Side benefits and activities

Besides the basic structure in apprenticeships, DORNIER offers a variety of “extras”.

In order to become acquainted with the two main business units of the company, weaving and special machines, the apprentices and students take part in a two-day weaving machine training. As this cannot be done for special machines, the sales department explains in detail these installations in a presentation.

In addition, foreign language classes are organized for all apprentices and students. One of the highlights during education is a stay abroad in Norway: A group of commercial and technical trainees has the possibility to work at the company of one of our long-time partners in Norway for three weeks.

Once a year, the “apprentice lodge days” take place. The apprentices/students spend a few days with their educational supervisor in a cabin in the Allgäu alps. An external trainer accompanies them and runs special team-building activities. Furthermore, a safe driving education is organized on the ADAC premises in Kempten.

DORNIER contributes to many information events and nationwide apprenticeship initiatives. For instance, the trainees are responsible for the organization of the Girls’ Day – an initiative supported by the Federal Ministry of Education and Research.

### Objective and challenges

DORNIER’s objective is to provide our apprentices and students with a sound, professional education. They get to know the company very well and can be employed in specialized departments at the end of their apprenticeship without a long period of additional training. Thanks to its home-grown employees, DORNIER is able to guarantee high-quality products.

An apprenticeship at DORNIER opens our graduates many doors. Every year, the best graduates are eligible to receive an award. Among them in 2014 Ms. Ulrika Brinz, successfully passed the final examination of her vocational training as industrial business manager at the Chamber of Industry and Commerce (IHK) Schwaben. For her outstanding performance she received the traditional “Sünfzen Prize”, comprising a handwritten certificate as well as a precious silver coin of honour from the “Sünfzen” guild (founded in 1358 in Lindau to promote culture and business).

Regular prestigious awards won by our trainees prove that Lindauer DORNIER prepares its graduates well for the steadily growing demands, also in comparison with international standards.



Ulrika Brinz during her the award ceremony in 2014

## AN ULTRA-LIGHT HEAVY WEIGHT

Modern logistics and packaging technology, especially for perishable goods, permit today that a greater amount of people are more safely supplied with food than ever before in the history of mankind. Polyester films are perfectly suited for this task.

Did you know that those super thin films down to 8 µm (0.008 mm) of thickness can comprise several individual layers, each of them having a particular protective function relevant for the material to be packed?



DORNIER polyester film production line at POLYPLEX manufacturing a 3-layer packaging film with a trimmed final width of 8.7 m

Polyester films are recyclable high-tech products – a fact which is not generally known. Such films must have high barrier characteristics concerning oxygen, flavours, oils, greases, light, humidity and temperature. Furthermore they have to protect against dirt, dust and any kind of damage. Those functions are performed by separate layers, often being eight times thinner than a human hair. Receiving individual print in addition, they become a business card of the company. Therefore, today, film packaging has become indispensable for modern trade of goods. In addition to high stability, the high degree of transparency of the film enables automatic bar code reading without removing the product from its packaging.

### Some far sighted decisions

More than 30 years ago, entrepreneur Sanjiv Saraf founded a company for

the production of polyester films (BOPET) in India. At the time of Polyplex' foundation, no one could guess what would happen in the future. In those days, the production of polyester film was in the hands of few, large, international chemical enterprises in the US, Japan and Europe. The technical know-how for efficient film production was only held by these film manufacturers. At first, the newly founded company required a team of capable engineers coming from the film business. Secondly, they needed a machinery manufacturer who was willing to meet the import regulations dictated by the Indian government, which implied that a certain amount of such equipment must be manufactured locally.

The founder of Lindauer DORNIER, Peter Dornier, had the foresight and was ready to accept the challenge. He already had positive experience

with the sales of textile machines to the Indian market and considered India to have great potential for the future. After a long search, a local cooperation partner to manufacture the ovens for the transverse stretching and crystallizing machine was found. In 1989, the first film line was successfully started up under the guidance of DORNIER, in collaboration with the German companies Barmag and Kampf. Thereby, a partnership has been developed between customer and supplier, based on mutual trust and understanding, creating the basis for the success of such an ambitious project.

### Global expansion

It all started with the first DORNIER plant in Khatima, producing around 4,000 tons of polyester film per year. Today the company has become one of the world's largest producers of



Packaging films

BOPET films with an output of 185,000 tons per year on nine DORNIER production lines.

The most important strategic move for the company's success was early internationalization. It became aware of the necessity to develop closer towards regional markets in order to supply customers more efficiently and at lower costs. Another important reason was, that short delivery distances help to protect the environment. Therefore, over the past years, besides another production plant in Bazpur/India, facilities and representations have been built in Thailand, Turkey and the US. Polyplex continued broadening the product range step by step for creating added value in the end. The first focus was on the production of polyester films (BOPET) with different thickness levels and surface finish for various applications. Later, polypropylene film production lines were added, complemented by offline equipment for metallizing and silicone coating.

As a measure of backward integration, Polyplex built production lines for polyester granulate in India, Thailand, Turkey and the US. Today, Polyplex supplies about 1,600 customers in more than 70 countries.

### Arranging molecular strands

For the production of co-extruded plain film, the different polymer melts are brought together via a multi-layer die and cast onto a cooled roller. From there, the resulting "preform" is guided to the longitudinal stretcher and afterwards into the transverse stretching machine for biaxial stretching. This takes place in two steps. Firstly the "preform" is passed over several heated rollers. The prewarmed film is

then stretched by fast running rollers to approximately 4 times the original length and cooled again. For the second step, a transverse stretching machine is used, equipped with clip chains to grip the film edges. In its oven the film is heated and stretched up to a width of 8.7 m, depending on the size of the film line. The unique technical features are the clamping elements (clips). The DORNIER clips with roller bearings are suitable for all levels of thickness, from thin films (0.8 - 50  $\mu\text{m}$ ), through medium thicknesses (50 - 125  $\mu\text{m}$ ) to thick films (< 350  $\mu\text{m}$ ). At speeds of up to 30 km/h the clips have to withstand high permanent mechanical forces at extreme temperatures without lubrication. In a last process step, the stretched film is crystallized. During this process, the film is still clamped to the clip chain with a constant width at temperatures of about 220 - 240° C. The stretching "arranges the molecules" and forms the film's characteristics such as tear resistance, gloss and transparency.

### A sustainable philosophy

In order to develop their activities in an environmentally friendly manner, Polyplex, as a company, values optimum energy use and waste management comprising reclaim, recycling and reuse of materials. It attaches great importance to emission and waste reduction as well as raising staff awareness by efficient communi-

cation and training. Polyplex has also taken extensive initiatives to reduce the impact on the environment:

- Switching from fuel oil to husk for oil heatings in India, thereby reducing gaseous emissions
- Development of solutions for the recycling of film-based waste at the end of its lifetime
- Monitoring of CO<sub>2</sub> emissions at all production facilities

Sanjiv Saraf, founder, Chairman and principal shareholder of Polyplex Corporation Ltd., has additionally launched other business segments like investments in renewable energy with the installation of small hydro-power plants. As a humanist, he takes a personal interest in several projects of the company which also include a non-profit school for 1,200 pupils.

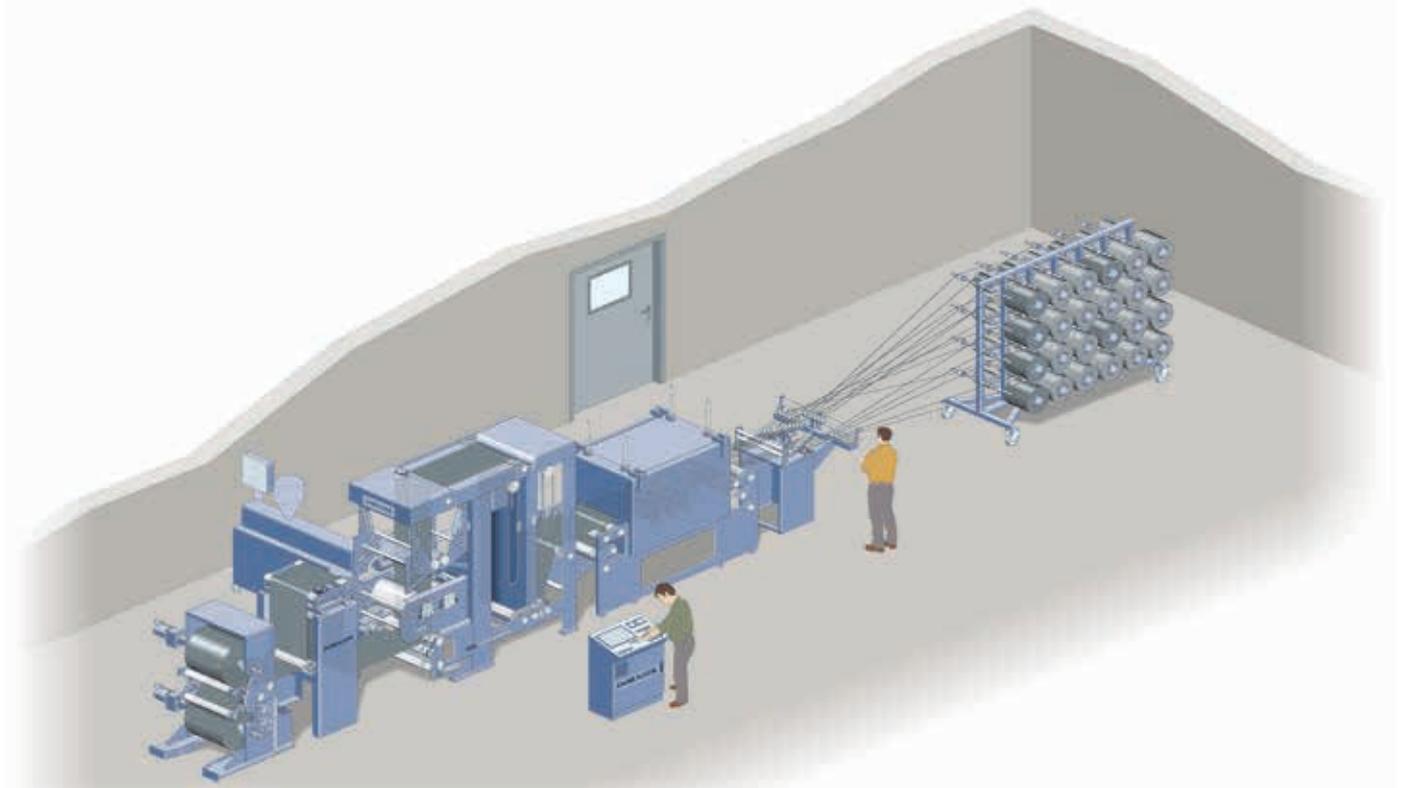
Adapting dynamically as well as quickly to the ever-changing world, was and is an exciting journey for Polyplex. Thanks to on-going investments in new technology and further developments cooperating with suppliers like DORNIER, the company sustainably contributes to the protection of our environment and its population.



Take-Up and Transfer (TUT) unit of a modern DORNIER film production line

# DORNIER COMPOSITE SYSTEMS®

Fiber-reinforced plastics (FRP) are a material class with very high technological and economical potential. Under the newly formed brand "DORNIER Composite Systems®", Lindauer DORNIER offers machines and installations for the production of textile reinforced preforms serving the fiber composite industry.



DORNIER ToTaP line for the manufacturing of unidirectional fiber tapes

Textile light-weight construction topics gain relevance in many sectors of industry. Legal regulations and energy costs are boosters in traffic engineering. The performance of wind power plants is enhanced by light-weight constructions and in mechanical engineering the weight of components can be reduced. This increases productivity. Furthermore, textile light-weight constructions contribute considerably to fulfill ecological goals, especially concerning CO<sub>2</sub> reduction, and – thanks to weight savings – to a more sustainable world.

The use of fiber-reinforced plastics (FRP) on the basis of carbon and glass fiber, offers an interesting profile of properties. This comprises lower weight than metallic materials with even better mechanical characteristics. The potential can be ideally used for example by arranging the fibers in direction of the acting forces. In addition, the used matrix material (thermoplastic or thermoset) plays an

important role for the achievement of specific component characteristics.

The quality assurance for automated processes and the number of possible material combinations put high demands on the flexibility of production resources.

### A unique combination

The aim of DORNIER Composite Systems® is to supply machines and plants for the flexible and economical production of high-quality semi-finished composite products. Our skills in textile and plastics technology complement each other perfectly. The result of this cross-departmental cooperation is an innovative product line consisting of three different machine types: A tape production plant, a tape weaving machine as well as a technology platform for 3D fabrics. In the newly founded department of Composite Systems (CS), projects of this topic are developed in close teamwork with the customers.

### Spread tape production

Base material for the production of composite components are wound fibers (rovings). The use of cost-efficient "heavy tows" (rovings with a high amount of filaments) is thereby interesting from an economic point of view. The conflict of objectives between cost-efficient material and good mechanical attributes such as a low area weight, is solved by spreading the rovings. For stabilisation of the spread fibers (tapes), a lateral-fixation is necessary for the following production processes.

In order to fulfill the various requirements, a modular concept for the tape production unit has been chosen. The DORNIER Toolbox for Tape Production "ToTaP" serves as a guideline. The process starts with the controlled pull-off of the rovings from the creel. Afterwards they are spread to their defined width and the tape is stabilized with a small amount of powder, melt or suspension. Only then, the

fiber material is mixed with the plastic matrix adjusting the fiber volume content. Casting dies, calenders or blade systems are suitable for this step. The fully impregnated tape can be cut to a defined width and wound onto pancake spools.

The process is suitable for the production of tapes for thermoplastic fiber composite material as well as intermediate products of thermoset FRP. In the latter case, matrix compatible materials are used for fixation and full impregnation is not required. A “dry” tape is produced that can be processed further, for instance, by Resin Transfer Moulding (RTM).

There are two possibilities to produce tape by DORNIER's ToTaP method: For “single tow spreading” (STS), the rovings are separately spread to the final width, treated and each of the tapes individually wound onto a coil. The number of rovings equals the number of tapes.

During “multi tow spreading” (MTS), all rovings are spread together in a set. The full width tape is fixed, impregnated and slit into single tapes. From a specific number of rovings it is possible to produce any number of tapes.

“Heavy tows” can thus be processed to narrow tapes with a low area weight. The working width of the commercially offered DORNIER ToTaP line is up to 600 mm. In our “Technology Center” a laboratory plant with a width of 70 mm is available for customer trials and internal development projects.

### **DORNIER tape weaving machine**

Compared to other reinforced textile semi-finished products woven fabrics have advantages: High reproducibility, high degree of automation and production efficiency, precise fiber orientation as well as good drapeability. A tape weaving machine has been especially designed for the production of high-quality tape fabrics. This mono rapier machine processes weft tapes with a width of up to 25 mm. A unique “zero twist feeder” is used for the necessary twist-free weft insertion, which works according to the yo-yo principle and ensures a continuous production.

Complex kinematics provide a safe and precise weft tape presentation. As a classic reed beat-up cannot be used with sensitive weft tapes, a new, patented fabric creation system has been developed, where the fabric is moved backwards in direction of the reed. A clip-down holder temple, moving synchronously with the fabric, positions the last inserted weft tape. The warp system has been developed for processing tapes of up to 40 mm width. In a special creel, the individual bobbins are mechanically braked, ensuring a constant warp tension.

### **High-quality tape fabrics**

With this new DORNIER tape weaving machine, also tapes sensitive to slipping can be woven with minimal undulation. The flexibility of the machine is very high, even fully impregnated tapes can be processed. In numerous weaving trials, tapes made from carbon, glass, aramid or other synthetic fibers were converted to high-quality fabrics.

In combination with the DORNIER ToTaP plant, the customer is able to cover the complete process chain from fiber rovings to textile semi-finished products.

### **A new dimension**

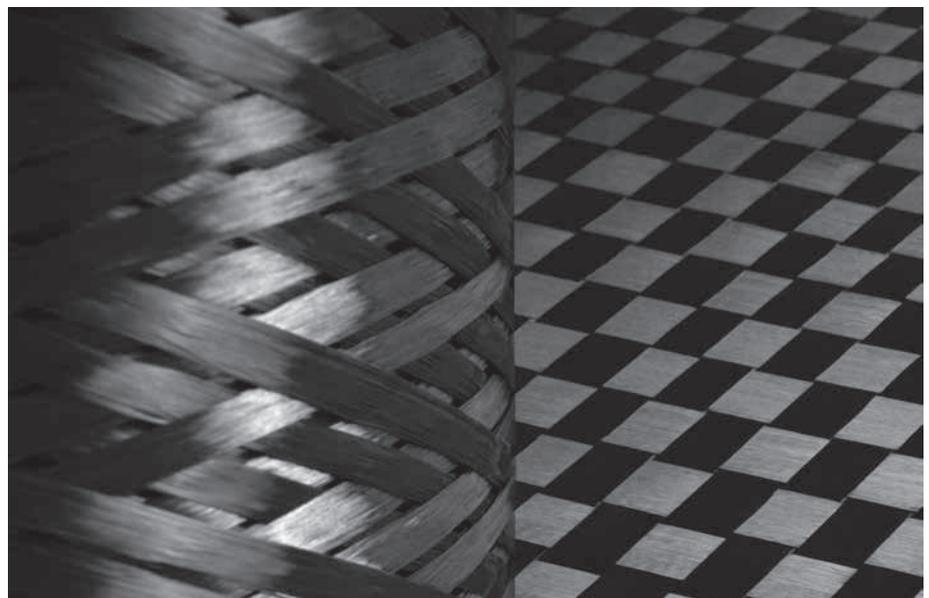
Fiber-reinforced plastics usually have a layer type structure. For components exposed to high impact loads, there is a risk of delamination in case of damage. By intentionally inserting fibers vertically to the layers, the com-

posite structure can be reinforced and delamination is prevented effectively. The 3D weaving technology enables the production of such reinforced, multiple layer semi-finished products. Using the most modern Jacquard technology, high reproducibility and documentability of production is ensured. Near-net shape structures can be created, which reduce the rate of manual process steps, waste and ultimately manufacturing costs.

### **Modern “Technology Center”**

In the DORNIER CS “Technology Center”, a ToTaP tape production plant, a tape weaving machine as well as a 3D Jacquard weaving machine are available for trials. A building extension, realized in 2015, permits test runs of installations together with customers. The in-house test laboratory allows relevant parameters to be determined and their dependence on process and material data to be evaluated. At the headquarters in Lindau a team of experts continuously further develop the product line according to our customers' needs.

The technological and economical potential of the production technologies devised at DORNIER Composite Systems® is high. To ultimately reach more efficient fiber composite components, an even closer cooperation throughout the value chain is necessary and actively pursued by DORNIER.



Carbon tapes and tape fabrics produced on DORNIER Composite Systems® technology

# THE “GREEN” WOOL

It all started with the water coming from the Alps and cutting its way through the mountains of the province Biella in direction to the river Po. The clear water is ideal for fully integrated wool businesses, which have to wash their raw materials several times during production. Surely, that is the reason why this Italian region is called the “Promised Land” for the finest, highly fashionable men’s outerwear fabrics.



Sheep farming of Successori Reda S.p.A. on New Zealand pastures

## Humble beginnings

We are writing the year 1865. In the small hamlet of Croce Mosso, near the town of Biella, a great story begins, that is deeply interlaced with the passion for wool and the entrepreneurial spirit of a man – the company’s founder and name giver, Carlo Reda. He transformed a simple factory into a remarkable wool spinning mill, which was taken over by Albino and Francesco Botto Poala in 1919. Since then, the company continuously invested in its own growth, producing fabrics which distinguish themselves by their elegance and beauty. In 1968, a flood destroyed the factory premises, but not the motivation of the entrepreneurs. They seized the opportunity to reconstruct their factory as a springboard for technical innovation. In the following decades, the company pushed its expansion abroad by cooperating with the world’s top men’s fashion houses. Although nowadays approx. 85% of

the collections produced are exported, the Reda as wool mill epitomizes “Made in Italy”, since the complete production process, from the greasy wool to the finished fabrics, takes place exclusively in Croce Mosso.

## A fully vertical approach

The main pillar of sales are high-quality fabrics, which are used in the Haute Couture for the production of classic men’s wear. Twice a year Reda presents its new collections, that consist of an average of 2,500 different fabrics to its customers. The focus is set on spontaneity and phantasy, on fine, soft but high-performance fabrics that have gloss and style suiting perfectly for every occasion. As Reda became aware of the fact that the quality of these fine fabrics depend decisively on the purchased wool, they decided to take over their first own farm in New Zealand in 1993. Later on, the company acquired two other farms with a total of 30,000

hectares and 30,000 merino sheep. Only this enabled them to ensure complete control and traceability over the entire process chain. In 2010, Reda started a second mainstay: A sportswear line, named “Rewoolution”, made of pure merino wool, awarded with the Zque certificate of the New Zealand wool association as a quality seal. “Rewoolution” is a functional clothing line with outstanding wearing comfort. Merino wool is antibacterial, breathable, thermo-regulating, quickly drying, easy-care and water-repellent. Protecting against ultraviolet rays, it is odourless and does not itch. The latter became possible because Reda was the first wool spinning mill to exclusively use the Compact<sup>3</sup> spinning method - which increased the value of the wool yarn produced by Reda even more. Compared to yarn spun in a classical way, it has a higher strength, lower hairiness and thus improved processing properties.

The company's major sales markets are Germany, Italy, Japan, the US and China. At an annual output of 6.5 million meters of fabric, the turnover in 2014 increased by around 15% to 80 million Euros, employing 380 people. Francesco Botto Poala, since 2003 Managing Director of Reda S.p.A. in the fourth generation, expects a



Francesco Botto Poala

further increase this year. In order to reach new target groups worldwide, the classic channels of distribution were complemented in 2013 by Reda's modern e-commerce platform with its own online shop.

### The weaving mill

Already in 1986 the company decided to invest in Japanese air-jet weaving machines. Over the years it became obvious that despite the use of high-quality merino wool the higher performance of these air-jet weaving machines could not be exploited in an optimal way. This incited Reda to carry out trials in Lindau, getting an impression concerning the performance of DORNIER air-jet weaving machines. Their advantages – gentle weft insertion (senza pelosità, which means no hairiness of the fabric) – the reliability of the automatic filling repair and the elimination of start-marks in fine wool fabrics resulted in an essential improvement of the fabric quality. The positive results of these trials led to an initial order of DORNIER air-jet weaving machines in 2007. Three years later, the first air-jet weaving

machines with the new DORNIER FT electronic control system were delivered. They provided energy saving as well as yarn and material protection and are equipped with the patented DORNIER SyncroDrive® system. Consequently the energy costs were reduced by 10% per m<sup>2</sup> of produced wool fabric. Today, worsted yarns of all yarn counts are processed to high-quality fabrics on more than 100 DORNIER weaving machines. Meanwhile, two thirds of these air-jet weaving machines are equipped with DORNIER's SyncroDrive®, a unique drive technology in the field of weaving machines. This technology makes it possible to fully exploit further developments in spinning and weaving shop preparation concerning speed and fabric quality. In the course of new investments during 2014, all remaining tape rapier weaving machines were replaced by DORNIER positive rapiers. The latter are used for special articles completing the picture of the DORNIER system family at Reda.

### Quality and sustainability

Thanks to its ecological company policy, in 2010 Reda was awarded the EMAS environment certificate - an initiative of the European Union encouraging companies and organizations of any size and business to continuously optimize their environmental performance. Sustainability and environmental compatibility shall be stimulated, legal environmental regulations respected and improved to strive for constant reduction of the companies environmental footprint.



High-quality woolen fabrics by Reda

Reda can guarantee this through:

- Production exclusively in Italy
- Use of pure merino wool
- Production cycle with continuous quality controls in the farms, the wool combing works, worsted dyeing, spinning, twisting and weaving mills and the finishing – up to the manufacture of Reda "Rewoolution" clothing
- Introduction of environmentally sound technologies, especially for water treatment
- Eco-friendly organisation of operating procedures for energy recovery and own power generation by photovoltaic systems generating a peak value of 500 kilowatts, thus enabling a limitation of CO<sub>2</sub> emissions.

"Respect for the people and the environment" – these are the values and principles pushing company Reda to stay competitive with high-quality fabrics also in the future.



Reda's modern weaving plant with DORNIER A1 air-jet weaving machines

Quality creates value

**DORNIER**



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