



**METER · MIX · DISPENSE**

# **WIND POWER INDUSTRY**

**SOLUTIONS FOR THE  
PRODUCTION OF  
ROTOR BLADES**





# We understand the challenge

## Sturdy quality for extreme conditions

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At rotor speeds of up to 400 km/h, even rain drops can be a threat. With innovative solutions, we help to ensure that everything runs smoothly – even under extreme conditions.

The wind power industry is a steadily growing market with great potential for plant manufacturers and rotor blade producers. Besides the growing needs of onshore wind power plants, especially the offshore industry rejoices in a strong demand. For instance, off the coasts of Northern Europe, large offshore wind farms are installed that constantly produce energy due to the favorable wind conditions. The individual wind turbines, however, have to withstand extreme weather conditions – on a permanent basis.

In Germany alone, already about 15% of the energy are generated by means of wind power plants. If nothing else, the joint signature of the international climate agreement by all member states of the United Nations shows that the negotiated climate targets can only be achieved by consequently implementing the generation of renewable energy. Here, the wind energy makes a significant contribution.

# New dimensions

## Trends in rotor blade production

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The development in the past years has shown that the blades of wind turbines reach new dimensions due to the requested output.

With the aid of carbon fibre preforms combined with the usual glass-fibre reinforced materials, blade lengths of more than 80 meters can be achieved today. The risen demand of reinforcing fibre layers leads to an increase of the mold cycles and of the tonnage for infusion and adhesive resins as

well as coating materials. This means that the systems used to supply mixed materials as well must be able to meet the growing requirements. This also applies to the particularly high quality requirements in the offshore range.







# To make everything run smoothly

## DOPAG solutions for the production of rotor blades

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As leading manufacturer of metering and mixing systems for the wind power industry, DOPAG provides the comprehensive portfolio needed for the various applications for the production of rotor blades.

The DOPAG offer comprises infusion systems with flow rates of more than 60l/min and adhesive-resin systems being able to process masses of more than 30kg per minute. This ensures minimum mold cycle times. Due to the high resin consumption of the infusion process and to the high quality requirements of composite fibre components, resin degassing systems must be used. Here, DOPAG offers a validated system that is able to degas more than

40 liters of resin per minute.

Furthermore, for surface finishing of the turbine blades, a broad range of gel coat systems and of systems that mix anti-erosion coatings and filling compounds is offered. Moreover, DOPAG developed innovative materials e.g. for leading-edge sealing to avoid damage caused by water drops on the blade tips rotating at speeds up to 400km/h.

### DOPAG – Competence that pays off

- Reliable and precise metering and mixing technology
- Global distribution and service
- Decades' worth of industry experience
- Broad product portfolio
- Dedicated technical centre

# A rotor blade is produced

## Use of metering and mixing technology by DOPAG

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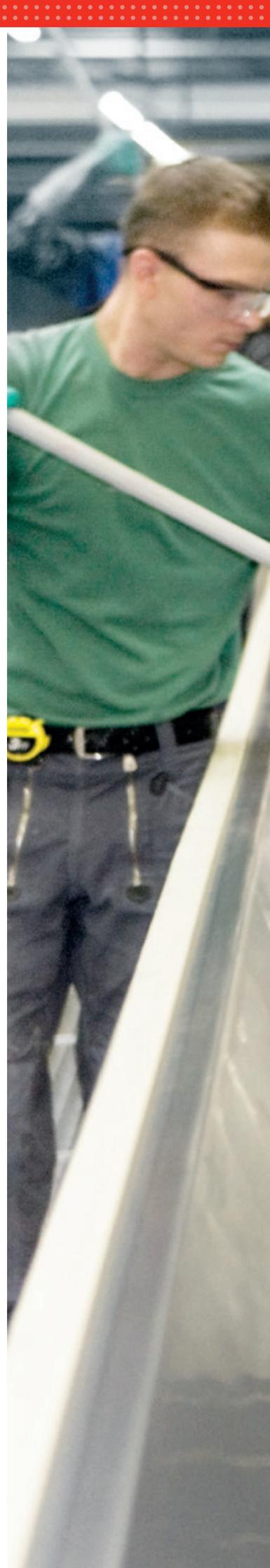
During operation, rotor blades are exposed to extreme stress, so even the smallest production faults can have severe impacts.

In general, rotor blades consist of glass-fibre reinforced plastics and reinforcement materials such as Balsa or foamed materials that transfer the shear stress. The production process begins with the manufacture of the upper and lower shells. As the first layer, a gel coat is applied using the gelcomix metering system to give the component a high-quality surface finish. Afterwards, dry fibre preforms are placed into the mold and provided with so-called auxiliary means, before the complete component is vacuum sealed with a foil and evacuated. This guarantees minimum porosity.

Further steps are degassing of the infusion resin and the actual infusion process. Degassing is required because various air bubbles may form both due to the contact with air and to the transport and these bubbles might lead to undesired air pockets in the fibre composite during the vacuum build-up.

Degassing removes even the finest bubbles from the material with high reliability. By means of hoses, the compomix-type infusion system is directly connected to the vacuum generation unit. As an alternative, surge drums may be used that are fed with mixed material and are also connected using infusion hoses. After the infusion, the mold is cured. During this process, the temperature is precisely monitored and controlled to make sure the material is not damaged due to the exothermic reaction of the resin.

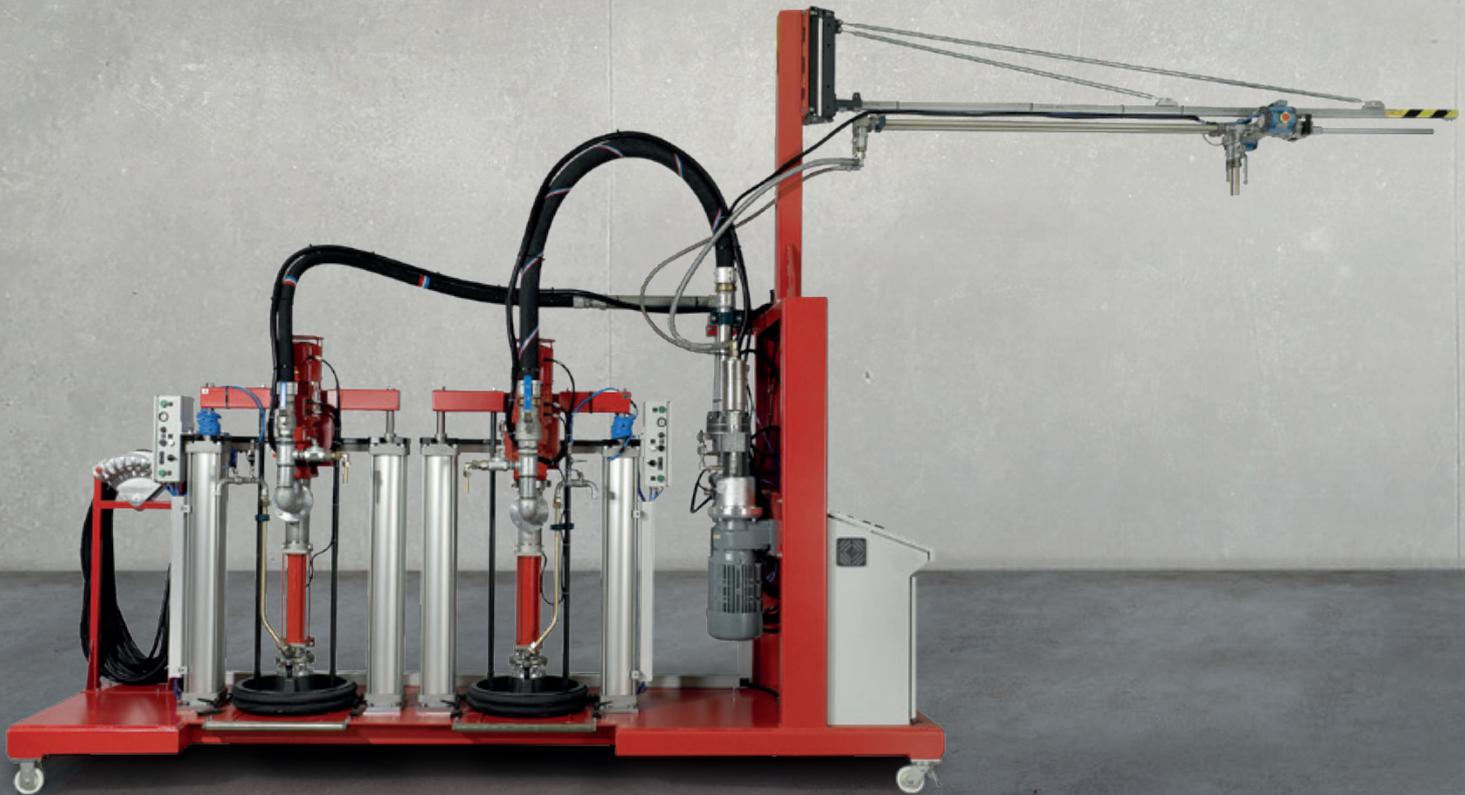
After the component has completely cured, any excessive auxiliary means are removed and the bonding of the stiffening members and the two shell halves begins. Adhesive beads are applied with an adhesive mixing system of the gluemix type. After this process has been finished, the mold halves are closed and the complete rotor blade is produced.





# Our products for the production of rotor blades

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# Overview

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The share of wind power in the generation of electrical energy will further increase in the years to come. Effective power generation, however, is only possible if a long life of the systems can be combined with maximum performance. This requires threshold parameters for the production to be strictly observed.

Demands on automated metering and mixing systems for the production of rotor blades:

- Precise maintenance of the specified mixing ratios
- High flexibility in terms of the flow rate
- Fast reaching of the working point

For the three basic production processes for the manufacture of rotor blades in the wind power industry (manufacturing, bonding and surface finishing of the rotor blade segments or of the rotor blade halves), DOPAG offers the optimum industrial manufacturing equipment:

**compomix** for vacuum-assisted infusion (saturation of the fibre mats placed into the mold)

**gluemix** for bonding the rotor blades or blade segments

**gelcomix** for coating the rotor blade surface



# compomix BL



A deviation of less than 1% of the mixing ratio can not only be achieved with the compomix I, but the output rate can also be modified during production. Depending on the system configuration, magnetically-coupled, leakage-free axial piston pumps are used, which due to the principle of construction present no internal leakage during changes in rotational speed. Additionally, they are hermetically sealed at the drive end which is important when feeding hygroscopic hardeners. The metering

system range for the processing of unfilled infusion resins combines highly accurate metering pumps with extremely fast control engineering. Metering is carried out from a regulated by-pass so that the normal initial process of filling the mixing tube is avoided. In addition, the output rate can be changed during the metering process almost at will – without exceeding the permitted tolerance limits of the metering ratio.

## Equipment

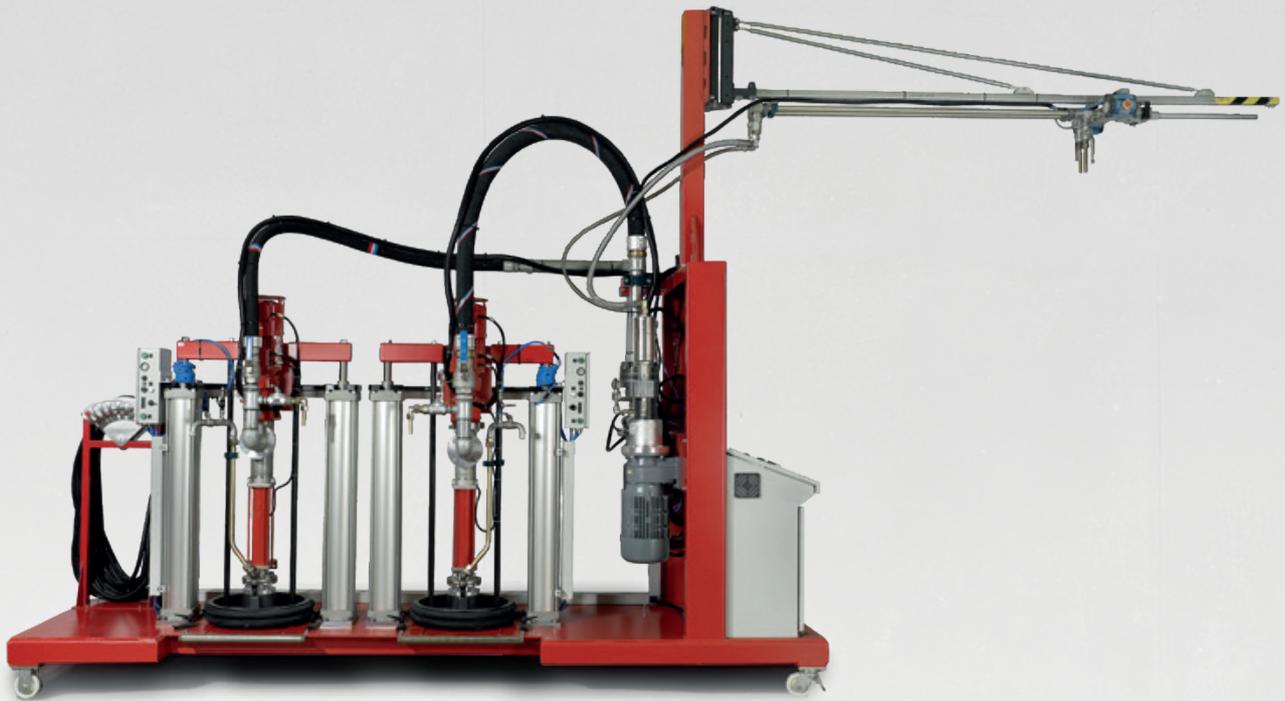
### Standard

- 2K system
- Control cabinet and material pressure vessel mounted onto a completely enclosed, mobile chassis
- Metering pumps with overpressure protection
- Axial piston pump of the B-component with magnetic coupling and manual stroke adjustment
- Three-phase asynchronous motor with external fan
- Metering computer MR40
- Control and regulation of mixing ratio by use of volume counters
- Material pressure vessel with preparation for automatic refilling, level control and regulation of the mixing ratio in the bypass
- Heating via fan heater

### Optional

- 3K system
- Material pressure vessel with preparation for automatic refilling, level control and regulation of the mixing ratio in the bypass
- Axial piston pump with magnetic coupling for the A-component
- Feed pumps
- Heating via fan heater
- Cabinet cooling
- Touch-screen control system

# gluemix



The reliability of the bonding of both halves of the rotor blades is a fundamental aspect of the performance of a rotor blade. With the gluemix the highly viscous glue is processed via high precision gear metering pumps. The material feed from the 200 l original drums is realised with eccentric screw pumps mounted on follower plates.

The pumps are equipped with special sealing systems and additional wear protection. This allows the processing of glass-fiber filled adhesives.

## Equipment

### Standard

- 2K system
- Control cabinet and material pressure vessel mounted onto a completely enclosed, mobile chassis
- Mast and boom with mixing system mounted on the chassis
- High pressure pump rams or material pressure vessel with level control
- Metering pumps with overpressure protection
- Three-phase asynchronous motor
- Metering computer MR40
- Control and regulation of mixing ratio by use of volume counters

### Optional

- 400 l buffer drum
- Automatic refill
- Hose and cable reels
- Cabinet cooling
- Touch-screen control system

# gelcomix



The gelcomix has been especially developed for processing highly thixotropic materials onto the untreated surfaces of rotor blades. Output rates of up to 5 l/min can be achieved with gear metering pumps, which are also suitable for abrasive fillers. Magnetically coupled axial piston pumps are used for

the B component. The material is supplied from material pressure vessels that are installed on the chassis of this mobile system. With gelcomix technology, materials with viscosities of up to the flow limit can not only be applied but the mixing ratios are also adjustable within a wide range.

## Equipment

### Standard

- Control cabinet and material pressure vessel mounted onto a completely enclosed, mobile chassis
- Material pressure vessel with level control
- Metering pumps with overpressure protection
- Metering pump of the A-component with glide ring seal and coated
- Three-phase asynchronous motor
- Control and regulation of mixing ratio by use of volume counters
- Metering computer MR40
- Mast, boom and balancer to handle the manual pistol mounted on the chassis (5 l-system)

### Optional

- Metering pump of the B-component with magnetic coupling
- Automatic refill
- Heating system
- Cabinet cooling
- Touch-screen control system
- Hose and cable reels (5 l-system)

# Technical Data

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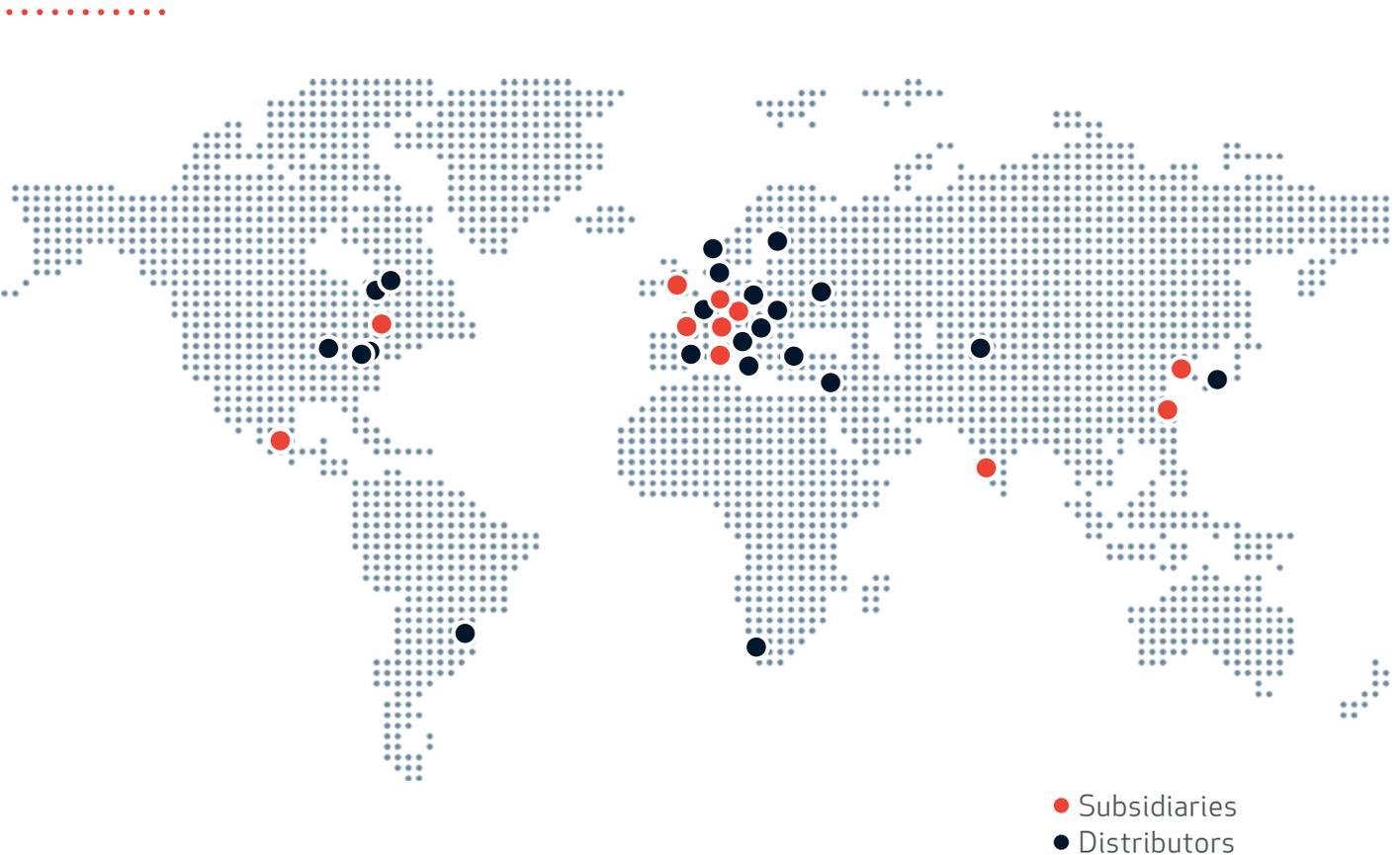
|   | compomix  | gluemix   | gelcomix                                      |
|---|---|---|---|
| Flow rate<br>depending on mixing ratio<br>and viscosity | 2 – 20 l/min (60 l/min)                                       | 3 – 20 l/min  | 1 – 5 l/min                                   |
| Mixing ratio  | 100:5 – 100:100,<br>volumetric                                | 100:10 – 100:100,<br>volumetric                                     | 100:10 – 100:100,<br>volumetric               |
| Material supply   | circular pipeline,<br>original container,<br>pressure vessels | Pressure vessels,<br>original container<br>(depending on viscosity) | Pressure vessels                              |
| Viscosity range   | 1 mPa s – 50.000 mPa s  | 10 mPa s – 500.000 mPa s  | 100 mPa s – 80.000 mPa s                      |
| Material characteristics                                | Unfilled  | Unfilled, filled, abrasive<br>MOHS hardness 7                       | Unfilled, filled, abrasive<br>MOHS hardness 7 |
| Power supply  | 400 VAC 3/PE / 50/60 Hz                                       | 400 VAC 3/PE / 50/60 Hz   | 400 VAC 3/PE / 50/60 Hz                       |
| Max. air inlet pressure                                 | 6 bar   | 6 bar   | 6 bar   |
| Dimensions L × W × H                                    | 1350 × 1850 × 2100 mm   | 3700 × 1100 × 4100 mm   | 2500 × 1100 × 4100 mm                         |
| Weight  | ca. 1500 kg   | ca. 2200 kg (12l)<br>ca. 2500 kg (20l)                              | ca. 1500 kg                                   |



We are one of the world's most experienced manufacturers of high-quality metering technology. Wherever adhesives, resins, silicones or lubricants are metered and applied in industrial production, we offer reliable, precise solutions. We provide systems and components for highly automated production processes, including for the automotive, wind, household appliances and electrical industries, as well as for aviation and space travel.

DOPAG is part of the HILGER & KERN GROUP, a reliable supplier, development and service partner to industrial companies in a variety of market segments for over 90 years. The group employs around 350 people and has subsidiaries and distributors in more than 40 countries.

## Worldwide sales and service



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