Steel solutions for the construction of offshore wind energy plants

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ABSTRACT
Large amounts of steel are used for the construction of wind energy plants. The towers and the foundations of modern wind energy plants require steels with special mechanical properties regarding toughness, strength and weldability. Modern high-strength fine grained steels combine the advantages of high strength properties with an optimum cost/performance ratio. They enable the use of constructions with wall thickness reductions.

This article gives an overview on the production, properties and processing behaviour of high-strength steels for applications in wind energy plants. Further an insight into modern methods of computer modelling for optimisation of mechanical properties and steel processing is given.

KEY WORDS

INTRODUCTION
The wind energy industry has developed in the last years to an important economic sector. The present state of the art in wind energy technique are plants with up to 5 MW installed power (Fig. 1). Until end of the year 2006 the total installed power of wind energy plants in the world will reach the amount of more than 60,000 MW. Roughly calculated, this is the consumption of 35 million average middle European households. In times of carbon dioxide restrictions by international laws the generation of power by wind energy gets more and more interesting even from the economic point of view. The countries with the highest installed wind energy power are Germany (~18,000 MW) followed by Spain (~10,000 MW), the USA (~9,000 MW), India (~4,500 MW) and Denmark (~3,100 MW, the numbers in brackets show the installed wind energy power at the end of the year 2005, roughly).

Fig. 1: Offshore wind energy plants (© REPower Systems AG)

Fig. 2 shows the development of the new installed wind energy power per year in Germany since 1990 and gives a forecast for the next 20 years. This includes the installation of new wind energy plants as well as the so called repowering, i.e. the replacement of old wind energy plants through bigger and more efficient new wind energy plants. Even with careful calculation it is clearly visible, that for the future a remarkable amount of special structural steels for wind energy plants is needed.

Steel is one of the most important materials in the construction of wind energy plants. The most common types of construction for wind energy plants are steel tube towers. The amount of steel required only for the tower itself can be calculated approximately with 80 t/MW installed power. For the foundation of the steel towers different constructions are used, e.g. monopile, jacket of tripod foundations. For these constructions steel is the optimally suitable material due to its good mechanic characteristics.