Steel and wind energy

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Example of an offshore wind farm

How steel is improving the efficiency of wind turbines

Wind power is an increasingly important part of the renewable energy mix in many countries around the world. ArcelorMittal is uniquely placed to provide the steels and logistics to create the support structures and electrical gearing required to realise the full potential of the wind.

As global concerns about climate change grow, wind energy is beginning to make a significant contribution to the world's sources of renewable energy. The United States government has set a goal to produce 20% of energy needs from wind power alone by 2030. In Europe, the target is 20% of energy needs from renewable sources by 2020.

Kinetic transformation

Wind turbines transform the kinetic energy of the wind into electrical energy which can be utilised in the local grid. The turbines consist of the following main parts:

- A platform (base)
- Tower
- Blades
- Nacelle which contains the generator
- Electric-grid connection gear including a transformer

All wind turbines utilise electrical steels in the generator and transformer, while around 85% of all installed wind turbines have a tower that is made from quarto plate, also known as heavy plate.

It takes between 225 and 285 tonnes of steel to build an onshore wind turbine. Grades utilised in the tower range from cast iron to quarto plates. Between 150 and 180 tonnes of quarto plate goes into the tower alone. This includes the body, doors, frames, and the foundations of the structure.

In both the generator and the transformer, high-grade electrical steels are used. The generator at the top can weigh up to 100 tonnes.

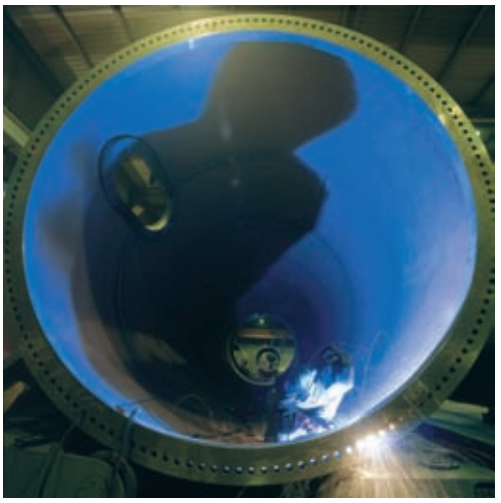
Prefabricated for quick assembly

A benefit of steel towers is that they can easily be prefabricated and transported to site. Once the foundations and civil work are complete, it is possible to erect an onshore steel turbine tower within one to two days. By contrast, concrete towers can take around a month to erect without a foundation.

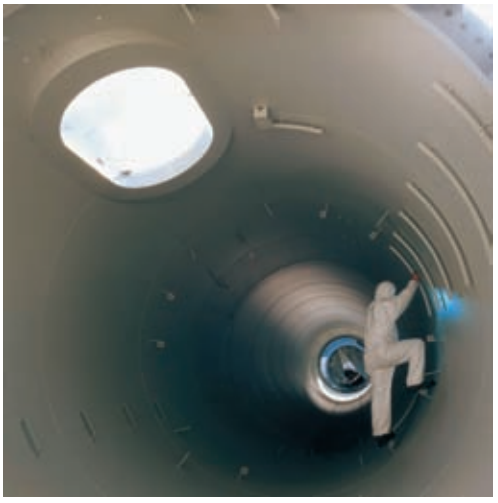
Tower bodies are almost identical whether they are installed on land, or in vast offshore wind farms. The main difference is that in offshore installations, a foundation is needed to anchor the tower to the sea bed. The type of foundation differs depending on water depth, however, steel is often preferred.

Today the ArcelorMittal Asturias quarto plate mill in Gijón (Spain) is one of the leading suppliers to major wind turbine companies. The mill has supplied plate for more than 3,000 wind turbine towers since 2005. Quarto plates for turbine towers are also produced at ArcelorMittal Galati (Romania).

Wind turbine with steel tower



Steel tower undergoes final assembly before transport to site



ArcelorMittal is actively working with turbine makers to develop new multi-megawatt tower designs.

Future potential of wind

Depending on height and the prevailing wind speed, wind turbines can generate between 0.85 and 3 megawatts of power. New designs are aiming to increase this to 5 MW per turbine and more. The wind turbine industry estimates that each MW of wind power saves around 1,500 metric tonnes of CO_2-equivalent emissions each year of the turbine's life. (Source: Gamesa, Vestas)

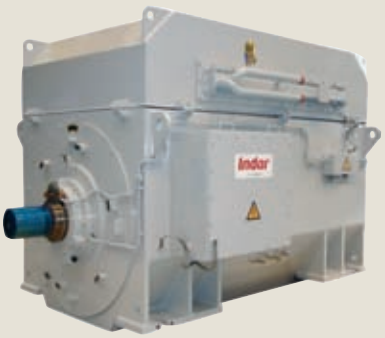
ArcelorMittal is actively working with turbine makers to develop new multi-megawatt tower designs. With its global presence, ArcelorMittal is uniquely positioned to supply turbine makers with the steels they require in a timely fashion.

Electrical steels power the future

Electrical steels play a vital role in transforming wind energy into power that can be fed into the local electricity grid. They are typically used in the generator and transformer which are housed in the nacelle at the top of the turbine tower. Each electrical steel is specially tailored to produce certain magnetic properties.

There are two types of turbine: geared and gearless. Each requires very different types of electrical steel.

Geared turbines have a gearbox which enables the speed of the blades to be regulated. As high rotation speeds can be achieved, the generator can be smaller than that in a gearless turbine. Low-loss, non-oriented electrical steels are needed for this type of generator.



An example of a generator (picture by Indar)

Gearless turbines always turn at the speed of the wind. They are beneficial at locations where maintenance is difficult, such as offshore. This type of turbine requires high permeability, non-oriented electrical steels.

Transformers adjust the generated power to a level that is compatible with the electricity grid. They require grain-oriented steels. Once the electricity is adjusted, it is fed into the grid and used in local homes and businesses.

Low-losses key

ArcelorMittal works closely with major turbine producers to develop the next advances in generators. We assist our customers to find the optimal steel grade for their generator development requirements, whether that be higher power levels, generators suited for higher wind speeds, cost reduction or lower weight generators.

ArcelorMittal also works with turbine makers to develop new grades of electrical steels. Virtual prototyping and analytical calculations can be carried out to determine exactly which properties are most beneficial. Whatever the requirements, ArcelorMittal's Global R&D teams will be there to help.