MATERİALS USED İN WİND TURBİNE BLADES AND SELECTİON

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Abstract

With rapid population growth in our world, energy needs are also increasing. The increase in energy consumption brings with it environmental pollution and global warming problems. For this reason, the search for clean energy has been made. Solar, wind, hydroelectric, geothermal, ocean, biomass energy, as well as the environment less damaging and renewable terms of these energy resources have been used by many countries. The use of wind energy in electricity generation among renewable energy sources is quite large. Wind energy is produced by wind turbines. Wind turbines are the most widely used wind turbines in the world. With the rapid development of technology, the standards of turbines produced have increased and the blades design, materials and production form has gained importance. In this study, we will focus on the selection of materials used in wind turbine blades.

Introduction

Given the renewable energy resources, it can be said that wind energy is the most advanced and commercially available energy type (1). World Wind Energy Production Capacity by the end of 2015, 435 GW has reached about 7% of total global energy production capacity. Global wind power generation in 2015, 950 TWh, total global power generation was about 4%. The largest wind parks exceed 1 GW, such as the Gansu wind farm in China, the Muppandal wind Park in India and the Alta wind energy centre in the United States. China has installed huge wind energy with 73 GW, Germany 45 GW, India 25 GW, Spain 23 GW and the United States followed by Britain 14 GW with 145 GW. (2)
China, the largest overall market for wind power since 2009, retained the top spot in 2017. Installations in Asia once again led global markets, with Europe in the second spot, and North America in third. By the end of 2017 there were 30 countries with more than 1,000 MW installed: 18 in Europe; 5 in Asia-Pacifi c (China, India, Japan, South Korea & Australia); 3 in North America (Canada, Mexico, US), 3 in Latin America (Brazil, Chile, Uruguay) and 1 in Africa (South Africa). Nine countries have more than 10,000 MW of installed capacity, including China, the US, Germany, India, Spain, the UK, France, Brazil and Canada (3).

Table 1. Cumulative Installed Wind Capacity in 2017 (3).

Country	Wind Capacity (MW)	Share (%)
PR China	188,392	35
USA	89,077	17
Germany	56,132	10
India	32,848	6
Spain	23,170	4

United Kingdom	18,872	4
France	13,759	3
Brazil	12,763	2
Canada	12,239	2
Italy	9,479	2
Rest of the world	82391	15
Total top 10	456,732	85
World total	539 123	100

This paper presents a critical review of the advanced materials used for wind turbine blades. Wind turbine is indicated to improve power with reduced weight with advanced features related to wing materials and progress in the wing field of wind turbine. The advantages and disadvantages of these materials are explained (4).

The study examines the strain fatigue and progression of a one-way glass fiber composite made of a non-curvilinear fabric similar to those used for the main load carrying parts of a wind turbine blade (5).

Glass fiber reinforced polymer (GFRP) a wind turbine shell made of composite materials is machined into thin elements called “needles” mechanically. It is stated that needles are used to change 5% and 10% of coarse aggregate by volume in concrete mixtures tested to investigate a number of important properties of fresh and hardened concrete. It was found that the stability and machinability of the needles of fresh concrete did not adversely affect (6).

The reliability of rotor blades is a prerequisite for the development and wide use of large wind turbines. Wind turbine blades reliability and power three main elements of wind turbine blades and design models are used in experimental verification design to determine the experimental properties of reliable materials, in order to improve wind turbine wing behavior, the reliability and power of rotor blades are discussed (7).

In parallel with the developments in composite materials technology, wind turbine wings are also developing as design and production. Improvements in the structural properties of raw materials, as well as improvements in production methods, and increasing the durability and surface quality of the wing structure have enabled the turbine wings to work for a long time. With the rapid development of technology, the standards of turbines produced have increased and the wing design, materials and production form has gained importance. In this case, the wind turbine can be used to generate electricity. As a result of this, continuous development and change is experienced in the wings of wind turbine.

Wind turbine blades are required, long-term durability, aerodynamically to contribute to the energy efficiency of the turbine, not to lose its integrity and surface quality against all external factors. In order to achieve these characteristics, the most appropriate method is to produce wind turbine blades with composite technology (8).

Wind power is not the same in every region and country, the need for wind maps made with accurate measurements creates. Research and development activities are needed for the use of battery, hydrogen and other systems for the purpose of storing energy produced (9).

There are many factors that affect the selection of materials in wind turbines. Material selection performance requirements, material reliability, safety, physical impact on the

environment, easy to find and accessible, recycling and economic factors are important. The most important factor in these properties is the mechanical, thermal and chemical properties of the material for engineering design (8).

Wind turbines are used in the construction of a wide variety of materials and high efficiency of wind turbines can be obtained by selecting the appropriate material for each element.

Composite Materials

Composite materials are not new material. Different kinds of materials with different characteristics in different ways (grain, fiber, stratified etc.) based on the structures found in natüre are obtained as a result of merging. We can describe the composite as a combination of two or more materials at a macroscopic level. The purpose of the composite materials is to provide the properties of the materials that they do not have prior to the construction of the composite materials. These properties include strength, aging resistance, wear resistance, Fracture Toughness, thermal properties, conductivity, weight, corrosion resistance, etc. countable.

Wind turbine rotor wing design, especially as the main reason for the use of composite, mechanical property density ratio expressed in terms of specific mechanical property values compared to traditional materials can be shown significantly superiority.

Wind turbine rotor blades are the most preferred type of glass reinforced plastic materials. In particular, the reasons for selecting these materials are that they provide lightness on turbine blades, high resistance and corrosion resistance, and their production is easy and economical compared to other fiber reinforced plastics. Carbon fiber reinforced plastics provide higher strength and lightness than glass reinforced plastics, although their cost is high because rotor blades are limited to use.

Results

The objective of the European Union to reduce greenhouse gas emissions by 80-95% compared to the present year for the year 2050 is to achieve 100% renewable energy by this date (half provided by wind). Wind energy will contribute to EU energy policy objectives and will contribute to a great deal of struggle against climate change (10).

In the coming years, investments will increase even further for the use of renewable energy sources and especially solar and wind energy development will come to the fore.

Because of its impact on wind turbine efficiency, wind turbine wing materials are of great importance and therefore, investments in research and development studies are increasing day by day. In the wind turbine sector, especially on composite materials research and development studies are ongoing.

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