Application of Cast Iron Parts for Renewable Energy

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Content

- Introduction
- Cast Iron Materials
- Examples
- Conclusions
1. Introduction

- natural resources of coal, gas and oil are limited
- use of fusion energy is far to reach
- growing demand for energy in the future
- we are adapted to use energy, current comes out of the sockets
1. Introduction, continued

- it is necessary to develop new systems different from our conventional energy systems

- we have to beat the climate change, green house effect and nuclear phaseout
1. Introduction, continued

- since hundreds of years renewable energy is used:
  - wind mills
  - water wheels
  - archimedes screws
  - wind foils
- all these energies are offered without any costs by nature
1. Introduction, continued

- the next big step in using renewable energy was the installation of water power plants, a big engineering effort
- there exists a couple of technologies to get energy from water power
1. Introduction, continued

- the most known turbine types are:
  - Kaplan
  - Francis
  - Pelton

- but the used metallic material is cast steel in a higher quality
2. Cast Iron Materials

- cast iron is used worldwide
- the brittle cast iron is well known in Europe since hundreds of years, in China more than 2500 years
- grey cast iron was used in the past to build bridges, balconies, balustrades etc.
- nowadays a lot of applications you can see during our daily life, like drain manhole, doorscraper, garden seat etc.
2. Cast Iron Materials, continued

- since more than 50 years the material „ductile cast iron“ is used in different fields of industry
- the cast iron is developed since the time of invention to highest approved material
- standards are available in the States, Japan, United Kingdom and the whole Europe
2. Cast Iron Materials, continued

- The application of cast iron was extended in the years 1990 for an upgrowing industry, the wind power generation.
- The GJS 400 18U LT is certified by the GL for the application in castings in the wind power industry.
2. Cast Iron Materials, continued

- additional materials are:
  - GJS 350 22U LT for castings applied in wind farms situated in low temperature regions
  - GJS 700 2 for gear box castings
2. Cast Iron Materials, continued

- the ductile cast iron is best suited for the application in use of renewable energy
- the microstructure with the graphite nodules is responsible for a convenient behaviour in extrem situations
2. Cast Iron Materials, continued

- fracture mechanics behaviour is well researched and documented
- in the future fracture mechanics will be applied during the design process for the castings
- the development of a higher quality is going on
3. Examples

3.1 Wind Energy

- typical parts are:
  - hubs
  - adapters
  - base frames
  - gear boxes
  - support parts
3. Examples

- Cast iron parts in the nacelle
3. Examples, continued

- Central hub
3. Examples, continued

- Adapter with hub
3. Examples, continued

- Machine Carrier
3.2 Tidal Energy

- an upcoming sector using ocean current are tidal devices
- there are different types of tidal energy converters, they are:
Application of Cast Iron Parts for Renewable Energy

3. Examples, continued

Tidal Energy Converters

- horizontal axis turbine
- vertical axis turbine
- oscillating hydrofoil
- enclosed tips (Venturi)
- archimedes screw
- tidal kite
3. Examples, continued

- the most developed type is the horizontal axis turbine
- as example to use ductile cast iron for this type Siempelkamp Foundry has produced the three blades and the complete housing for the projekt EMEC (Voith Hydro Ocean Current Technologies)
3. Examples, continued

• Projekt Jindo
3. Examples, continued

- Installation
Application of Cast Iron Parts for Renewable Energy

3. Examples, continued

• Installation
Application of Cast Iron Parts for Renewable Energy

3. Examples, continued

- ductile cast iron blade projekt EMEC
3. Examples, continued

- housing
- projekt EMEC
3. Examples, continued

- up to 10 companies develop this type of turbine and learn at the moment in a testing phase the behaviour and the efficiency of this kind of energy generation
3.3 River Energy

- to use the river energy in free-flowing rivers a new type of turbine was invented, the hydrokinetic power-generation turbine
- the principle is similar to the tidal turbines: a three blade repeller that is installed in a tube
3. Examples, continued

Application of Cast Iron Parts for Renewable Energy
Application of Cast Iron Parts for Renewable Energy

3. Examples, continued
4. Conclusions

- for future applications as tidal energy generation and river impulse energy generation the material „DUCTILE CAST IRON“ is perfectly suited
- several companies run pilot projects to get direct experience over a defined time period
- the development of turbines to generate energy from renewables will be expanded in the future and the cast iron material will be successful