**Category: 3**

# Tolerance management and online process assurance in the production chain of rotor blades

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## 1. Introduction

1.1 Production of rotor blades for wind turbines
Nowadays the process steps in manufacturing rotor blades are still mostly manual part [1] while automation systems are not cost-efficient yet. Nevertheless, it will be necessary to improve blade quality to gain competitiveness through better performance and reliability.
A cost-efficient method to raise part performance is to implement an online quality control system with a detailed look at tolerance management. Therefore the institute of composite structures and adaptive systems is building up a test facility for online quality monitoring system including a rotor blade mould.

1.2 Tolerance management
For rotor blades not only assembly jigs need to be recognized for tolerance management. The influence of process parameters on composites, especially the process-induced deviations, has a much stronger influence. Such a tolerance chain is shown in **Figure 1**. To control these process parameters a measurement systems and statistical methods have to be implemented in rotor blade production.

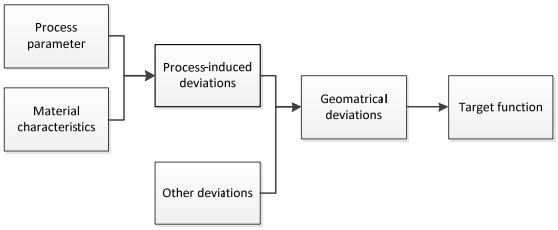

Figure 1: Tolerance chain for rotor blade

## 2. Tolerance management and online quality assurance

2.1 The E.V.A.R. - System
The online quality monitoring system E.V.A.R. contains the following benefits:

- Reduction of process time enabled with appropriate curing times
- Less energy usage, e.g. by active use of the exothermal energy of the resin
- Better traceability of parts
- Optimization of the production through continuous analysis of the quality data

Based on the OnQA-System [2] for autoclave processes in aerospace industry a new system, adapted to the needs of wind energy industries has been developed (see Figure 2).


Figure 2: E.V.A.R. system

The E.V.A.R. system contains temperature and ultrasonic curing monitoring as well as pressure measuring and optical sensors (resin flow, global temperature distribution etc.)

The main benefit of such an online quality measurement system is the opportunity to build up a production controlling and optimizing tool, based on statistical investigations. Here is the link to tolerance management. The process parameter temperature causes thermal stress within parts and fiber composite peculiarities like spring-in effect. Another aspect is the protection of auxiliary and construction materials from overheating through the exothermal reaction of resin.

## 3. References

[1]H. Apmann, „Technology Transfer Between Aircraft and Rotor Blade Manufacturing, DEWI Magazin 38,2/2011 [2]
[2] N. Liebers, H. Ucan et al. “Masterbox: new concept for a dynamic autoclave process control”. CEAS Aeronautical Journal, Volume 2, Combined 1 - 4 (December 2011), Seite 223-230. Springer Verlag.