

Productivity Improvement in Manufacturing of Wind Turbine Blades Using New Generation Epoxy Resin System

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Abstract

Productivity improvement is always a focus area in any manufacturing industry and in case of wind turbine blades (WTB) this is directly related to the cycle time. The cycle time in WTB manufacturing by vacuum infusion process is the total time from the first step of preparing the mold to the final step of de-molding the blade. Of the various components comprising the cycle, the infusion time and cure time typically account 30-40% of the total time and any reduction will significantly help in producing more number of blades and thus lead to increased productivity.

The reduction in cycle time can be achieved by either modifying the design, changing the processing conditions or using new materials. Of these alternatives the design modifications are the most complex as the changes made can affect aerodynamics and power output. The present work is focused on developing new generation materials which can directly replace the existing materials without the need to make any design modification or processing changes. The study focuses on epoxy resins which is the preferred matrix material in manufacturing of WTB by vacuum infusion process. New generation epoxy system is developed which is based on optimum combination of process and performance properties. The system provides low initial mix viscosity, long working time and slow viscosity rise improving the fibre impregnation and wetting and also enabling faster infusion. Unlike the conventional systems, the new system provides rapid strength built-up when compared to epoxy systems of similar reactivity. This feature enables reduction in the cure time in WTB manufacturing. Additionally the resin component of the new system is designed to be non-crystallizable which provides further advantage in processing under low temperature environmental conditions. Comparative studies of processing and performance properties of the new system are conducted with conventional systems under identical conditions and results indicate potential of the new system to reduce infusion and cure time by 15-25% and further by 20-30% if used along-with Epotec toughened adhesive system. Apart from the productivity improvement, the new infusion system is also expected to reduce process defects: dry areas, wrinkles and surface pitting & pinholes and thus contribute in lowering the re-work time.

Key words: *Cycle time , Wind turbine blade, Productivity, New generation epoxy system, Conventional epoxy system, Infusion time, Curing time , Strength built-up*

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