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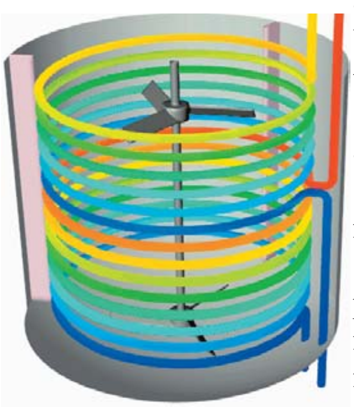
FLUENT Adds Value to Wood Panel Adhesives

Courtesy of A.C.M. Wood Chemicals

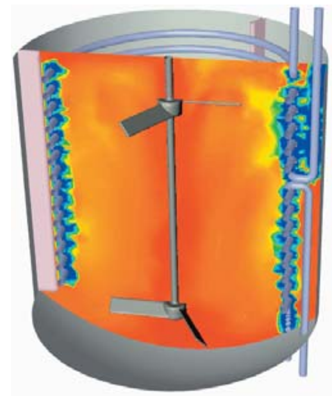
A.C.M. Wood Chemicals is a world leader in resin and resin additives for wood panel production, with manufacturing units in 6 countries worldwide, licenses in 33 countries, and a corporate R&D center in Thessaloniki, Greece. The right combination of resins and resin additives, chosen to suit the specific requirements of a particular wood panel, can make a significant impact on the final product cost and quality. Each panel line needs a resin with specific properties, such as reactivity, viscosity, tack, pot life, and water tolerance.

Resin adhesives are typically manufactured in a batch process, which involves methylolation and polymerization. The polymerization process takes place in a mixing vessel under specific pH and temperature conditions. The pH levels are maintained with the controlled addition of an acid during the course of the batch process. Proper temperature levels are maintained by cooling coils that are immersed in the mixture. Control of the temperature throughout the process is necessary for two reasons. First, the resin product is cooled in order to halt the reaction at the end of the process. Second, if hot spots develop during polymerization, a condition known as thermal runaway can occur, in which the reaction continues out of control, resulting in regions of solidified product. When this "freezing" of the reactor occurs, the entire batch must be discarded.



Two sets of cooling coils are used in the reactor to keep the temperature controlled

The introduction of novel or modified resin formulations to make products that are tailor-made for each wood panel manufacturer has given rise to continuous redesign and reevaluation of the resin plant equipment. Process engineers at A.C.M. Wood Chemicals are using FLUENT for this purpose. Of particular interest is the study of mixing patterns during the polymerization process, to ensure uniform acid catalyst distribution and adequate temperature distribution, both of which are critical for maintaining quality and minimizing production costs.



The temperature on a slice through the reactor after about 11 minutes of cooling

Recently, FLUENT has been used to simulate a batch reactor installed at a new resin plant in the Greek city of Komotini. Prior to being put into production, the batch reactor has been operated with water, and experimental measurements have been taken during the reactor cooling process. These measurements were subsequently used to validate the FLUENT model of the vessel, which used the multiple reference frames (MRF) model for the impellers, and the RNG k-e model for turbulence. An isothermal flow-field was computed first, and was followed by a transient energy calculation to track the temperature during the vessel cooling process. After a few mesh refinements, the predicted temperature curve was found to match the experimental curve.

The reactor is now being simulated with the resin polymer material. The goal of this phase of the project is to calculate the cooling curves for varying impeller speeds and varying cooling water flow rates and inlet temperatures. Since the cooling time may correspond to as much as half of the overall batch manufacturing time, the plant throughput can be significantly increased by selecting the optimal cooling scenario.