Numerical Investigation on the Influence of Material Properties on Bending Behavior in Stator Production

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Abstract. Rotating electrical machines, e.g. traction drives, recuperation machines, starters and generators for automotive industry have to meet increasing requirements regarding efficiency and power density. Parameters with high impact on these targets are a small air gap between stator and rotor and high copper filling of active electromagnetic components.

In this paper the stator production will be discussed with respect to so called flatpack technology. With this technology comparatively high levels of copper filling can be achieved, at the expense of obtaining higher roundness deviations that lead to enlarged air gaps between rotor and stator. This flatpack forming process is classified as a rotary draw bending process of stator core bearing applied copper wire packages that leads to outer cylindrical torus of electrical machine. In order to gain deeper knowledge about this bending process a mechanical simulation model was created representing the nonlinear bending behavior of the flatpack. Goal of calculations mainly was given to identify boundary conditions for incoming parameters on the manufacturing process. In this paper two parameters were selected to investigate their influence on the obtained geometry of flatpack. The first parameter was chosen as the bending angle being defined by machine settings, the second one as the mechanical behavior of applied copper windings. At the end this paper delivers a numerical approach to comprehend and predetermine roundness deviations caused by bending and springback behavior of an assembly with multiple material characteristics and contact conditions. This understanding can be used to decrease scrap rates in production and increase efficiency and power density of the electrical machine.