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MINOR LOOPS IN THE DYNAMIC TAKACS MODEL

S. Steentjes*, M. Petrun, K. Chwastek***, and K. Hameyer***

* Institute of Electric Machines, RWTH Aachen University, *Schinkelstr. 4, D-52062 Aachen, Germany*
** University of Maribor, *Smetanova 17 , 2000 Maribor, Slovenia*
*** Czestochowa University of Technology, *Al. AK 17, 42-200 Czestochowa, Poland*

The hysteresis model developed by Takács [1, 2] has proven its usefulness in physics and engineering and given rise to some other descriptions based on hyperbolic tangent transformations of loop coordinates [3]. The present paper explores the possibilities of the model described in [3] to describe hysteresis loops of electrical steel under different excitation conditions. The so-called inverse model is used [4]. The output variable is identified as the 'effective field', following the suggestions in [5]. This leads to an interpretation of the inverse Takács model as a generalized stop model [6]. Replacement of external field strength with the 'effective' one introduces a feedback in the system modifying the congruency feature for the minor loops [7]. Figure 1 depicts the improvement in representation of major loop resulting from taking into account the mean field term in the relationship for the effective field.

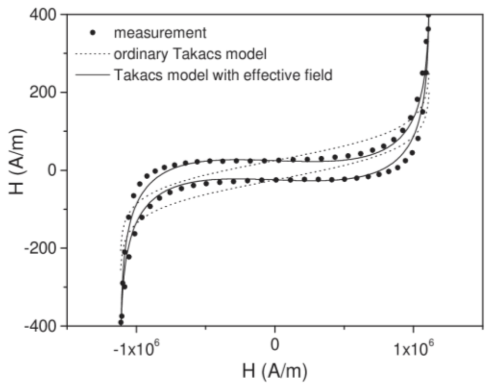

Fig. 1

The basic model equation for the considered extended model may be written as

$$\mathrm{H} = a\ \mathrm{atanh}\left(\frac{M \mp b_1}{M_s}\right) - \alpha M \pm H_{c0}\,, \qquad (1)$$

where H_{c0} is static coercive field strength, α is the mean field parameter accounting for collective action, a is a normalization constant, M_s is saturation magnetization, whereas $b_1 = 0.5 M_s \left[\tanh\left(\left(H_{eff}^{TIP} + H_{c0}\right)/a\right) - \tanh\left(\left(H_{eff}^{TIP} - H_{c0}\right)/a\right)\right]$. In the full paper the modeling results for minor loops under increased excitation frequency shall be discussed.

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Name and e-mail of corresponding author: simon.steentjes@iem.rwth-aachen.de