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电除尘器壳体墙板立柱结构体系缺陷敏感性研究

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IMPERFECTION SENSITIVITY OF WALL-COLUMN STRUCTURAL SYSTEM IN ELECTROSTATIC PRECIPITATC CASING

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摘要 电除尘器是用于消除大气烟尘的重要环保设备,壳体是其中最重要的工艺部分。壳体墙板为加劲钢板,与立柱连续焊接连接,组成共同承载的结构体系。壳体承受的横向荷载为负压与风荷载,作用在墙板上,壳体承受的竖向荷载主要作用在立柱上。墙板的初始缺陷会影响立柱的承载能力。该文通过非线性有限元方法,研究不同缺陷幅值时,完善结构极值点变形缺陷模态、完善结构非线性分岔点变形缺陷模态、特征值屈曲缺陷模态、墙板正弦波形缺陷模态以及墙板安装过程中的焊接收缩残余变形与残余应力对立柱承载力的影响。当缺陷幅值一定时,各种初始几何缺陷形式中,以完善结构的极值点变形缺陷模态为最不利。墙板安装过程中的焊接收缩引起的残余应力对于立柱承载是有利的,但是提高承载力很小。随着焊接收缩量的增大,残余应力值增大,同时考虑残余应力和残余变形影响得到的立柱承载力比仅考虑残余变形得到的承载力的增加量变大。

关键词: 结构工程 电除尘器壳体 墙板-立柱结构体系 初始几何缺陷 焊接残余变形 焊接残余应力 缺陷敏感性

Abstract: An electrostatic precipitator is one of important environment protection facilities to eliminate the dust in atmosphere. The casing is the most important technical component. The casing wall being made of stiffened steel plates is connected with columns by continuous welding. The wall and columns form the structural system to bear loads cooperatingly. The transversal load of negative pressure and wind loading to which the casing is subjected are applied to the wall, and the vertical load is mainly applied to the columns. The initial imperfections on wall will influence the bearing capacity of columns. By the method of nonlinear finite elements, the influences of several imperfection forms on the bearing capacity of a column are investigated as the imperfection magnitude is varying, including the imperfection mode of limit point deformation of the perfect structure, the imperfection mode of nonlinear bifurcation point deformation of the perfect structure, the imperfection mode as eigenvalue buckling mode, the sine wave shape imperfection on wall, the residual deformation and residual stresses resulting from the welding shrinkage in erection process for wall. When the imperfection magnitude is determined, among all the geometrical imperfection forms, the imperfection mode of limit point deformation of the perfect structure is the most unfavorable. The bearing capacity of the column with the consideration of both residual stresses and residual deformation is slightly greater than the capacity with residual stresses being excluded. By increasing the magnitude of welding shrinkage, the residual stresses increase and the increment increases between the column bearing capacity with the consideration of both residual deformation and residual stresses and the corresponding capacity with the consideration of only residual deformation.

Key words: structural engineering electrostatic precipitator casing wall-column structural system initial geometrical imperfection welding residual deformation welding residual stress imperfection sensitivity

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