This paper proposes an $H_{\infty}$ robust current controller for doubly fed induction generator (DFIG) based wind turbines (WTs) subject to grid voltage distortions. The controller is to mitigate the impact of the grid voltage distortions on rotor currents with DFIG parameter perturbation. The grid voltage distortions considered include asymmetric voltage dips and grid background harmonics. An uncertain DFIG model is developed with uncertain factors originating from distorted stator voltage, and changed generator parameters due to the flux saturation effect, the skin effect, etc. Weighting functions are designed to efficiently track the unbalanced current components and the 5th and 7th background harmonics. The robust stability (RS) and robust performance (RP) of the proposed controller are verified by the structured singular value $\mu$. The performance of the $H_{\infty}$ robust current controller was demonstrated with a 1.5 MW DFIG model, showing its harmonics suppression ability with DFIG parameter perturbation and improved robustness.