It has been demonstrated that there is an enormous amount of energy that is currently wasted, since it is not used to generate any work, becoming heat due to friction in the mechanical braking system. In the proposed system, the energy recovered and stored during the landing is used in the next flight for taxiing, so that it is possible to reduce in part the necessary energy to be supplied to the battery before starting a new flight.

Regarding the weight variation, the weights of all the additional elements have been added, such as fuel cells, hydrogen tank, wheels and battery motors; also, the assumed weight of the converters. Similarly, the weight of water generated by the fuel cells as by-product has been removed, since it is an amount of water no longer required to be carried in the aircraft in the time of take-off because of being generated on flight. The weight of the removed tires is also subtracted, and the weight of the kerosene equivalent to the energy generated by the proposed systems; This includes kerosene used for traction saved in taxiing before take-off and after landing, the used for on-board power generation during the flight and the saved by energy regeneration during landing.

Fuel savings are directly dependent on the price that Hydrogen can adopt in the coming years.

5. Conclusions

This paper has presented an optimal micro grid to supply the electrical consumptions of a commercial long-distance jet airliner, recover energy during landing and propel the airliner during taxiing movements. The micro-grid is composed of two PEMFCs, power converters, a hydrogen tank, li-ion cells and a set of in-wheel reversible synchronous machines.

The optimal design proposed has allowed reducing the amount of water needed at the time of landing because it is obtained from the by-product of the electrochemical reactions of fuel cells during the flight. Besides, it has allowed a reduction of 370 tons/year in CO_2 emissions due to a reduction in kerosene consumption. Economically, considering a reasonable price of hydrogen (1.7 €/kg) there would be a net savage of 14,070 €/year per airliner in terms of fuel with a null alteration of the total weight of the airplane.

Although the analysis for optimal location of all the equipment has not been realised, it will be developed in future work. This aspect could allow to optimise the energy fluxes and reduce the total energy needed. All other relevant factors have been taken into account in the analysis, although several assumptions have been made due to the lack of information about the costs of the non-commercial equipment used, the price of labour for the installation, the pilot's decisions regarding the landing, weather conditions and many other factors.

Taking into account DOE's forecasts regarding hydrogen production costs for 2020, if a central production system were used, the payback would be about 19 years, which makes the proposed microgrid configuration attractive from the economic and environmental point of view.

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