LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Master Thesis Project, 2022-2023

— Recycling of Electrical Machines used in Automotive Application —

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Context

Massive electrification in automotive necessarily require the increasing of mass production of electrical machines. In a context of sustainable development, these electrical machines must lead to a limited environmental impact throughout their life cycle, in particular by promoting energy efficiency and recycling. Moreover, the increasing of production will lead to a higher demand of raw materials, with a part of them considered as critical like rare earth or copper. Due to shortage of raw material, it could lead to supply risks as well as an increase of the cost.
Recycling is interesting alternative to limit the environmental impact as well as the risk of supply or of cost by reusing either used parts of the electrical machine or by manufacturing new raw materials. However, currently, the recycling of electrical machine produced in mass is not really efficient. It exists some sectors of refurbishing or of recycling of raw materials by grinding the stator and the rotor but not at a large scale. This sector can be greatly improved by taking advantage of "mass production" by creating a "mass recycling" or "mass re-use / refurbishing".

Objective

The aim of the project is to propose methods to improve the recycling of electrical machines taking advantage of the mass production at the following stages (see figure 1):

-« Preparing for re-use » (reusing, repairing, refurbishing or re-selling used parts like the stator, the rotor, the bearings…),

-« Recycling » (turning waste into new raw materials for product like copper, rare earth material…)

-« Prevention » (acting on the design in order to facilitate the re use and the recycling).

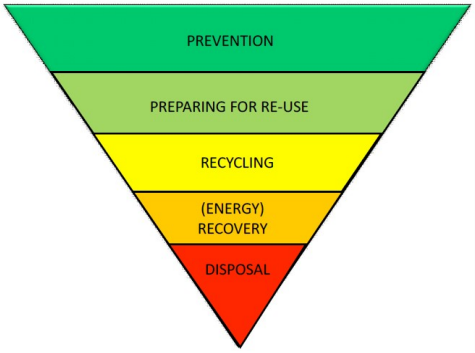

Figure 1 : Waste hierarchy

Work steps

The main steps are:

-State of art of existing methods:

*to diagnose the health state of an electrical machine for a refurbishing or a reuse of some parts (rotor, stator…),

*to recycle raw materials in order to reuse them for the manufacturing of electrical machine or other products.

*to re-use components or sub-systems of electrical machines

*on innovative design approach for new architecture of electric machine in order to ease End of Live re-use /refurbish or recycling

-Select the most adapted technics for an existing electrical machine used for car propulsion taking advantage of the mass production and considering technical criteria, cost, market….

-Simulation of the selected technics using CAD to diagnose the health state of the electrical machine as well as well as the disassembling of the electrical machine in order to reuse healthy parts.

-Propose modifications of the design in order to make a more recycling friendly electrical machine to improve the diagnostic or the disassembling

Keywords

Recycling, Re-Use, Electrical Machine, Automotive, Mass Production

References

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