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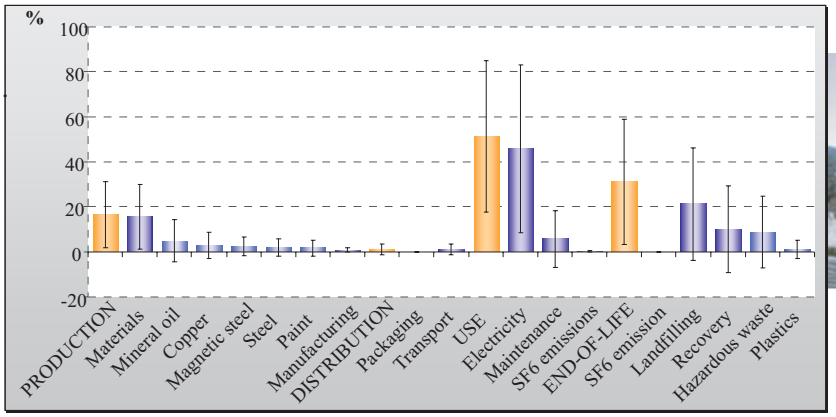
Eco-design of the medium voltage PFU-3 transformer centre

Company	ORMAZABAL, Zamudio (Spain)
Industrial sector	Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus ISIC Rev 4 nº 2710 (*International Standard Industrial Classification of all Economic Activities*)
Environmental considerations	Increasing interest of public and public authorities in environmental matters, particularly energy saving & efficiency and climate change, the need to remain competitive in a global market and the appearance of the ErP (Energy-related Products) Eco-Design Directive 2009/125 EC (former EuP - Energy-using Products Directive (2005/32/EC), led the company ORMAZABAL to become involved in this eco-design project.
Company background	ORMAZABAL decided to take part through this case study in an eco-design pilot project addressed to the electrical and electronic sector, which was supported by Ihobe. This project was carried out between May and September 2008 and concluded with the publication of an Electrical and Electronic Eco-design Guide by Ihobe in April 2010. The product assessed and eco-designed was the transformer centre model PFU-3. This is a conventional 20 kV/480 V transformer with 24 kV switchgear, with a total weight of 12,598 kg and an energy consumption of 14,169 kWh per year.
Summary of actions	In order to identify the main environmental aspects of the product, an environmental assessment - streamlined LCA - was carried out considering the whole product lifecycle (manufacturing, distribution, use and end-of-life) using the software tool EuPmanager®, nowadays updated to a free cost version named EuPeco-profiler® under the LiMaS project (www.limas-eup.eu). This software tool uses the MEEuP methodology developed by VHK for the European Commission for assessing Energy-using Products. The graph below shows the environmental profile of the complete life cycle of this transformer centre assuming a product lifetime of 40 years. As can be observed, 16% of its overall environmental impact corresponds to the manufacturing stage, 1% to distribution, 51% to actual use and 31% to the end-of-life stage. A more detailed analysis reveals the most significant aspects and thus the priority processes and materials for improvement efforts.



Original PFU-3 transformer centre

Summary of actions (cont.)

After identifying the most significant aspects of the product and considering the main company's motivations, potential eco-design strategies were identified and evaluated for the improvement of the product. Not all the strategies initially drawn up were implemented in the final improved design, as some proved unviable due to technical and/or economical reasons.

The eco-design measures finally applied are summarised below:

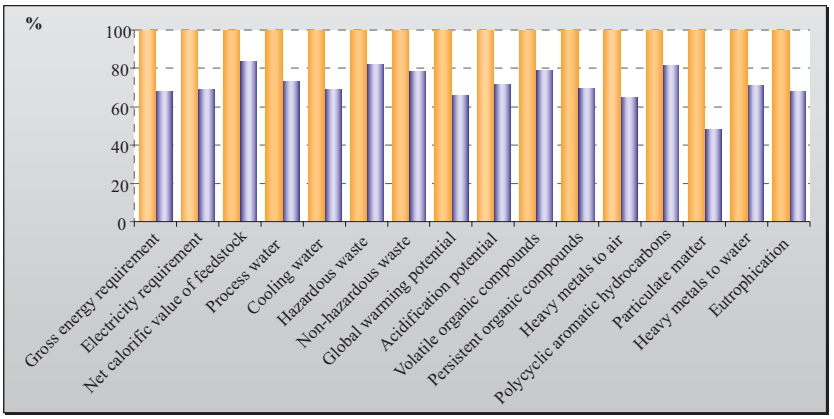
Reduced consumption of energy:
Improve transformer efficiency: development of a new type of DC transformer with lower levels of losses from hysteresis, eddy-currents, coil resitance, etc. This resulted in energy savings of 4,415 kWh per year.

Reduced consumption of materials:
Make the transformer centre housing smaller: this requires fewer materials, mainly concrete. In all, the new smaller housing uses 5.5 tonnes less concrete.
Reduce the amount of dielectric gas in the switchgear: SF6 is a greenhouse gas, so the amount used was reduced to the bare minimum required to ensure a proper operation of the transformer centre. The overall reduction achieved in SF6 was 42%.

Improved leak-tightness:
Make the switchgear more leak-tight: using laser welding to improve the leak-tightness of the switchgear means that less SF6 leaks out during the useful lifetime of the transformer centre. In all, the annual SF6 leakage rate was cut by 98%.

Balances

The graph below shows the improvements in percentage terms achieved in each of the 16 environmental impact indicators considered, after the implementation of the eco-design measures described above. The average environmental improvement achieved in the new transformer centre model is 28.6%. A 31.2% reduction in energy consumption during the useful lifetime was achieved. The new design implies energy savings of 4,415 kWh per annum compared with the previous model (approx. 620 €/year).



Improved PFU-3 transformer centre

Conclusions

The main benefits achieved in this eco-design project were the following:

Improvements in the product:
- 28.6% reduction in overall environmental impact
- 31.2% reduction in energy consumption during the useful lifetime
- 44.1% reduction in the total weight of the product
- Reduction of used dielectric gas (SF6) and improvements in switchgear leak tightness

Improvements in the company:
- Implementation of a practical methodology for environmental assessment and improvement
- Alignment with the future requirements of the ErP Directive (2009/125/EC)
- A greater capability for innovation through eco-design
- Market position improvement

NOTE: This case study seeks only to illustrate a pollution prevention example and should not be taken as a general recommendation.

Regional Activity Centre for Cleaner Production
Dr. Roux, 80
08017 Barcelona (Spain)
Tel. (+34) 93 553 87 90
Fax. (+34) 93 553 87 95
e-mail: cleanpro@cprac.org
http://www.cprac.org