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Life cycle assessment of carbon xerogels

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SOMABAT
Development of novel SOlid MAterials for high power Li polymer BATteries (SOMABAT). Recyclability of components.
SEVENTH FRAMEWORK PROGRAMME

INTRODUCTION

In the framework of the SOMABAT European project aiming namely at developing new materials for the design of lithium-polymer batteries, a life cycle assessment applied to the production of carbon xerogels was carried out. These carbon materials with controlled texture are thought to be used as active material at the anode side. This analysis focuses only on the transport of raw materials and the synthesis of carbon xerogels. The functional unit is 1 kg of carbon xerogels.

EXPERIMENTAL

The synthesis is carried out in four steps (fig.1): (1) transport of reagents by truck and homogenization of synthesis reagents by mechanical agitation, (2) reaction, gelification, and gel aging in an oven at 85 °C for two or three days, (3) drying and (4) pyrolysis under a nitrogen flow to 800 °C. Three drying technologies were compared by the ReCiPe Endpoint method: vacuum drying at 60 °C for one day and then at 150 °C for 5 h, convective drying at 115 °C under a hot air stream with a superficial velocity of 2 m/s and ambient humidity, and microwave drying at 1000 kW of power for 30 minutes.

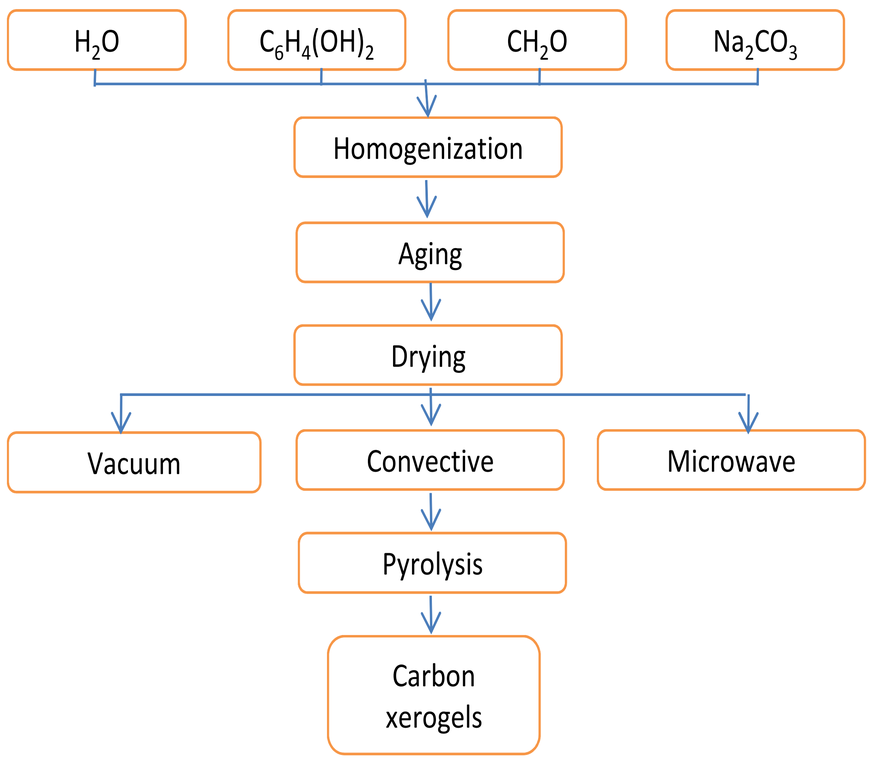

Figure 1.
Schematic representation of carbon xerogels production

The Belgian energy mix 2008 (table 1) was used to calculate the electricity demand and the involved impact categories in this synthesis are (fig.2): fossil depletion, climate change human health and ecosystem health, particulate matter formation and human toxicity.

'Fuel'	%
Nuclear	56,75
Gas	30,70
Coal	9,01
Hydraulic	2,19
Wind	0,79
Oil	0,51
PV	0,05

Table 1.
Belgian energy mix 2008

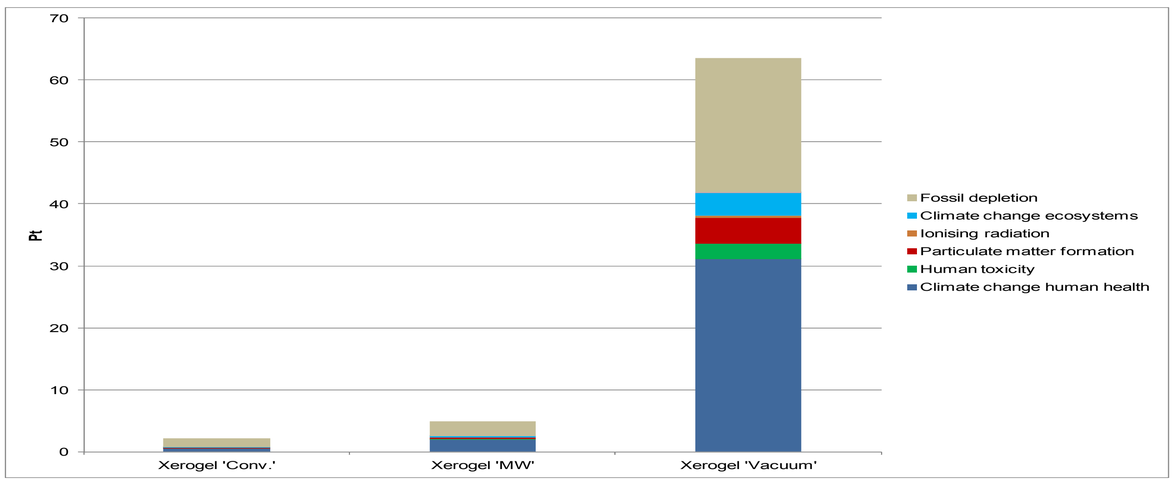

Figure 2.
Single score for the 3 production ways of carbon xerogels

RESULTS AND DISCUSSION

The results show that the least detrimental technique for the environment is convective drying because of its low energy demand. Moreover, this technique operates under a heat stream while the others drying technologies require electricity.

In the case of convective drying (fig.3), the most critical step is the production and transport of reagents while in the others cases, owing to the high electricity consumption required by the dryer, it is this step which has the greatest impact.

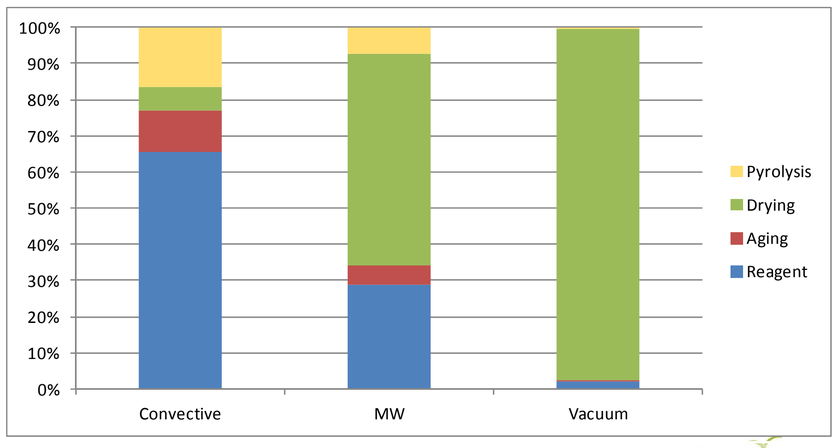

Figure 3.
Environmental contributions of production steps

CONCLUSIONS AND PERSPECTIVES

1. The choice of production process is crucial.
2. Further work will gradually integrate other components to achieve a full battery.

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