Insights into Novel Solid Materials, their Recyclability and Integration

into Li Polymer Batteries for EVs. Future research directions in this field.

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LIFE CYCLE ASSESSMENT OF CARBON XEROGELS

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Introduction

In the framework of the SOMABAT European project, 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.

Methodology

This analysis focuses on the transport of raw materials and the synthesis of carbon xerogels. Their use as active material in the anode of lithium-polymer batteries will be considered later. The functional unit is the synthesis of 1 kg of carbon xerogels and the used method is ReCiPe endpoint. The synthesis is carried out in four steps: (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. For drying, three technologies were compared:

- Vacuum drying (‘vacuum’): the sample is simply kept at 60 °C and the pressure is progressively decreased in one day from 10^5 Pa to 10^3 Pa. The sample is then heated to 150 °C at 10^3 Pa during 5h.
- Convective drying (‘conv.’): the sample is dried in a classical convective rig under a hot air flow at 115 °C with a superficial velocity of 2 m/s and ambient humidity.
- Microwave drying (‘MW’): the sample is dried in a cavity oven using a power of 1000 kW for 30 minutes.

Results et discussion

The results (Table 1) show that vacuum drying is the technique that uses the most energy with 96.8% of the environmental impacts associated with this step. Microwave drying uses less energy compared to the vacuum technique but presents an important environmental contribution of 58.6 %. For convective drying under a hot air stream, it represents only 6.4% of the total impact of the synthesis because its low energy demand. Moreover, the energy demand corresponds to a heat consumption and not electricity as in the other two cases. Heat production is assumed to be produce from natural gas.

	Vacuum	Convective	Microwave
Reagents	2.2	**65.4**	28.9
Aging	0.4	11.5	5.1
Drying	**96.8**	6.4	**58.6**
Pyrolysis	0.6	16.7	7.4
Total	100.0	100.0	100.0

Table 1 : Environmental contributions of synthesis steps

The single score chart (Figure 1) which identifies the involved impact categories for the whole production process, confirms the previous results. The vacuum technology has a single score around 64 points while the two other drying technologies are below 10 points. The involved impact categories are mainly due to the energy needs of processes, particularly the high demand for electricity.

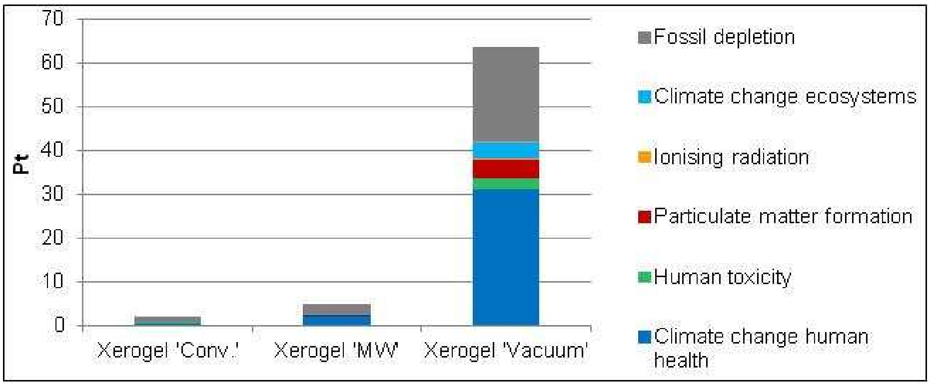

Figure 1 : Single score for the 3 production way of carbon xerogels

Conclusions

From this analysis, it appears that convective drying, in view of its lower environmental impact, is the most appropriate drying technique for an industrial-scale production of carbon xerogels.

References

1. ADEME, *Les procédés de séchage dans l'industrie*, (2000) Angers.
2. Arlabosse, P., *Séchage industriel ; Aspects pratiques*, Techniques de l'ingénieur.
3. Vachet, F., *Séchage dans l'industrie chimique,* Techniques de l'ingénieur.
4. Vasseur, J., *Séchage : principes et calcul d'appareils. Séchage convectif par air chaud,* Techniques de l'ingénieur.

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