VALORIZED ZINC OXIDE FROM NON-FERROUS METAL WASTE AND VALIDATION IN INDUSTRIAL CATALYTIC APPLICATIONS.

E. Añó-Montalvá, R. Beneito-Ruíz, J. Fortes-Monteiro, A. Alfonso-Esteve, L. Rey-Martinez

Environmental and Energy Area (UT-4 Innovation & Sustainability), AIJU (Technological Institute), Avda. de la Industria, 23. Apdo. 99, 03440, Ibi (Alicante), Spain.

INTRODUCTION

Nowadays, most of the resources contained in wastes are being spoilt by depositing them in controlled landfills.

The following work, developed within the European project LIFE+ GREENZO, aims to obtain a new source supply of zinc oxide (ZnO) from industrial waste. A pre-industrial pilot plant using plasma technology has been developed to obtain ZnO from non-ferrous metal waste (zamak). The ZnO has to meet all requirements (physical and chemical properties) to ensure its validation in two industrial sectors: the manufacture of rubber/EVA and chemical catalysts.

ACTIONS

TYPE OF WASTES / CHARACTERIZATION (% w/w):

- Single metal composition (zamak foundry slag, metal shavings and defective pieces) : Zn (≈95%), Al (≈4%) and others: Mg, Cu, Fe, Pb, Cd, Sn,… (≈1%).
- Mix metal/polymer composition (sludge vibrated): Zn (≈55%), Si (≈9%), Al (≈3%) and others: Cu (≈0'5%), Fe (≈1%),…

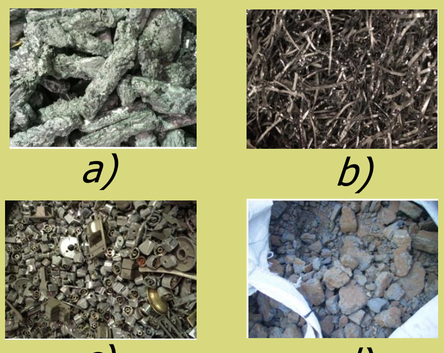

Figure 1. *Selected wastes: a) zamak foundry slag, b) metal shavings, c) defective pieces and d) sludge vibrated.*

PILOT PLANT DESIGN (MODULES):

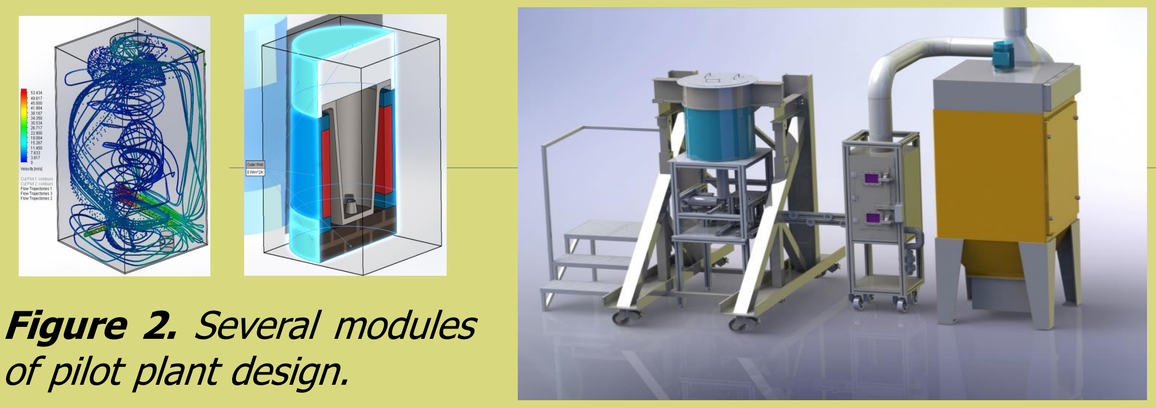

Figure 2. *Several modules of pilot plant design.*

PILOT PLANT CONSTRUCTION AND ASSEMBLY:

Figure 3. *Assembled modules of pilot plant.*

MODULE	DESCRIPTION
1	Foundry system.
2	Continuous extraction of solidified material.
3	Plasma chamber.
4	Filtration system and particle retention (zinc oxide).
5	Storage unit (zinc oxide).

VALORIZED ZINC OXIDE CHARACTERIZATION:

- 10 ZnO samples from wastes (3 foundry slag, 3 metal shavings and 4 defective pieces).
- Area BET: 20'1-27'8 m^2/g.
- % w/w: Zn (89-96'2), Al (1'7-2'4), Cu (0'9-1'7), Si (0'1-0'2),…

RESULTS AND DISCUSSION

DEMONSTRATOR 1. CATALYST IN THE VULCANIZING OF RUBBER/EVA:

- Rubber: decreased vulcanization time (15-30%), influenced color, identical physical / mechanical properties and metal particles undesired.

Figure 4. *Color blackening.*

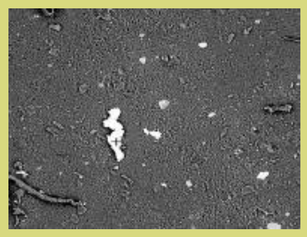

Figure 5. *Undesired metal particles.*

- EVA: decreased vulcanization time (18-27%), not-influenced color, identical physical / mechanical properties and metal particles undesired (pores).

Figure 6. *Not-influenced color (commercial ZnO vs valorized ZnO).*

DEMONSTRATOR 2. CATALYST IN THE REFORMING OF BIO-ETHANOL:

- Cobalt and niquel supported on valorized ZnO (impregnation at pore volume; 15Ni/ZnO and 15Co/ZnO): best results (↑EtOH conversion, ↑H_2 selectivity).
- Second metal incorporation (↓%C): 15Ni10La/ZnO and 15Co10La/ZnO.
- Third metal incorporation (↓%C): 15Ni1Pt10La/ZnO and 15Co5Mn10La/ZnO.

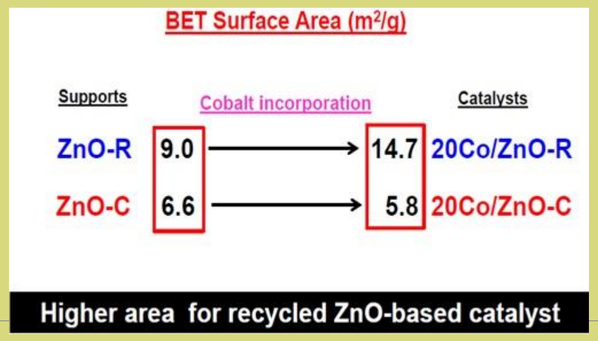

Figure 7. *Catalysts surface area.*

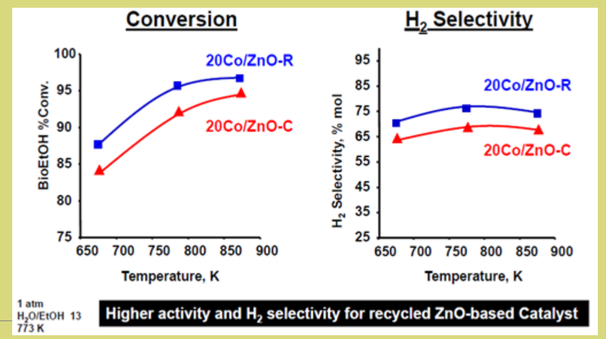

Figure 8. *Conversion/H_2 selectivity.*

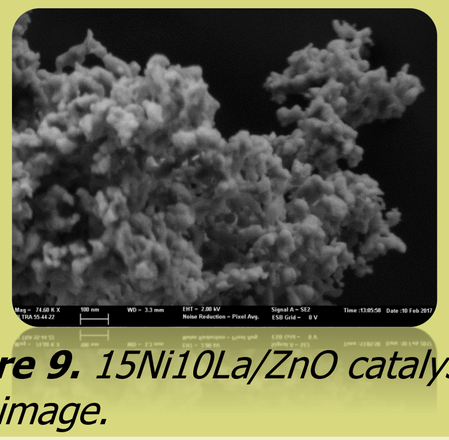

Figure 9. *15Ni10La/ZnO catalyst SEM image.*

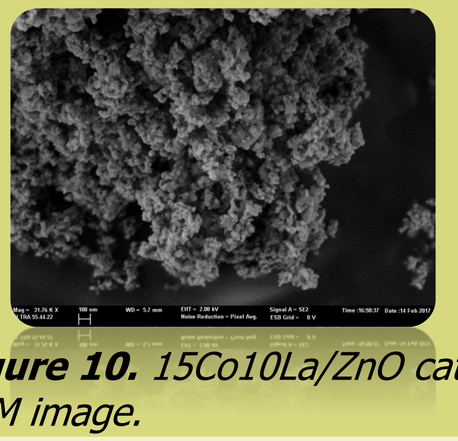

Figure 10. *15Co10La/ZnO catalyst SEM image.*

CONCLUSIONS

- This is a viable technology to valorize this kind of industrial waste and to obtain a new source supply of zinc oxide.
- ZnO valorized is useful to rubber/EVA applications (footwear, sports floor and animal floor).
- This is the first time a steam reforming process is described, in which the raw material (bioethanol) and the catalyst support (ZnO) have renewable nature.
- ZnO valorized has a lot of possibilities to be used in other industrial applications (cosmetic, waste water photocatalytic treatment…).

GREENZO LIFE13 ENV/ES/000173
(www.lifegreenzo.eu)