Study of the sinterability of a recycled tungsten carbide powder

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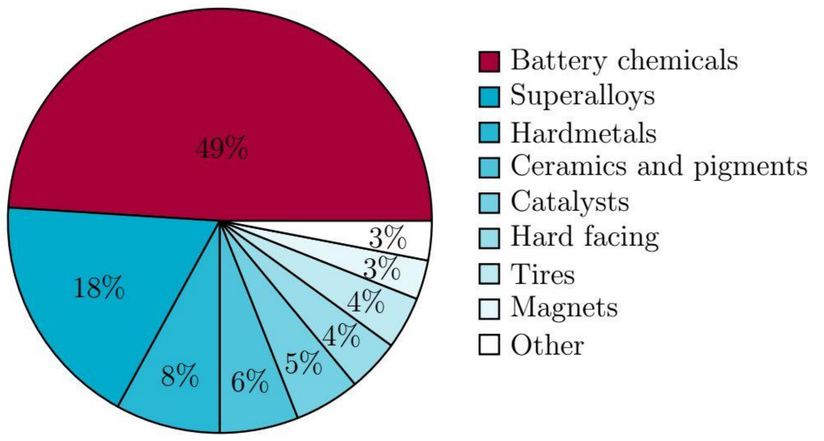
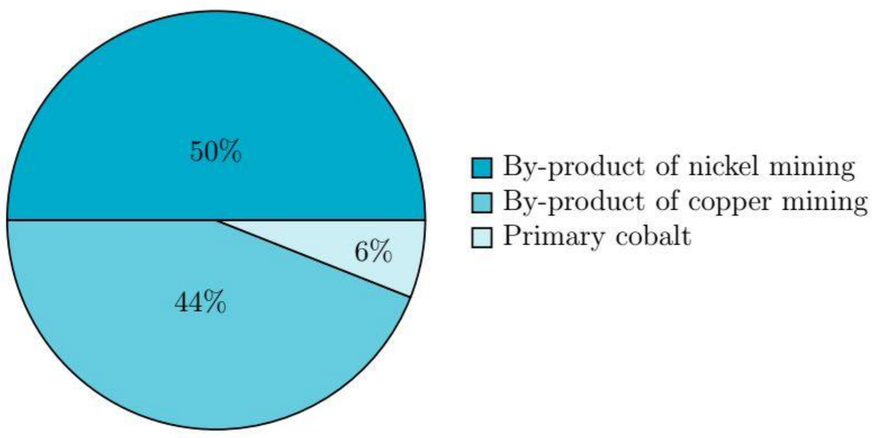
According to a 2011 report, The EU Commission has classed 14 elements, including cobalt, as "critical raw materials" (CRMs). Cobalt suffers from its large use in Li-ions batteries for electrical cars: in 2015, 50% of the cobalt demand was used for batteries.





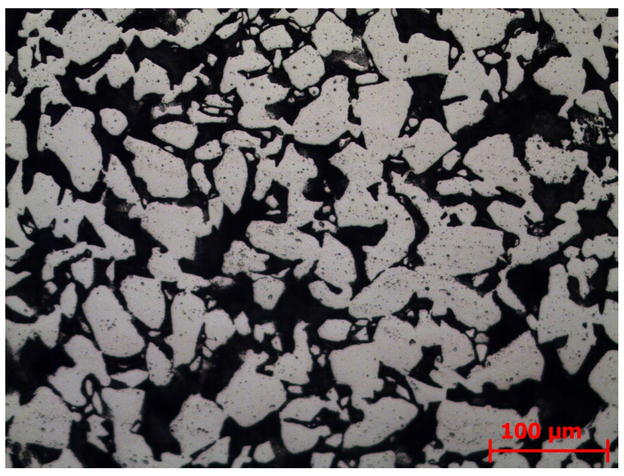
Another issue with the cobalt is the fluctuation of its price due different factors:

- More than 50% of the world resources are located in DRC and Zambia, two politically instable countries.
- Co price depends on the copper and nickel mining since its extraction comes from by-products of Cu and Ni.

Necessity to recycle cobalt!
However extracting cobalt from WC-Co hardmetals is not easy…
Alternative: **recycling WC and Co together**.

Preliminary results

Conditions: 1400°C - 1 h – Vacuum - 4°C/min



Only 65% of full density was reached

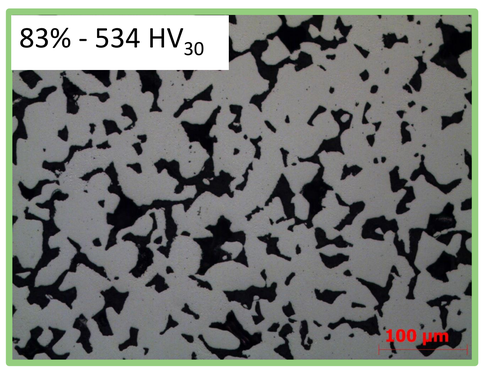
To increase the sinterability :

- Sinter in **higher temperature conditions**.
- **Ball mill** the powder to break the agglomerates
- Use **unconventional sintering** technologies.

Experiments

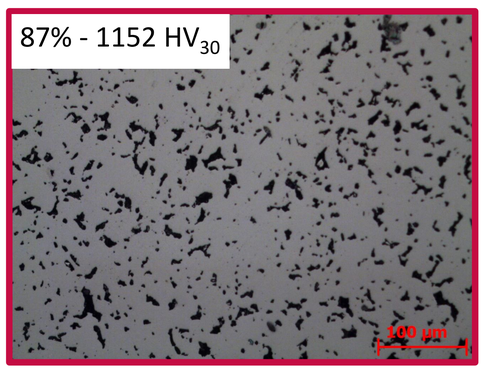
Vacuum sintering

1500°C
1h
4°C/min

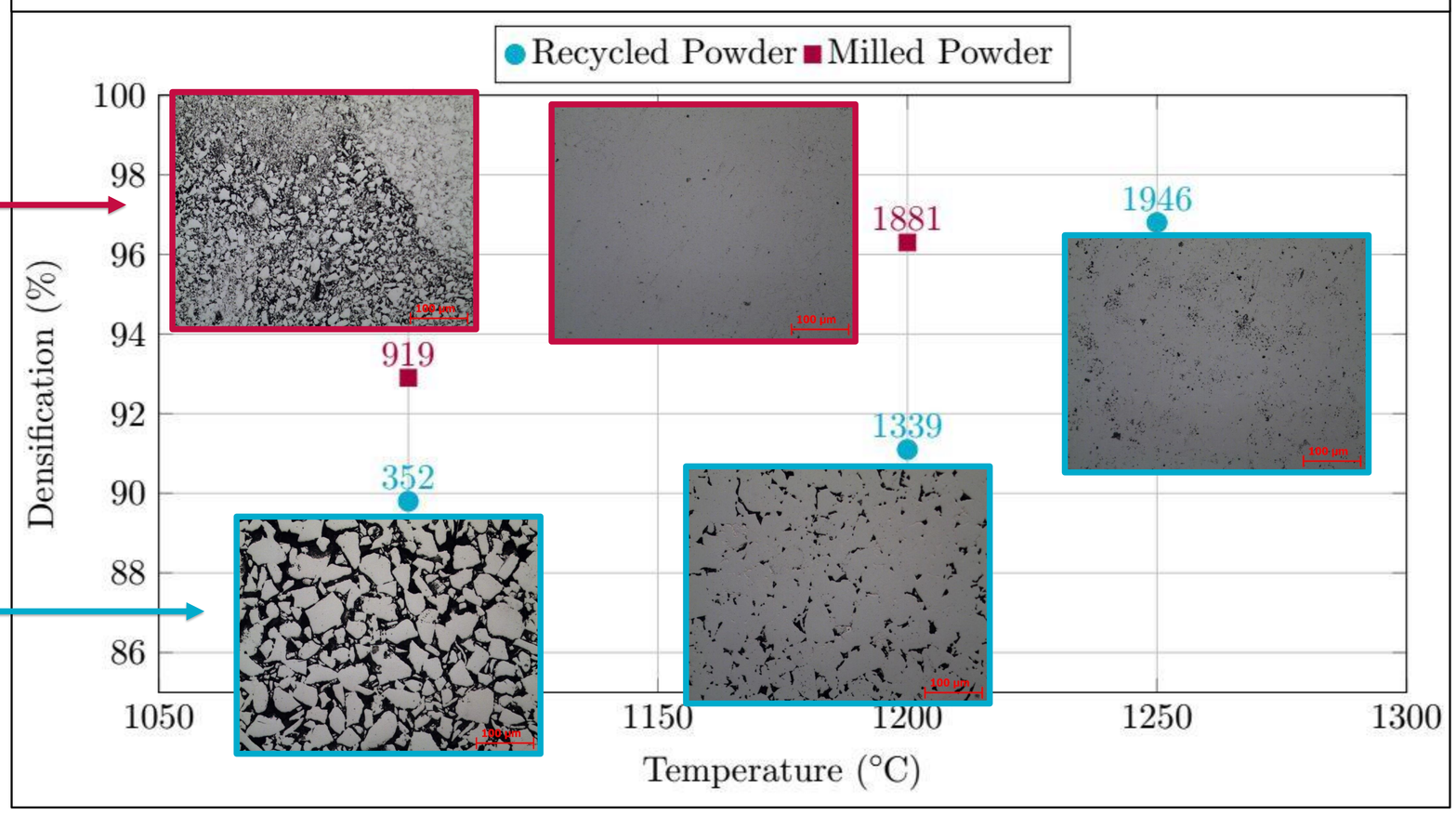


6h dry ball milling

300 rpm
Balls/powder: 4/1



SPS on the recycled powder (as-received and ball milled) – 50 MPa; 5 min; 150°C/min



References

- European commission, "Tackling the challenges in commodity markets and on raw materials", Brussels, 2011
- P. Alves Dias and al., "Cobalt- demand-supply balances in the transition to electric mobility", JRC Science for Policy Report, 2018

Conclusion

Higher temperature: not sufficient to reach a full dense sample
Ball milling: sinterability ↑ and sintering temperature ↓
SPS: sinterability ↑ and hardness ↑