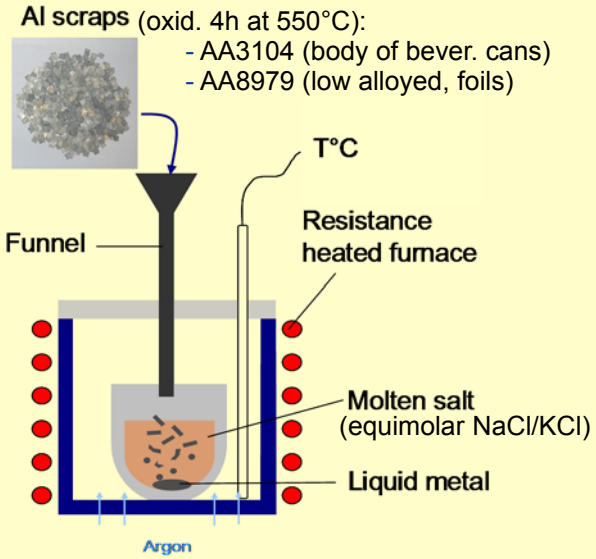
Improving coalescence in Al-Recycling by salt optimization

Background and Motivation

- Melting of Al scraps under salt flux cover → formation of a slag made of salt and collected oxides
- During the process, slag becomes more dense and viscous → entrapment of metal droplets
- The coalescence of these droplets allows a faster settling through the slag and their recovery
- In the industry, additions of cryolite to enhance the coalescence

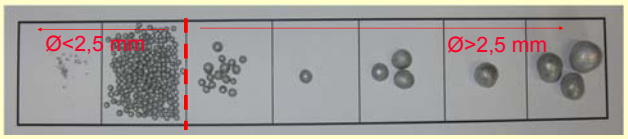
→ **Study of the coalescence of Al droplets in salts with different cryolite (Na_3AlF_6) additions**

Experimental Set-up



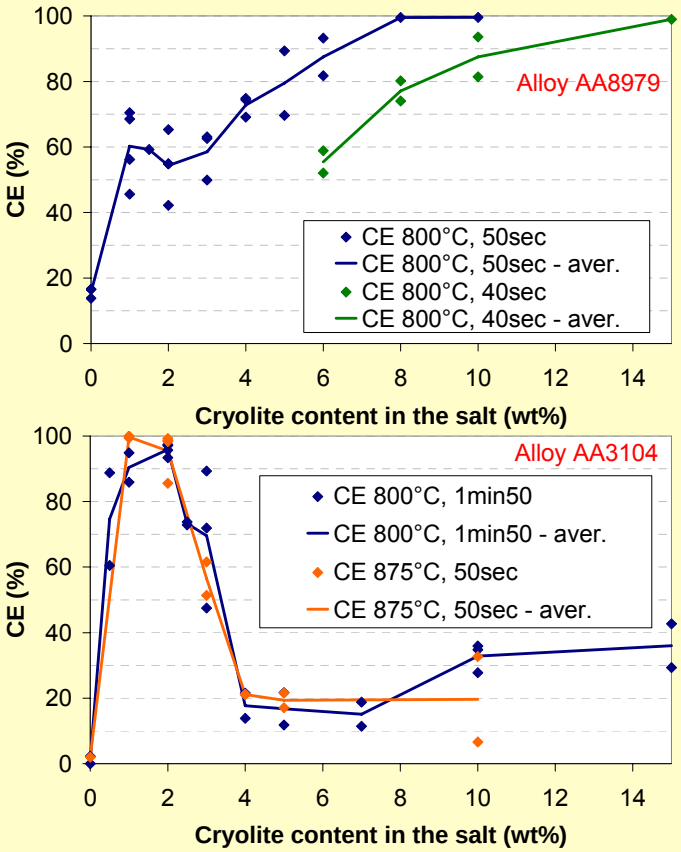
- Melting of 37.5 g of salt
- Introduction of 12.5 g of metal (~700 pieces)
- Holding time
- Crucible content quenched, leached, dried and weighed
- Criterion for coalescence efficiency:

$$CE = \frac{\text{weight} > 2.5\,\text{mm}}{\text{total weight of recovered balls}} * 100$$



Example of coalescence test result (3 wt% cryolite, AA3104)

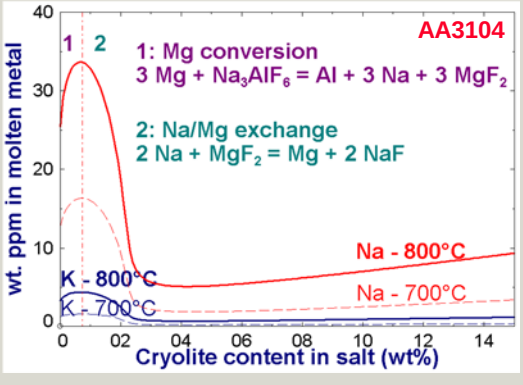
Results



- Enhancing effect of cryolite for coalescence
- Strong difference between the 2 alloys: influential effect of alloying elements in AA3104 on CE (especially Mg)

Mechanisms of coalescence

- Modifications in the oxide layer in contact with salt → weakening of the layer *(SEM/EDX)*
  - from Al_2O_3 to β-Al_2O_3 in the case of alloy AA8979
  - from spinel to Al_2O_3 in the case of alloy AA3104
- Precipitation of $KMgF_3$-type species around the droplets in the case of alloy AA3104 *(XRD/Factsage™)* → only for the curve at 800°C
- Quantity of Na and K on the surface of the droplets



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