

## **Reactivity between carbon cathode materials and electrolyte based on industrial and laboratory data**

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Interaction between electrolyte and carbon cathodes during the electrolytic production of aluminium decreases cell life. This paper describes the interaction between carbon cathode materials and electrolyte, based on industrial and laboratory data. It also reports on the degree of expansion of semi-graphitic and graphitised materials when exposed to a sodium rich environment. Phase relations in the slow cooled bath electrolyte, spent industrial cathodes and laboratory scale cathode samples were similar: all contained  $\text{Na}_3\text{AlF}_6$ ,  $\text{NaF}$ ,  $\text{CaF}_2$  and  $\text{NaAl}_{11}\text{O}_{17}$ .  $\text{Al}_4\text{C}_3$ ,  $\text{AlN}$  and  $\text{NaCN}$  were only detected in the spent industrial cathodes. The inability to locate  $\text{Al}_4\text{C}_3$  in the laboratory scale samples could be due to very low concentrations of  $\text{Al}_4\text{C}_3$  which could not be detected by XRD, or to the limited direct contact between the produced aluminium and carbon material. X-ray diffraction analysis confirmed that sodium intercalation into graphite did not take place. Wear of the examined carbon cathodes proceeded due to penetration of electrolyte and sodium into the cathode, followed by reactions with carbon and  $\text{N}_2$  whereby  $\text{AlN}$  and  $\text{NaCN}$  formed. Once electrolysis started the carbon cathodes expanded rapidly, but slowed down after approximately an hour. Sodium expansion decreased with degree of graphitisation of the carbon cathode material.