Chapter V

Conclusion

1. The first achievement for this investigation is the further development of a method to study the batch melting process. The measurement of resistivity changes in terms of voltage is very useful to identify the formation of primary liquid phase. With this respect, the method is superior to DTA.

2. By a combination of classical and newly developed methods, a comprehensive picture of the thermodynamics of batch melting was obtained. The individual mechanisms, and the methods to observe them, were: .

- dehydration (by resistivity due to Na^+ mobility in H_2O),
- appearance of primary melt (by a drop of resistivity due to Na^+ mobility),
- turnover of heat (by a temperature probe, and by DTA),
- availability of redox additions (by oxygen partial pressure measurement at the interface batch/melt),
- presence, formation, and decay of crystalline phase (by hot-stage XRD).

3. The attack of sand by soda ash is one of the key reactions. In the binary soda-sand system, the formation of disilicate and metasilicate is the predominant mechanism. Primary melt occurs at the respective eutectic at ~ 840 ^oC.

4. In commercial batches, the formation of $Na_2Ca(CO_3)_2$ and of $2Na_2O.CaO.3SiO_2$ mark the reaction path. Significant amounts of primary melt are found at ~ 840 ^oC, probably the pseudobinary joint N_2CS_3-NS_2.

5. The soda-sand reaction is strongly dependent on the grain size of the sand, investigated from "coarse" (0.355-0.500 mm) to very fine (0.063 mm). All sizes had the same resistivity "nose" at 600-700 ^oC, this is the formation of disilicate and metasilicate. Fine flint presents a big nose, it indicates that substantial amounts of Na^+ are immobilized in newly generated phase.

6. The soda-lime system shows a constant level at 785 ^oC, this is caused by the eutectic melt of the "double salt" reaction. For the soda-dolomite system, eutectic melting among MgO, $CaCO_3$, and Na_2O_3 occures at 700 ^oC (no phase diagram aviable yet).

7. Reactions involving dolomite are very sensitive towards changes of the heating rate, while reactions involving limestone are not.

8. NaCl additions as small as 0.3 to 1 wt. % change the entire reaction path. NaCl strongly interacts wilt limestone, with dolomite, and with sand. A three-phase mechanism among NaCl, soda, and sand helps to lower the primary melt formation by 100 K.