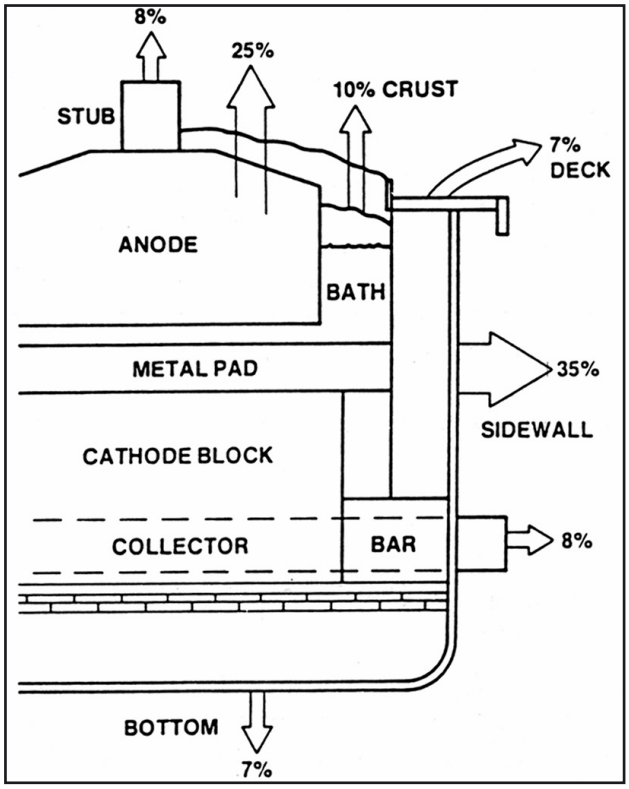
Thermal Conductivity

Background and Relevance

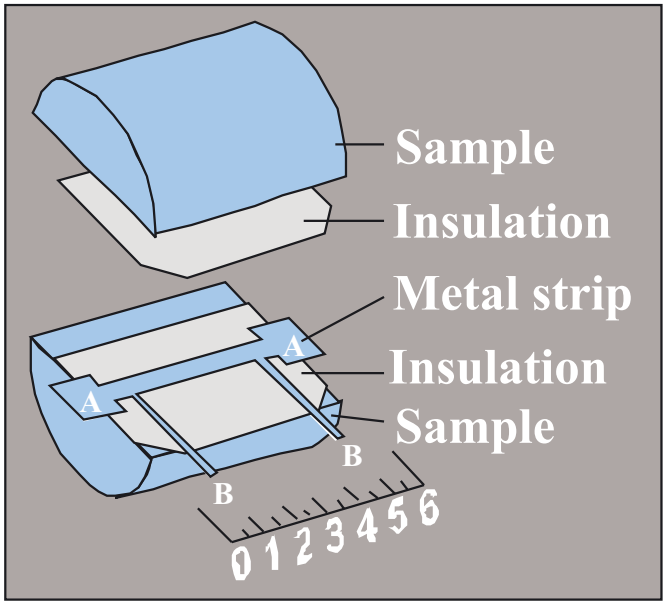
When the heat balance in an aluminium cell is calculated the thermal conductivity of the different materials are of importance. The thermal conductivity will change as a function of temperature and it is beneficial to have reliable values for the different tem-

The transient hot strip method may be used on any solid material that is stable in the temperature range of interest for conductivity measurements.



The Transient Hot Strip Method

A thin metal strip is used as a planar heat source. The metal strip is pressed between two sample halves, and heated by a constant direct current. The sample is insulated from the strip with thin insulation layers. The voltage drop over the strip is recorded as a function of time, and the temperature rise of the strip is calculated from the measured coefficient of the metal strip resistance.



The thermal conductivity is calculated from the strip temperature as a function of time, the strip dimensions, the voltage drop and the current.

Now up to 1000 °C

Adaption of new insulation materials have now made us able to measure thermal conductivity up to 1000 °C, which is 300 °C higher than previously possible.

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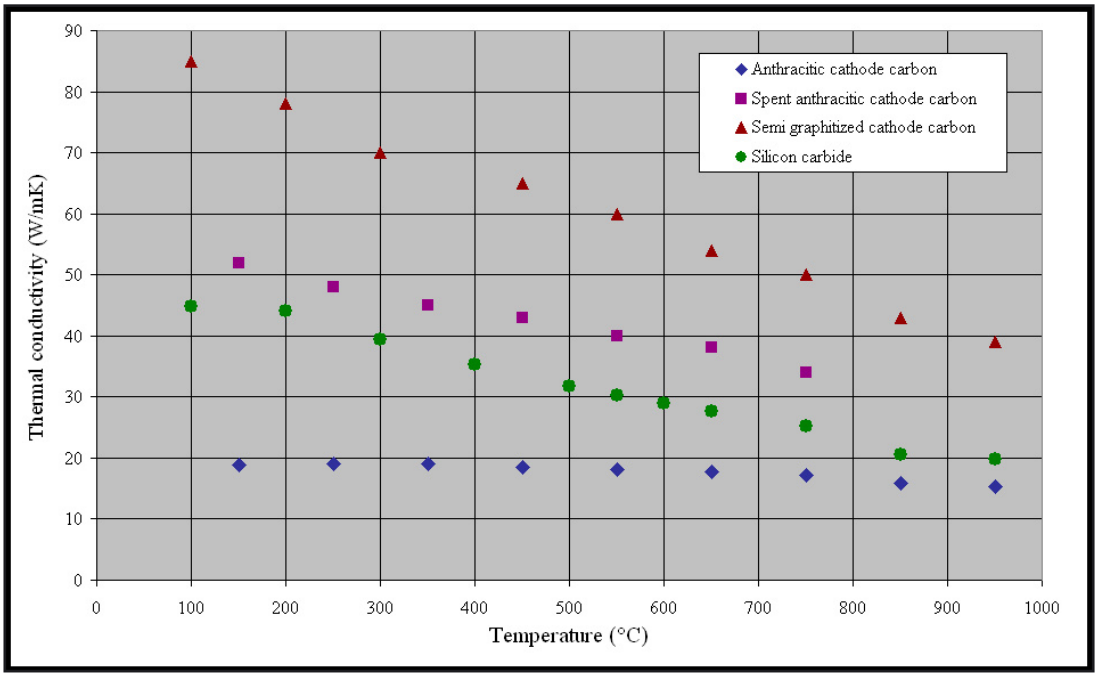
Thermal Conductivity Results

The graph beneath shows how the thermal conductivity changes with temperature for different cathode lining materials. The semi graphitized carbon materials show the highest thermal conductivity of the unused carbon materials.

Many of the carbon materials experience significant changes in thermal conductivity during operation. For instance, anthracitic carbon materials have a much higher thermal conductivity after some years in the cell. This is mainly due to graphitization during operation.



Reference

Jørund G. Hop and Harald A. Øye, "Thermal Conductivity of Al-Cathode Lining Materilas up to 950 °C by the Use of the THS Method", EUROCARBON 2000. First World Conference on Carbon, Berlin, I(2000)373-374.

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