Acoustic emission for assessing risk of climate-induced damage: monitoring the altarpiece in the church in Hedalen, Norway

M. Łukomski [1], S. Jakieła [1], M. Strojecki [1], A. Haugen [2], T. Olstad [2]

[1] *Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, ul. Niezapominajek 8, 30-239 Kraków, Poland*

[2] *The Norwegian Institute for Cultural Heritage Research Storgata 2 Postboks 736, Sentrum N-0105 Oslo, Norway*

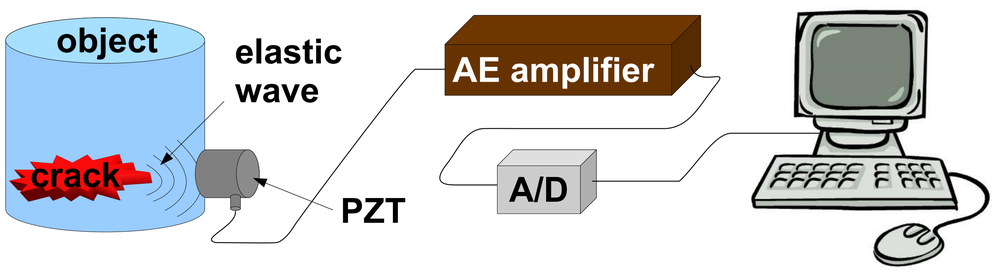
Wooden stave church in Hedalen, Norway.

Built 12-13th century, extended in 1600 and 1730.

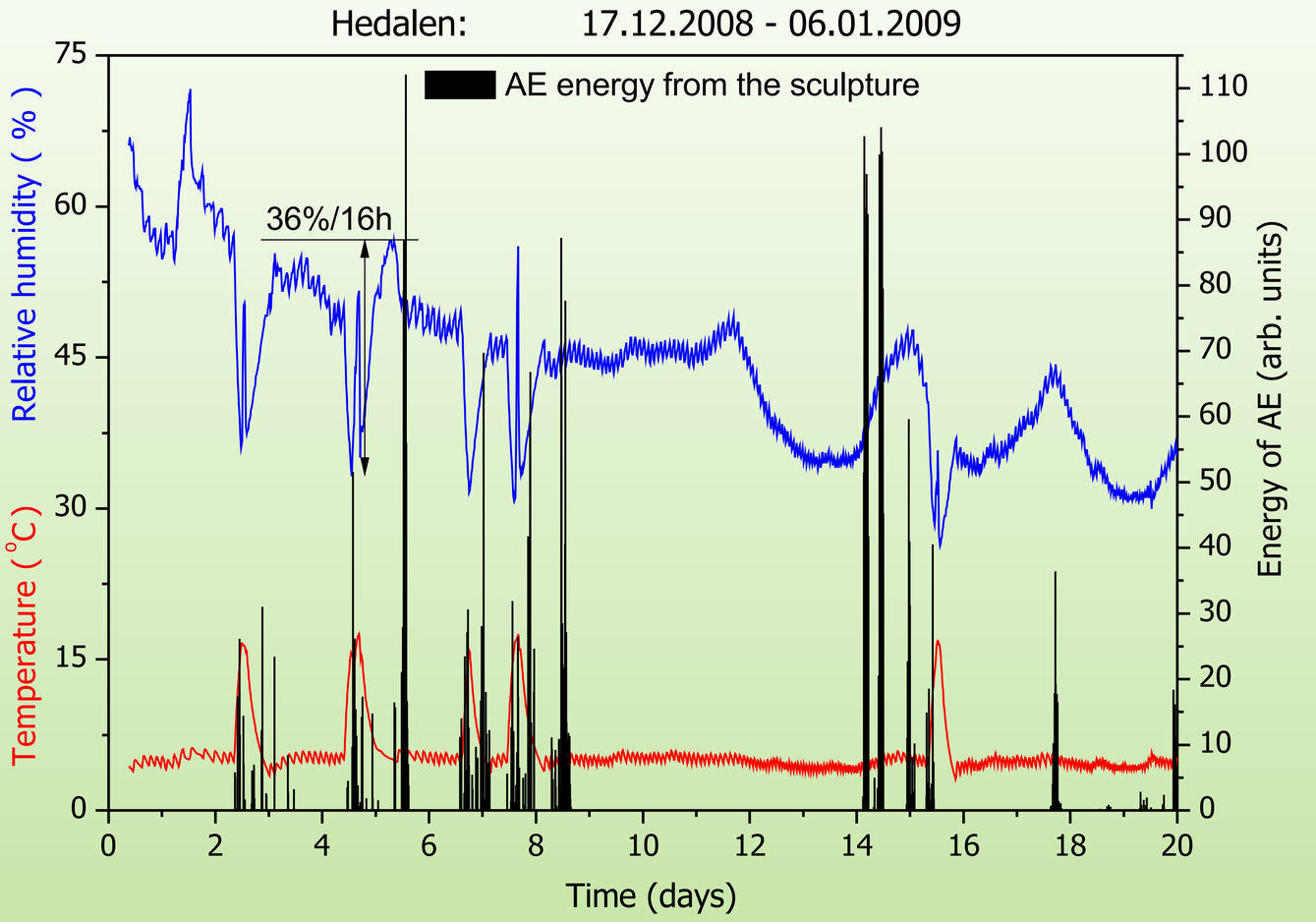
The altarpiece

A medieval wooden polychrome crucifix mounted in a thirteenth century tabernacle redecorated in the eighteenth century. System measuring acoustic emission: (a) sensor 1 mounted on the massive wooden figure of Christ, (b) sensor 2 mounted on a thin painted panel, (c) amplifier connected to a computer recording captured signals.

Acoustic emission (AE) is defined as energy released due to micro-fracturing of materials under load. The energy passes as ultrasound and sound waves, and is detected at the surface using a piezoelectric sensor which converts the surface vibration to an electric signal. The AE monitoring has become an important non-destructive tool to gain insight into the evolution of damage in materials.
In Hedalen, the AE monitoring was used to trace possible physical damage in the altarpiece, especially induced by fluctuations of relative humidity due to the intermittent heating operating in the church in winter.



Typical experimental AE setup. A/D – analog to digital converter; PZT – piezoelectric sensor.



Good correlation between AE signals captured from the sculpture and fluctuations of relative humidity and temperature is observed. The highest amplitude of AE signal was measured after 36% increase of RH over 16 hours.

Conclusions

The **panel** is not a matter of concern – no AE events were captured.
The **sculpture** is a matter of concern – AE events correlated with climate variations were recorded.

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