Unbound Water and Strength of Glass Ionomer Cements During Ageing

Michou, Stavroula; Benetti, Ana Raquel

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Objectives: To investigate the presence of unbound water in encapsulated restorative glass ionomer cements (GICs) and its influence on the materials' compressive strength (CS).
Methods: Six commercial GICs were investigated (ChemFil™ Rock, EQUIA® Forte, Fuji IX GP®, Ionofil Molar AC, Ketac™ Molar Aplicap™, Ketac™ Fil Plus Aplicap™). A total of 720 cylindrical specimens (4mm diameter and 6mm height) were prepared based on ISO 9917-1 guidelines and the manufacturers' instructions. The specimens were stored dry, wet or protected at 37°C and aged for 7 or 28 days. Each specimen's mass change during ageing was calculated followed by compression test. Non-parametric statistical methods were used in data analysis (α=0.05).
Results: For specimens stored dry, significant mass loss (mdn. 0.7 to 1%) was observed, which increased during ageing for all materials (mdn. 1.4 to 2.4%). Minimal mass loss was observed for protected specimens (mdn. 0.1 to 0.2%), which also increased during ageing (mdn. 0.6 to 0.8%). On the contrary, wet specimens significantly gained mass (mdn. 1.2 to 2.3%), which increased only for two materials (mdn. 1.2 to 2.5%). Surface protection and dry storage resulted in higher CS ($p<0.05$) at 28 days (mdn. 188.4 to 266.4 MPa and 196.5 to 271.3 MPa respectively) compared to wet storage (mdn. 169.3 to 229.4 MPa) for most materials. CS did not improved with ageing for all materials and storage conditions. A weak, negative correlation was found between mass change and strength ($r=-0.331$).
Conclusions: Unbound water was found in all investigated GICs in varying amounts, without always affecting the CS. The early exposure to water as well as the excessive amount of unbound water negatively influenced the CS. Relevant surface protection and adequate water proportion in the GIC mixture are prerequisites for optimal CS.

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Authors
- **Michou, Stavroula** (University of Copenhagen , Copenhagen Copenhagen , Denmark)
- Benetti, Ana (University of Copenhagen , Copenhagen Copenhagen , Denmark)

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