ADHESIVE FIXATION IN DIRECT COMPOSITE RESTORATIONS: THE ROLE AND IMPORTANCE OF THE POLYMERIZATION PERIOD

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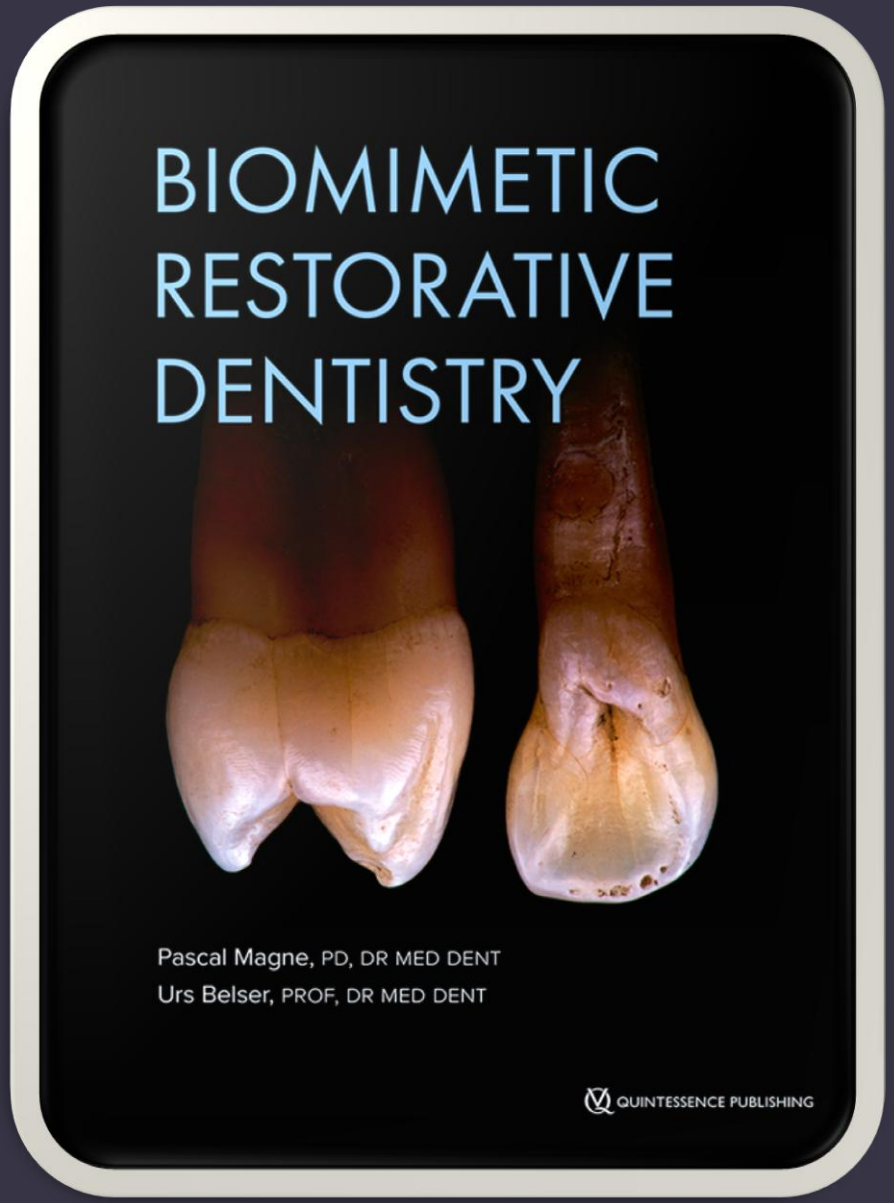
Pascal Magne and his «Biomimetic Restorative Dentistry»

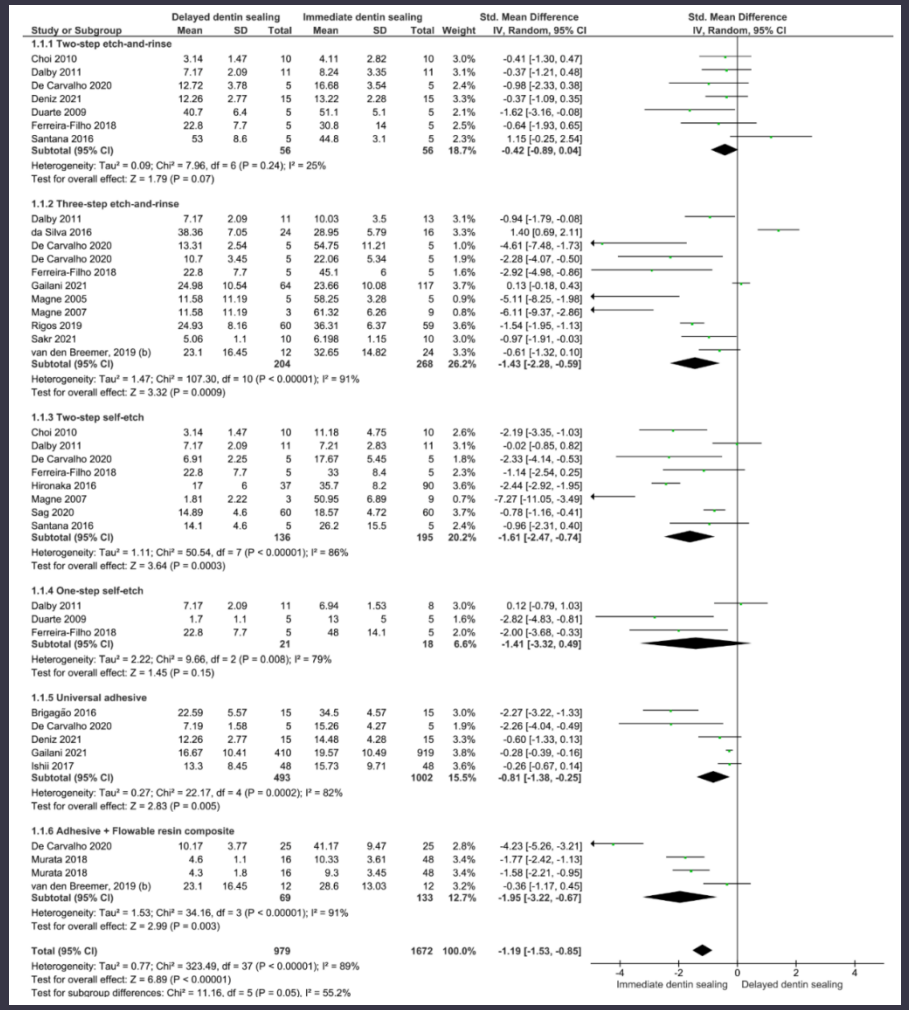
The IDS concept (Immediate Dental Sealing).

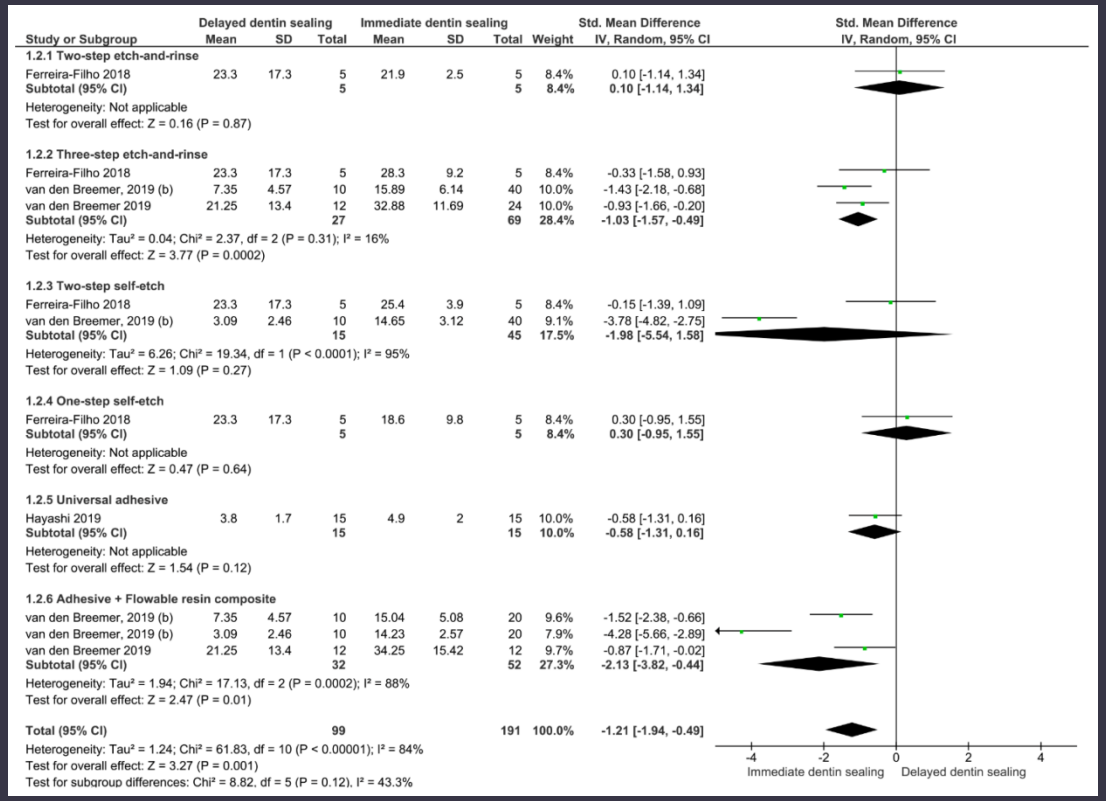
«IDS involves carrying out bonding procedures immediately after the tooth has been prepared. This commonly involves conditioning (e.g. with total etch or self-etch systems), priming, and applying a layer of adhesive of appropriate thickness to freshly-cut dentin».



Magne, Pascal. (2014). IDS: Immediate Dentin Sealing (IDS) for tooth preparations. The journal of adhesive dentistry. 16. 594. 10.3290/j.jad.a33324.

Data from the 2022 meta-analysis on the IDS technique





Hardan L, Devoto W, Bourgi R, et al. Immediate Dentin Sealing for Adhesive Cementation of Indirect Restorations: A Systematic Review and Meta-Analysis. Gels. 2022;8(3):175. Published 2022 Mar 11. doi:10.3390/gels8030175

- Polymerization "plateau" which occurs after approximately 5 minutes.

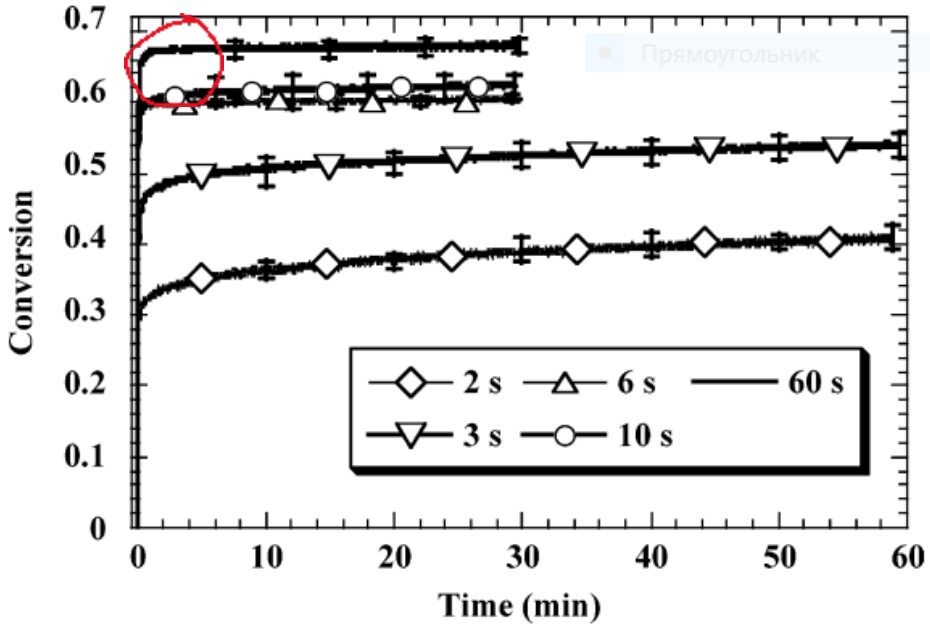


Figure 1 Double bond conversion vs. time of Bis-GMA/TEGDMA (70/30 by wt; Initiator: CQ 0.3 wt%; EDAB 0.8 wt%) filled with 30 wt% silanized barium glass irradiated for 2 s (◇), 3 s (▽), 6 s (△), 10 s (○), and 60 s (—) with light intensity of 450 mW/cm^2 (n=3).

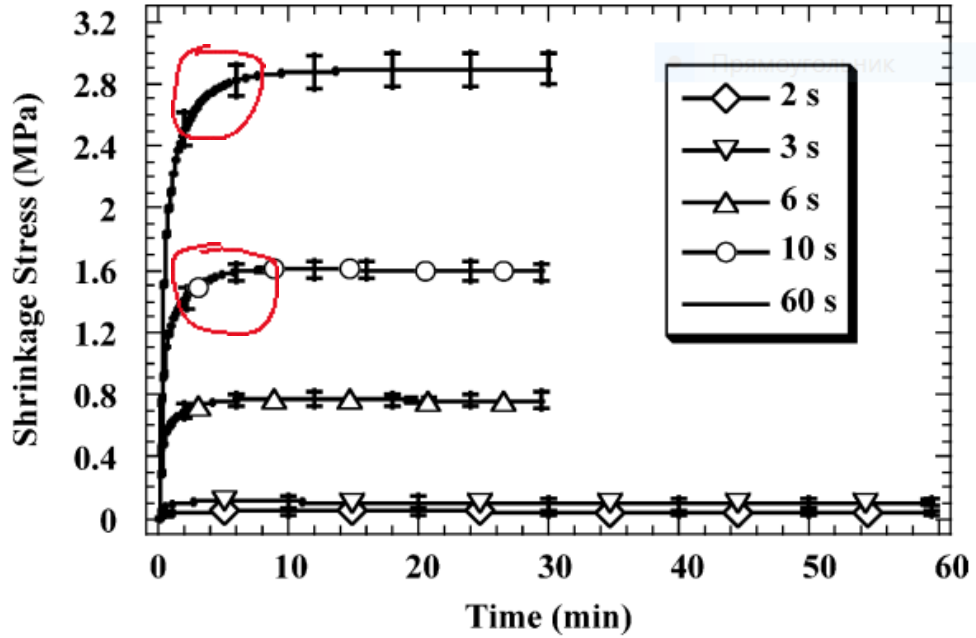


Figure 2 Average shrinkage stress development vs. time of Bis-GMA/TEGDMA (70/30 by wt; Initiator: CQ 0.3 wt%; EDAB 0.8 wt%) filled with 30 wt% silanized barium glass cured for 2 s (◇), 3 s (▽), 6 s (△), 10 s (○), and 60 s (—) with light intensity of 450 mW/cm^2 (n=3).

Lu H, Stansbury JW, Bowman CN. Towards the elucidation of shrinkage stress development and relaxation in dental composites. *Dent Mater*. 2004;20(10):979-986. doi:10.1016/j.dental.2004.05.002

Rationale for Research:

- The bond strength of composite material to enamel and dentin tissue is a decisive factor in the service life of a tooth restoration (Sirisha K, 2014) and has numerous publications in this field.
- The delayed polymerization protocol is less studied. The technique is more studied for indirect restorations as IDS, Immediate Dental Sealing. More and more data confirm the effectiveness of the technique (Alghauli MA, 2024).
- The topic of delayed polymerization for direct restorations is almost not covered (Hayashi J, 2019).
- Today, there is insufficient laboratory and clinical data to choose between immediate and delayed techniques for direct composite restorations.
- There are no standardized time parameters for the clinical use of the technique.
- Therefore, we see the relevance of our research.

Null Hypothesis:

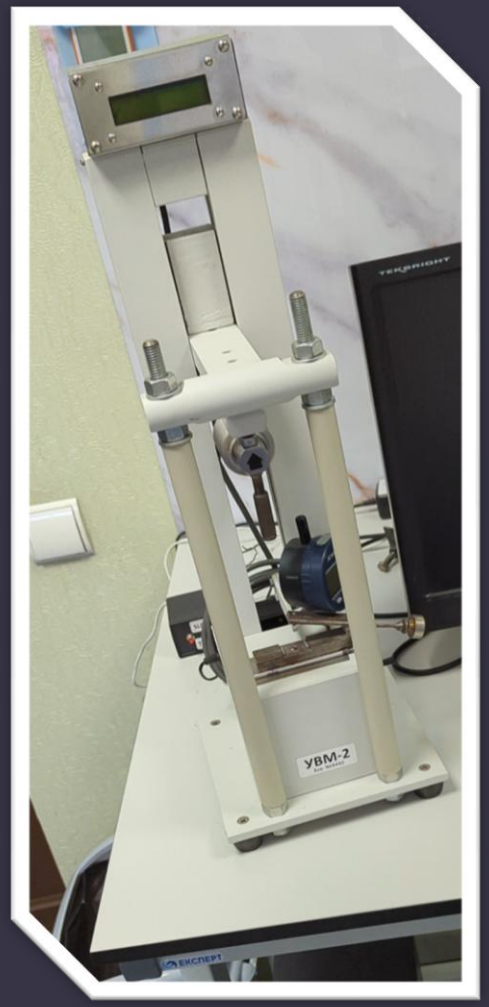
- This background allows formulating a null hypothesis for further laboratory and clinical testing – the delay time of composite application on the polymerized adhesive and adaptive layer does not affect the adhesion parameters and clinical indicators of the restoration.

Previous works:

1. Didier Dietschi - gIDE Institute, Geneva, Switzerland
2. David Alleman - Alleman Center of Biomimetic Dentistry, Utah, USA
3. Juri Hayashi - Department of Restorative Dentistry, Biomimetics Biomaterials Biophotonics Biomechanics & Technology Laboratory, School of Dentistry, University of Washington, 1959 NE Pacific Street, Seattle, WA 98195-7456, USA
4. Alireza Sadr - Cariology and Operative Dentistry, Department of Restorative Sciences, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, 1-5-45, Yushima, Bunkyo-ku, Tokyo 113-8549, Japan

Unresolved issues:

- Lack of a formulated protocol for delayed polymerization
- Lack of clinical studies and observations

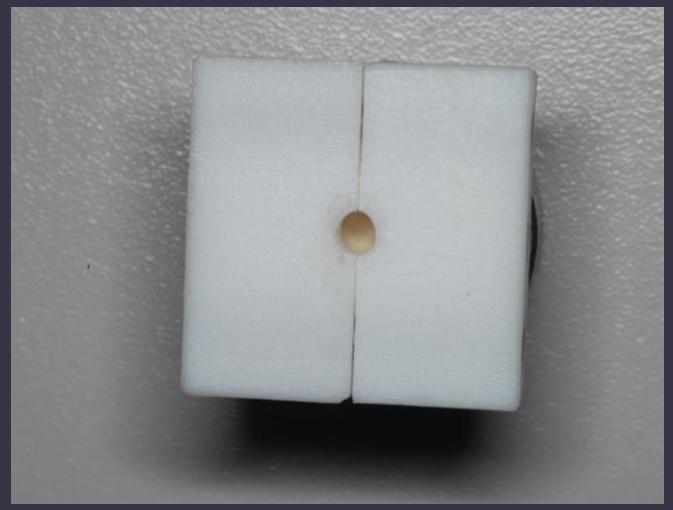


Strength measurement:
- tensile
- - shear

Compressive strength measurement.

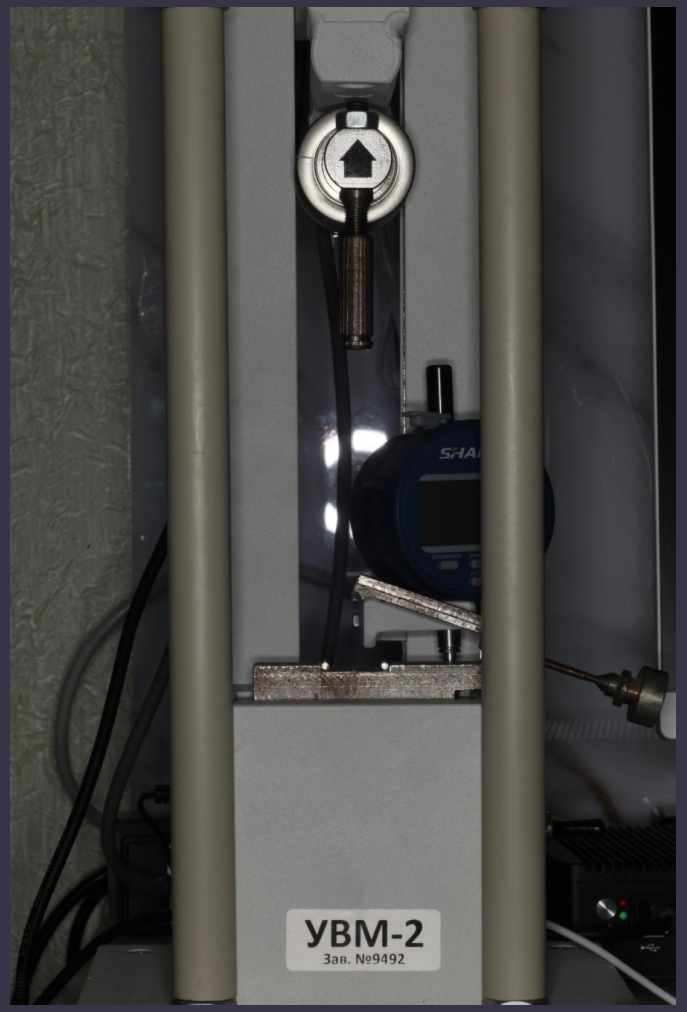
FTIR spectrometry

Steps of prepearing the samples for shear bond strength test



Steps of prepearing the samples for shear bond strength test

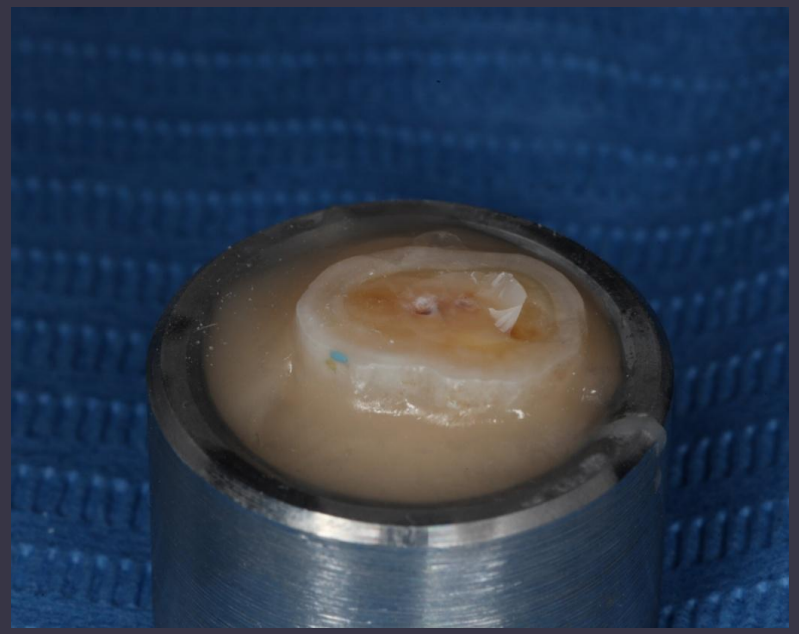
Cohesive breakage of composite rode in group 1 sample (delayed)



Setup for shear bond strength test

Shear bond test results in lab

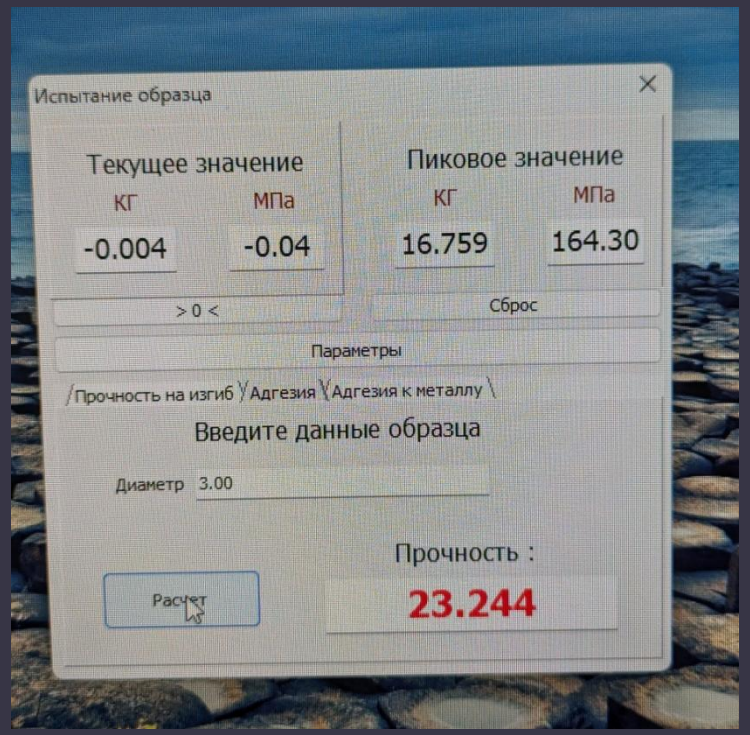
Cohesive breakage of composite rode in group 1 sample (delayed)



Cohesive breakage of composite rode in group 1 sample (delayed)

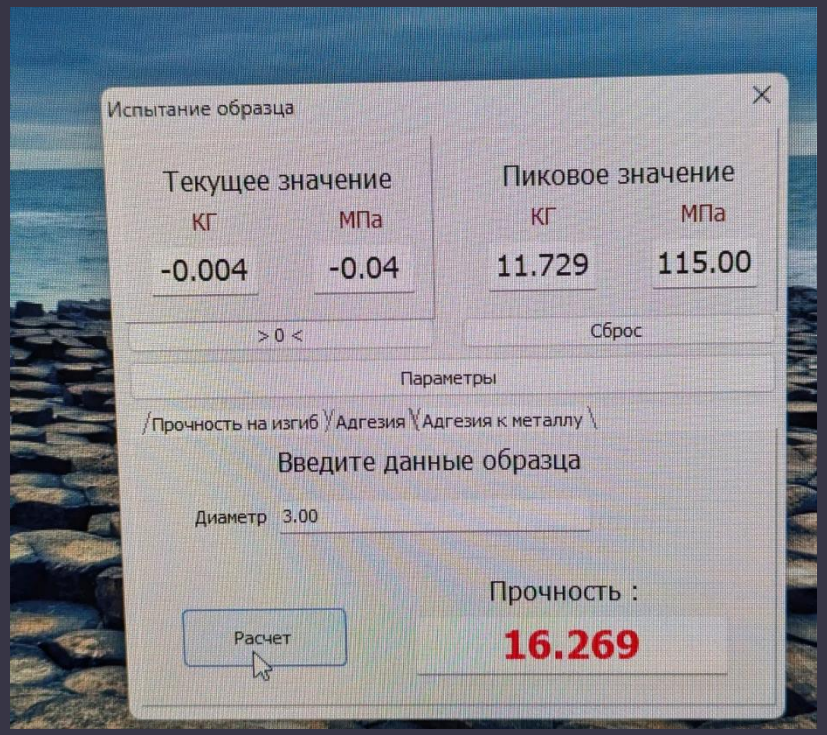
Adhesive breakage of composite rode in group 2 sample (immediate)

Group 1 (5 samples)



Average value – 22.7 MPa

Group 2 (5 samples)



Average value – 16,1 мПа

WORK IS ONGOING