

Beyond solids and liquids: the science of slime

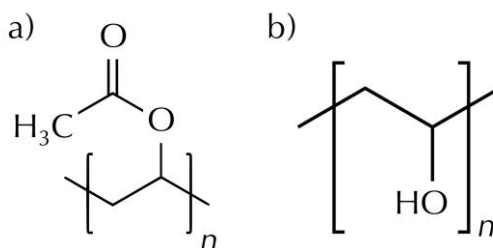
Slime infosheet

Slime is a fascinating material with properties between a liquid and a solid, but how is it made?



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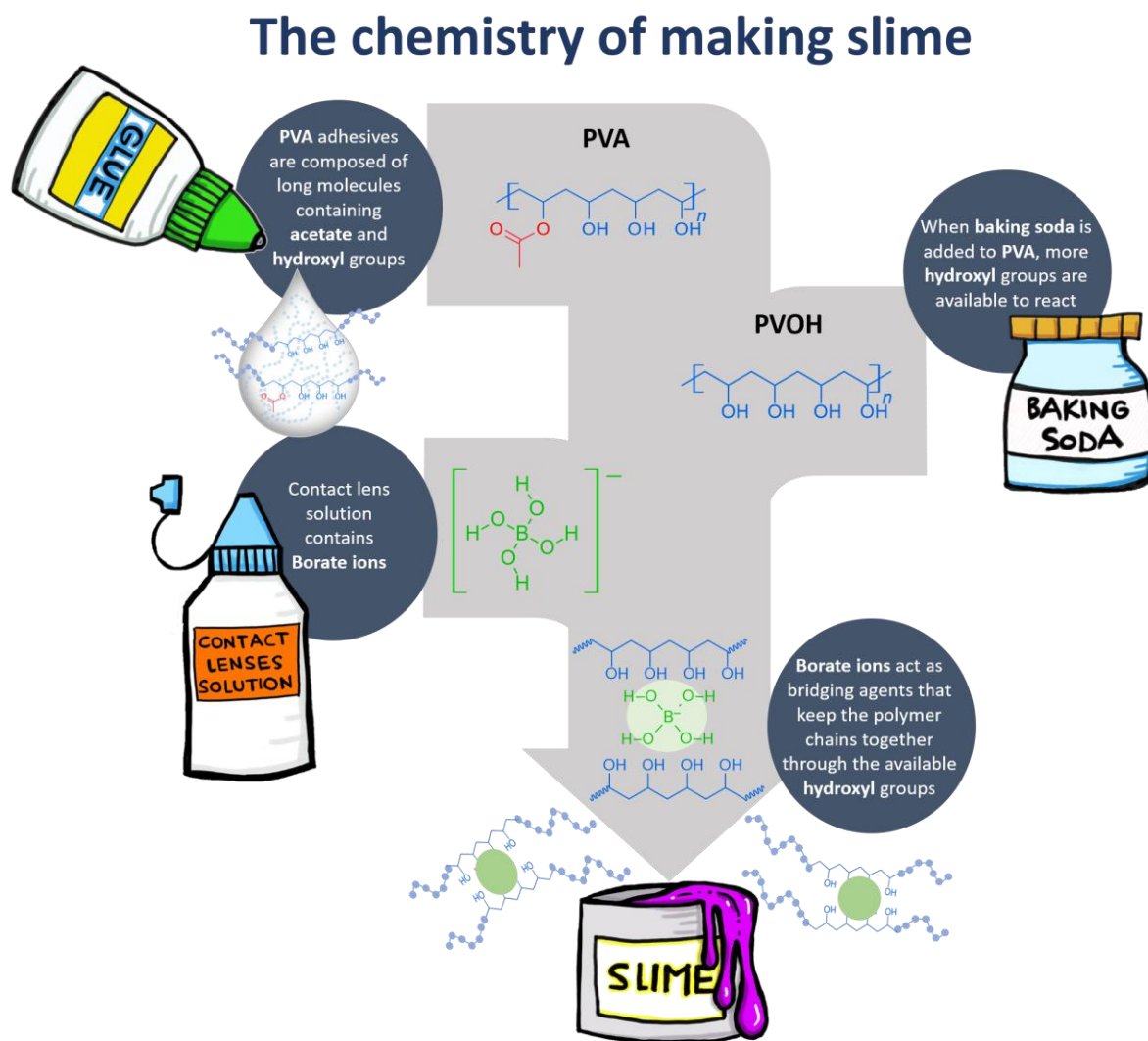
School glue is composed of a dispersion of polyvinyl acetate (PVA) polymer in water. However, it is common to find a mixture of polyvinyl acetate and polyvinyl alcohol (PVOH) units in the glue formulations. To initiate the reaction that produces slime, it is necessary to hydrolyze most of the PVA units to yield PVOH. The addition of sodium bicarbonate in the second step promotes hydrolysis of the acetate groups, thus making more hydroxyl groups available for the subsequent step of the reaction.



a) Polyvinyl acetate b) If the acetate groups are hydrolyzed, you land up with polyvinyl alcohol.

Boric acid is often found in contact lens solution due to its antiseptic properties. When it is introduced to PVA in the third step, a cross-linking reaction takes place. This reaction causes the polymer chains to link together through their hydroxyl groups, with boric acid acting as a bridging agent (green circle in the figure below). The new bonds restrict the movement of the initially free chains, which we perceive as an increase in the hardness. These bonds remain when subjected to slow stretching, but they break when fast effort is applied. However, they can reform again on contact, a property called selfhealing.^[1]

The exact bonding structure is not yet clear and is often misrepresented,^[2] but the nature of the borate ion and the cross-linking bonds play an important role in the curious properties of the material we will create.



Synthesis process to obtain the slime

Image courtesy of the authors

References

- [1] Ghosh SK (2008) *Self-Healing Materials. Fundamentals, Design Strategies, and Applications*. Wiley-VCH, Weinheim. ISBN: 978-3-527-31829-2
- [2] Read about widespread misconceptions in slime chemistry: <https://cen.acs.org/physical-chemistry/chemical-bonding/Errors-CEN-graphic-reveal-widespread/96/i28#>