

Use of MRI to investigate effects of SAP synthesis on swelling distribution

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Introduction: The feminine hygiene market encompasses a wide variety of products and is valued at US \$4.72bn with a projected increase of 4.37% by 2028. [1] Efficient uptake of specific bodily fluids is integral to the function of a personal hygiene product, and the rate and effectiveness of solution uptake is determined by multiple factors; composition and synthesis of materials, degree of crosslinking of SAP (directly related to swelling capacity), and the distribution of liquid over polymer material, as examples. [2] Understanding these parameters and how they impact the materials is integral to improving their function, which could lead to a reduction in cost and an increase in accessibility. Magnetic Resonance Imaging (MRI) is useful in this study of SAP swelling, as it can accurately determine the distribution of fluid throughout the sample.

Methods: This study uses 1D Profiling and T2 and diffusion maps to investigate the behaviour and properties of SAPs. 1D Profile images are used to provide kinetic information on the initial absorption of water into SAP particles, whilst T2 and diffusion maps give an overview of the behaviour of SAP particles at equilibrium. This setup allows for non-invasive, high-resolution imaging of SAPs as they undergo deformation, absorption, and swelling.

Results and Discussion: Initial results highlight the potential for this methodology to monitor kinetics of SAP particles and surrounding solution. Fig. 1, a 1D Profile space-time plot, shows initial proton distribution throughout the sample, from which we can infer the swelling behaviour of SAP changes over time from initial solution addition.

Conclusion and Outlook: These results will offer insight into water distribution and swelling behaviour throughout the polymer matrix. Multiple commercial SAPs produced under varying synthesis conditions will be used for testing. Using this technique and multiple scan protocols, we aim to deepen the understanding of SAP behaviour and optimize their application in real-world scenarios.

References:

1. Statista. Feminine Hygiene - United States 2024 [Available from: <https://www.statista.com/outlook/cmo/tissue-hygiene-paper/feminine-hygiene/united-states>].
2. Damiri F, Salave S, Vitore J, Bachra Y, Jadhav R, Kommineni N, et al. Properties and valuable applications of superabsorbent polymers: a comprehensive review. Polymer Bulletin. 2023.

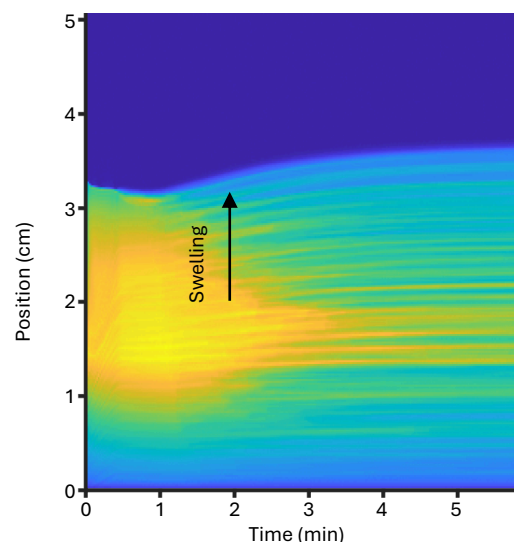


Fig. 1: The swelling process of SAP was monitored using the 1D profiling method. Stacked 1D T2-weighted profiles recorded in a slice as a function of time. Yellow = high intensity, blue = low intensity.