P1165

Cellulose fibres for surface disinfection

Analysis of the material of ready-to-use disinfection wipes for surface disinfection and their impact on patient safety

M. Krewing, C. Noderer, C. Linke, H. Niesalla

HARTMANN SCIENCE CENTER, BODE Chemie GmbH, a company of the HARTMANN Group, Hamburg, Germany

Background

Healthcare facilities face the challenge of becoming sustainable, not only in terms of CO_2 emissions, but also in terms of material consumption and waste production. Disinfectants may play a minor role in a hospital's overall waste production, however, in Germany alone surface disinfection wipes generate more than 1,800 tonnes of plastic waste per year [1]. Therefore, a shift from petroleum-based plastic wipes to sustainable cellulose-based fibres is needed to make surface disinfection more sustainable. However, the new wipe materials come along with new properties which can have an impact on disinfection efficacy and patient safety, and not every sustainable, cellulose-based wipe material is suitable for use in clinical settings.

Ready-to-use pre-impregnated disinfection wipes made from two different cellulose-based fibres and soaked either with a low-alcoholic or organic acid-based disinfectant were analysed for tensile strength, linting, and interaction between fibre and chemical formulation.

Materials & wipe compositions

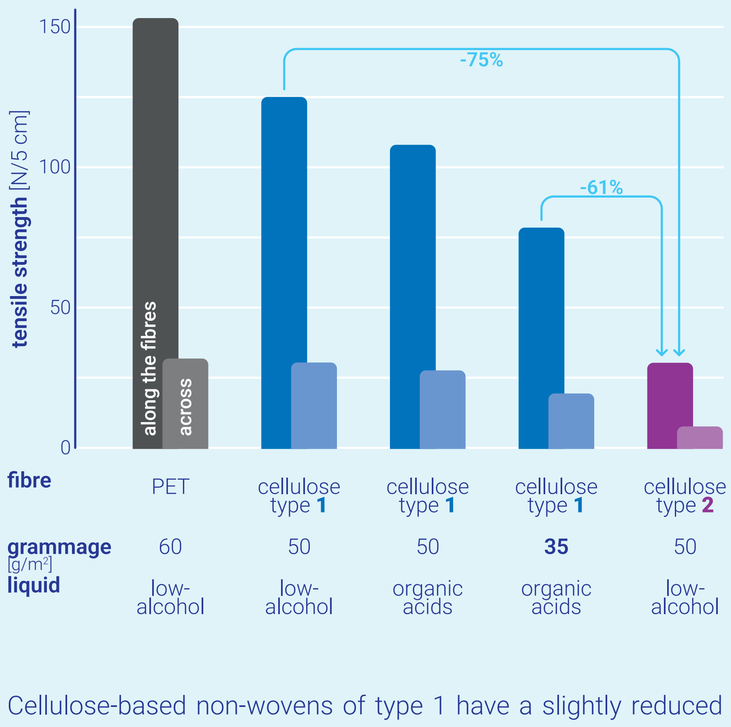
In this study two different types of non-wovens made from cellulose fibres were compared with conventional PET plastic fibres. For type-1 wipes, the cellulose fibres were bonded in a single layer similar to PET wipes. In case of type-2 wipes, an interlayer of pulp was included by the manufacturer. This pulp layer is supposed to increase the liquid absorption of the wipe.

Results

Tensile strength

A strong and tear-resistant disinfectant wipe can be applied with more pressure over the surface. Dirt and contamination are removed more effective. The fibres do not break as easily, thus, less fibre fragments are left on the surface.

Method: The maximum tensile strength of non-woven fabrics made from PET or the two types of cellulose was determined in accordance to DIN EN 29073.

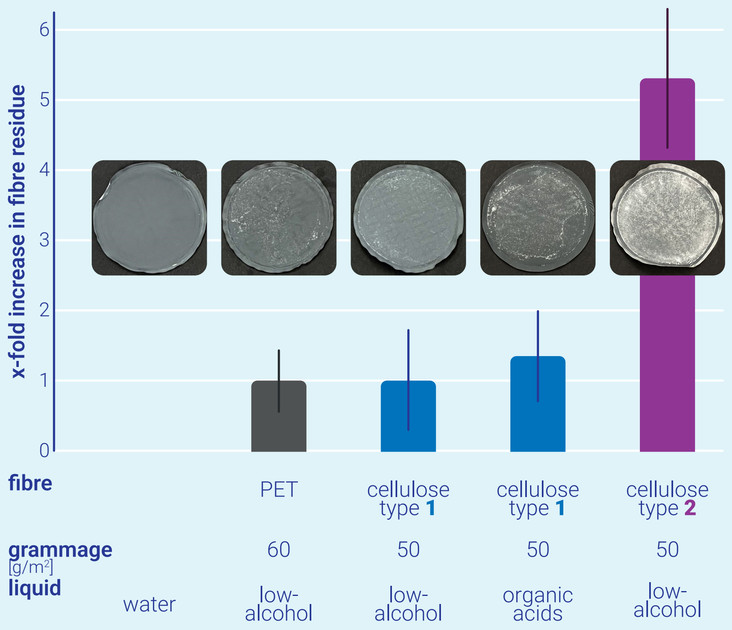


Cellulose-based non-wovens of type 1 have a slightly reduced tensile strength compared to PET fibres. However, the tensile strength of type-2 fibres is more than 75% lower than of type-1 fibres. It is even lower than that of non-wovens with lower grammage and a impregnation liquid (organic acids) that seems to reduce tensile strength in general.

Linting

Lint from textiles are an old problem which seems to be solved decades ago. Back then, fibre residue entering wounds in surgeries were described to prolong the healing process and cause granulomas or tissue adhesions [2,3].

Method: To determine the amount of fibre residue and lint from cellulose-based disinfectant wipes, stacks of pre-soaked wipes from flowpacks were squeezed out and the liquid filtered (pore size 0.45 µm). The filters were washed and dried. The amount of fibres measured based on the filters' weight was set in relation to PET wipes. A filter through which only water was filtered is also shown.



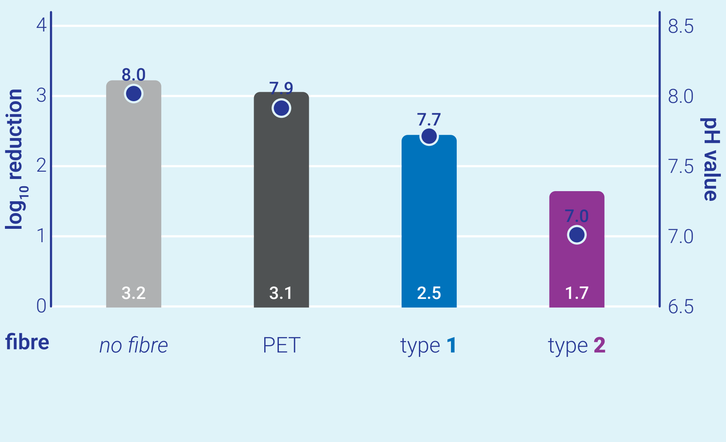
The tested pre-soaked wipes of fibre type 1 leave the same amount of lint as PET fibres. Non-woven wipes containing pulp as interlayer (type 2) leave more than five times more fibre residue.

Chemical interaction

Certain kinds of fibres can bind active ingredients in disinfectants and, thus, reduce the efficacy of the disinfectant [4]. Viscose fibres, e.g., are able to retain quaternary ammonium compounds [5].

The chemical interaction of certain cellulose-based fibres with disinfectants can be seen as discolouration of the squeezed out liquid (see left pictures).

Method: To characterise the interaction between fibre and liquid in more detail, non-wovens were soaked in an alcoholic solution (14 g ethanol, 6 g 1-propanol, 10 g 2-propanol, ad 100 g water, pH 8) for 72 h and then the squeezed out liquid was analysed. Pictures, the pH value, and the efficacy against adenoviruses according to EN 14476 (high organic load) were determined.



Cellulose fibres reduce the pH of alcoholic disinfectant solutions while fibres of type 2 containing pulp have the stronger influence ($\Delta pH = 1.0$, $\Delta \log_{10} = 1.5$). Here, a pure alcoholic solution was tested. The extent to which the observed influence occurs in more complex disinfectants on the market has yet to be investigated.

Conclusion

Reductions in tensile strength make forceful wiping difficult, while lint remaining on surfaces poses a risk to patients, as it can delay healing if it gets into wounds. The observed interaction between one of the tested cellulose-based materials and the disinfectant solution may influence the efficacy and should be further analysed. Cellulose-based non-wovens are a suitable successor of petroleum-based wipes, however, significant differences between cellulose fibre types were found here. Disinfection must undergo a green transformation, but patient safety and ease of use must not be compromised.

Visit here for more information

Research for infection protection
hartmann-science-center.com

Conflict of Interest

The authors are employees of BODE Chemie GmbH, a company of the HARTMANN Group, which is a manufacturer and vendor of disinfectants.

References

[1] IQVIA Commercial GmbH & Co. OHG
[2] Janoff *et al.* (1984). Am J Surg. 147(5): 598-600.
[3] Truscott (2004). Surg Technol Int. 12: 34-36.
[4] Bloß *et al.* (2010). J Hosp Infect. 75(1): 56-61.
[5] Pascoe *et al.* (2022). J Hosp Infect. 126: 37-43.