SUPPORTING INFORMATION

Rejection of micron-sized particles using wood xylem

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Figure S1: \(\zeta\)-potential of the particles as indicated by the supplier for (a) 5 \(\mu\)m and (b) 20 \(\mu\)m.

Figure S2: (a) Schematic representation of the filtration setup and (b) drawing of the custom filter-holder.
The image analysis of three beech samples, shown in Figure S3-5, was performed as follows: (1) digitizing the images in 256 gray levels, (2) applying size calibration based on the SEM scale bar, (3) Crop to remove all labels, (4) increasing contrast by adjusting the pixel intensity, (5) apply a global gray scale threshold of 0-129 with the default method to yield a binary image (black and white), where pore regions are displayed in black and membrane material is displayed in white, (6) remove manually the signal corresponding to the rays, (7) analysis of the area-and number-distribution of the black areas.

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<th>Step</th>
<th>EW</th>
<th>YR</th>
<th>LW</th>
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*Figure S3: SEM image of beech wood sample S1 subjected to image processing and the resulting images after following the steps described in the analysis method.*
Figure S4: SEM image of beech wood sample S2 subjected to image processing and the resulting images after following the steps described in the analysis method.
Figure S5: SEM image of beech wood sample S3 subjected to image processing and the resulting images after following the steps described in the analysis method.
Figure S6: (a) SEM image of the top surface of the beech wood filter showing the surface roughness due to cutting. (b) gives a zoom of the cell wall fragments blocking the lumina of intact cell below.
The measure of the pore volume can be determined by the quantity of mercury intruded under a known pressure. As mercury is a non-wetting fluid, it cannot penetrate a porous solid through capillary forces. Thus, from the volume of mercury intruded, the total pore surface area, and hence, the total internal volume can be calculated. Wood can be approximated to a bundle of small cylindrical capillaries. Therefore, the penetration of mercury into this porous body can be described by the Washburn equation. It relates the radius of the pores (r) with the measured pressure (p), the contact angle (θ) of mercury and its surface tension (γ) being constants:

\[ r = \frac{-2\gamma \cos \theta}{p} \]

Figure S7: Porosity of native beech wood determined by mercury intrusion porosimetry. The relative pore volume is given as a function of the pore size, the insert shows the distribution for pore sizes <10μm. The analysis was performed with a Pascal 140+440 instrument from POROTEC.
Figure S8: Beech samples as used for the filtration implementation, before and after particle test, showing the formation of the filter cake. The SEM image shows the transition (dashed line) between earlywood (EW) and latewood (LW) over a year ring.

Figure S9: Perforation plates present in beech wood: (a) scalariform or lace-like structure and (b) simple perforation.
Figure S10: Time-dependent spiking test conducted with microspheres of size 5μm, the sampling has been performed at the inlet (feed) and outlet (permeate) of the membrane, error bars represent 50% confidence interval.
Additional experiments have been conducted using beech and spruce wood. The surface of the samples has been polished by using a microtome to remove the rough upper layer visible in Figure S6. The prepared samples have been used to filter 100 mL of 20 μm-sized particles (initial concentration: $5 \cdot 10^5$ particles/mL). After the filtration, the presence of particles in the filtrate has been assessed by microscopy after drop casting of 1 mL of solution on a glass slide. The removal efficiency was calculated as the ratio of particles in the permeate to the initial amount of particles counted. The analysis were conducted on three replicates.

![SEM image of the top surface of a polished beech wood filter after filtration with 100 mL of 20 μm-sized particles.](image)

*Figure S11: SEM image of the top surface of a polished beech wood filter after filtration with 100 mL of 20 μm-sized particles.*
Figure S12: SEM images of spruce discs after filtration. (a) and (c) correspond to microtomed spruce (cross-section and longitudinal views respectively). (b) and (d) correspond to rough spruce samples (cross-section and longitudinal views respectively).

Figure S13: Light microscope images of the surrogate solution before (a) and after 20μm particle filtrations using beech and spruce samples with (b-c) polished surface, P, and (d-e) rough surface, R. The red arrows indicate the particles. The values for particle count were averaged over 3 samples.