AUTHORS ANSWER to REVIEWERS

We are very grateful to the Reviewers comments. After a full revision and modification of the manuscript we are confident that the comments of the Reviewers have been addressed, as follows:

REVIEWER 1

1) The Authors should include in the manuscript information about the membranes used in this study (e.g., pore size, porosity, thickness, physico-chemical, etc.) in order to provide to readers a comprehensive view of the membrane characteristics and to appreciate the differences with other suitable commercial membranes.

Answer:

The Section of Methods includes the following statement: "The synthesis of CA30/5%SiO2 and CA22/5%SiO2 was previously reported under the designation of A5 (Mendes et al., 2018) and CA22/5%SiO2 (Jardim Beira et al., 2019), respectively." These two references not only describe the synthesis of the CA30/5%SiO2 and CA22/5%SiO2 membranes but also report their morphological, physico-chemical and ultrafiltration permeation characteristics.

The text in the Section of Methods, line 57, would be modified and it will read:

The synthesis and characterization (SEM, ATR/FTIR, NMR) of CA30/5%SiO2 and CA22/5%SiO2 was previously reported by Mendes et al., 2018 (membrane A5) and Jardim Beira et al., 2019, respectively.

2) A more detailed description and discussion for Figure 4 would be more appropriate.

Answer:

We totally agree that Figure 4. contains information of great relevance to the Artificial Kidney that should be described and discussed. Therefore, the legend of Figure 4. was modified and a new statement was introduced in line 114.

Modified legend of Figure 4.

Figure 4. Experimental pressure drop, ΔP, with permeation of pure water and solutions of toxins & bovine serum albumin (BSA) in a surrogate system of a hemodialyzer as a function of the volumetric flow rate, Q, with membrane CA30/5%SiO_2. Black line refers to the experimental pressure drop in a slit with pure water permeation. Red line is the reference for the experimental pressure drop without permeation. The solutions of the toxins (urea, creatinine, uric acid & p-cresyl sulfate) and of the BSA have different concentrations.

New statement on Line 114 onwards

Taking into consideration that the CA30/5%SiO2 membrane complies with the kidney metabolic functions of preferential permeation of urea and retention of albumin (Faria et al., 2020), Figure 4 shows the results of ΔP vs. Q for the solutions of these two solutes and other typical toxins at different concentrations/ different viscosities. Within the range of the experimental error, there is no significant effect of the solutions viscosity on ΔP (all experimental points are around the black line for water).

REVIEWER 2

1) Lines 49-50: ‚pressure drop mirrors the magnitude of such forces', please explain more clearly what is the relation here (maybe add a reference?), and maybe replace 'such forces' by ' forces due to these shear stresses' or similar.

Answer:

We agree with the reviewer and the text was modified to:

In fully developed flow, as the slit flow case herein, the pressure drop mirrors the magnitude of the forces responsible for the shear stresses near the wall and its quantification is performed in a surrogate system of an AK/hemodialyzer mimicking tangential fluid velocities and membrane removal rates with circulating water.

2) Line 57: 'designation of …' is not clear

Answer:

The text now reads:

The synthesis & characterization (SEM, ATR/FTIR, NMR) of CA30/5%SiO2 and CA22/5%SiO2 was previously reported by Mendes et al., 2018 (membrane A5) and Jardim Beira et al., 2019, respectively.

3) Line 63: should be …Q <=160 ml/min ?

Answer:

The text is corrected as follows:

$$\mathbf{40}\boldsymbol{mL/min} \leq \boldsymbol{Q} \leq \mathbf{160}\ \boldsymbol{mL/min}$$

4) Three different units of measure are used for pressure – mmHg, bar, Pa. This is confusing, please convert to only one unit for measure throughout the paper for consistency.

Answer:

The units in the text were converted to Pascal:

Line 66…….. **±1.33 x 10^2 Pa**

Line 69 ….. **3x10^3 Pa to 1.5x10^4 Pa**

In lines 79 & 80 the hydraulic permeabilities of the membranes are expressed in kg/h/m^2/bar. These units are widely used and allow an easy assessment of the capacity of pure water permeation in the membranes used in pressure-driven processes.

For that reason, we would like to keep these units in the lines 79 & 80 of the text. It reads:

The hydraulic permeability of the membranes is 18.09 kg/h/m2 /bar for CA22/5%SiO2 and 198.65 kg/h/m2 /bar for CA30/5%SiO2.

5) Figure 3: Hydraulic permeability of the two used membranes is very different (factor 10), leading only to a small difference in the flow-pressure curves. The authors state that this might be attributed to similar surface roughness (line 95). It would be interesting here to at least roughly indicate how much of the total difference acetate – membrane can be attributed to roughness and how much to removal rates, as this is important for the addressed research question.

Answer:

Atomic Force Microscopy (AFM) measurements yielded for the CA30/5%SiO2 membrane a roughness mean value below 2.5 nm (Faria et al., 2020). Due to the lack of a AFM value for the roughness of the CA22/5%SiO2 membrane it is not possible to have a quantitative comparison.

The fact of being a smoother membrane allows only a qualitative assessment. The modification of text from the line 95 onwards is:

Moreover, ΔP line for membrane CA22/5%SiO2 exhibits a slope smaller than that of CA30/5%SiO2 (compare green line with red line). This is in accordance with the fact that the CA22/5%SiO2 is a smoother membrane.

A new reference was introduced:

Faria, M., Moreira, C., Eusébio, T., Brogueira, P., & de Pinho, M.N. (2020). Hybrid flat sheet cellulose acetate/silicon dioxide ultrafiltration membranes for uremic blood purification, *Cellulose*, 27, 3847–3869, DOI: 10.1007/s10570-020-02985-2.