# Supporting Information

# Removal of Different Dye Solutions: A Comparison Study Using a Polyamide NF Membrane

**Asunción María. Hidalgo [1,*], Gerardo León [2], María Gómez [1], María Dolores Murcia [1], Elisa Gómez [1] and José Antonio Macario [1]**

[1] Departamento de Ingeniería Química, Facultad de Química, Campus de Espinardo, Universidad de Murcia, 30100 Murcia, Spain; maría.gomez@um.es (M.G.); md.murcia@um.es (M.D.M.); egomez@um.es (E.G.); joseantonio.macario@um.es (J.A.M.)

[2] Departamento de Ingeniería Química y Ambiental, Universidad Politécnica de Cartagena, 30202 Cartagena, Spain; gerardo.leon@upct.es

* Correspondence: ahidalgo@um.es; Tel.: +34-868-887-353

**Table S1.** Comparison of dye removal between previous studies and this study in terms of water flux and rejection.

| Membrane | Target Dye | Experimental conditions | Water Flux (L/m² h bar) | Rejection (%) | Reference |
|---|---|---|---|---|---|
| **NF99** | Acid Brown-83 | 50 mg/L dye at 10 bar | 66.6 | 99.36 | This work |
| **NF99** | Allura Red | 50 mg/L dye at 10 bar | 82.9 | 99.92 | This work |
| **NF99** | Basic Fuchsin | 50 mg/L dye at 10 bar | 79.0 | 93.66 | This work |
| **NF99** | Crystal Violet | 50 mg/L dye at 10 bar | 72.9 | 99.77 | This work |
| **IM26** | Crystal Violet | 100 mg/L dye at 4 bar | 30.8 | 88.4 | Cheng et al. 2016 |
| **Psf UF** | Crystal Violet | 100 mg/L dye at 0.8 bar | 38.2 | 46.8 | Cheng et al. 2016 |
| **EGCG-PEI-TC/PTFE** | Crystal Violet | 100 mg/L dye at 2 bar | 4 | 100 | Zhang et al. 2020 |
| **Modified Psf (M1)** | Crystal Violet | 100 mg/L dye at 4.14 bar | 2.2 | 85 | Rambabu et al. 2019 |
| **NF99** | Methyl Orange | 50 mg/L dye at 10 bar | 78.5 | 88.49 | This work |
| **EGCG-PEI-TC/PTFE** | Methyl Orange | 100 mg/L dye at 2 bar | 5.5 | 100 | Zhang et al. 2020 |
| **ANF TFC** | Methyl Orange | 100 mg/L dye at 4 bar | 8.4 | 98.6 | Li et al. 2019 |
| **PMIA TFC** | Methyl Orange | 100 mg/L dye at 4 bar | 1.2 | 100 | Li et al. 2019 |
| **NF90** | Methyl Orange | 100 mg/L dye at 4 bar | 4 | 100 | Li et al. 2019 |
| **NF 270** | Methyl Orange | 100 mg/L dye at 4 bar | 9.3 | 98.6 | Li et al. 2019 |

| | | | | | |
|---|---|---|---|---|---|
| **PS/PEI (20%)** | Methyl Orange | 50 mg/L dye at 4 bar | 16.30 | 64.7 | Benkhaya et al. 2020 |
| **NF99** | Sunset Yellow | 50 mg/L dye at 10 bar | 86.4 | 99.39 | This work |
| **NF 90** | Sunset Yellow | 50 mg/L dye at 5 bar | 14.9 | >99 | Jun et al. 2019 |
| **Treat pH 13.5 ,7D** | Sunset Yellow | 50 mg/L dye at 5 bar | 16.0 | >99 | Jun et al. 2019 |
| **DEA-modified PA-TFC** | Sunset Yellow | 100 mg/L dye at 5 bar | 14.8 | 97.5 | Liu et al. 2017 |
| **PA-TFC** | Sunset Yellow | 100 mg/L dye at 5 bar | 9.3 | >99 | Lü et al. 2019 |
| **CMCNa/PP composite membrane** | Sunset Yellow | 100 mg/L dye at 5 bar | 8.6 | 82.2 | Yu et al. 2012 |
| **Sericin-TCM** | Sunset Yellow | 100 mg/L dye at 5 bar | 12.4 | 95.4 | Zhou et al. 2014 |

## References


Benkhaya, S.; M´rabet, S.; Hsissou, R.; El Harfi, A. Synthesis of new low-cost organic ultrafiltration membrane made from Polysulfone/Polyetherimide blends and its application from soluble azoic dyes removal. *J. Mater. Res. Technol*. **2020**, *9*, 4763–4772.

Cheng, L.; Zhu, L.P.; Zhang, P.B.; Sun, J.; Zhu, B.K.; Xu, Y.Y. Molecular separation by poly (N-vinyl imidazole) gel-filled membranes. *J. Membrane Sci*. **2016**, *497*, 472–484.

Jun, B.M.; Yoon, Y.; Park, C.M. Post-treatment of nanofiltration polyamide membrane through alkali-catalyzed hydrolysis to treat dyes in model wastewater. *Water*. **2019**, *11*, 1645–1659.

Li, Y.; Wong, E.; Mai, Z.; Der Bruggen, B.V. Fabrication of composite polyamide/Kevlar aramid nanofiber nanofiltration membranes with high permselectivity in water desalination. *J. Membrane Sci*. **2019**, *592*, 117396–117407.

Liu, M.; Chen, Q.; Lu, K.; Huang, W.; Lü, Z., S.; Zhou, C.; Yu, S.; Gao, C. High efficient removal dyes from aqueous solution through nanofiltration using diethanolamine-modified polyamide thin-film composite membrane. *Sep. Purif. Technol*. **2017**, *137*, 135–143.

Lü, Z.; Hu, F.; Li, H.; Zhang, X.; Yu, S.; Liu, M. Gao, C. Composite nanofiltration membrane with asymmetric selective separation layer for enhanced separation efficiency to anionic dye aqueous solution. . *J. Hazard. Mater.* **2019**, *368*, 436-443.

Rambabu, K.; Bharath, G.; Monash, P.; Velu, S., Banat, F.; Naushad, M.; Arthanareeswaran, G.; Show, P.L. Effective treatment of dye pollutant wastewater using nanoporous CaCl2 modified polyethersulfone membrane. *Process Safety Environ. Protection*, **2019**, *124*, 266-278.

Yu, S.; Chen, Z.; Cheng, Q.; Lü, Z.; Liu, M. Gao, C. Application of thin-film composite hollow fiber membrane to submerged nanofiltration of anionic dye aqueous solutions. *Sep. Purif. Technol*. **2012**, *88*, 121–129.

Zhang, N.; Huang, Z.; Yang, N.; Zhang, L.; Jiang, B.; Sun, Y.; Ma, J. Nanofiltration membrane via EGCG-PEI co-deposition followed by crosslinking on microporous PTFE substrates for desalination. *Sep. Purif. Technol*. **2020**, *232*, 115964–115974.

Zhou, C.; Shi, Y.; Sun, C.; Yu, S.; Liu, M; Gao, C. Thin-film composite membranes formed by interfacial polymerization with natural material sericin and trimesoyl chloride for nanofiltration. *J. Membrane Sci*. **2014**, *471*, 381-391.

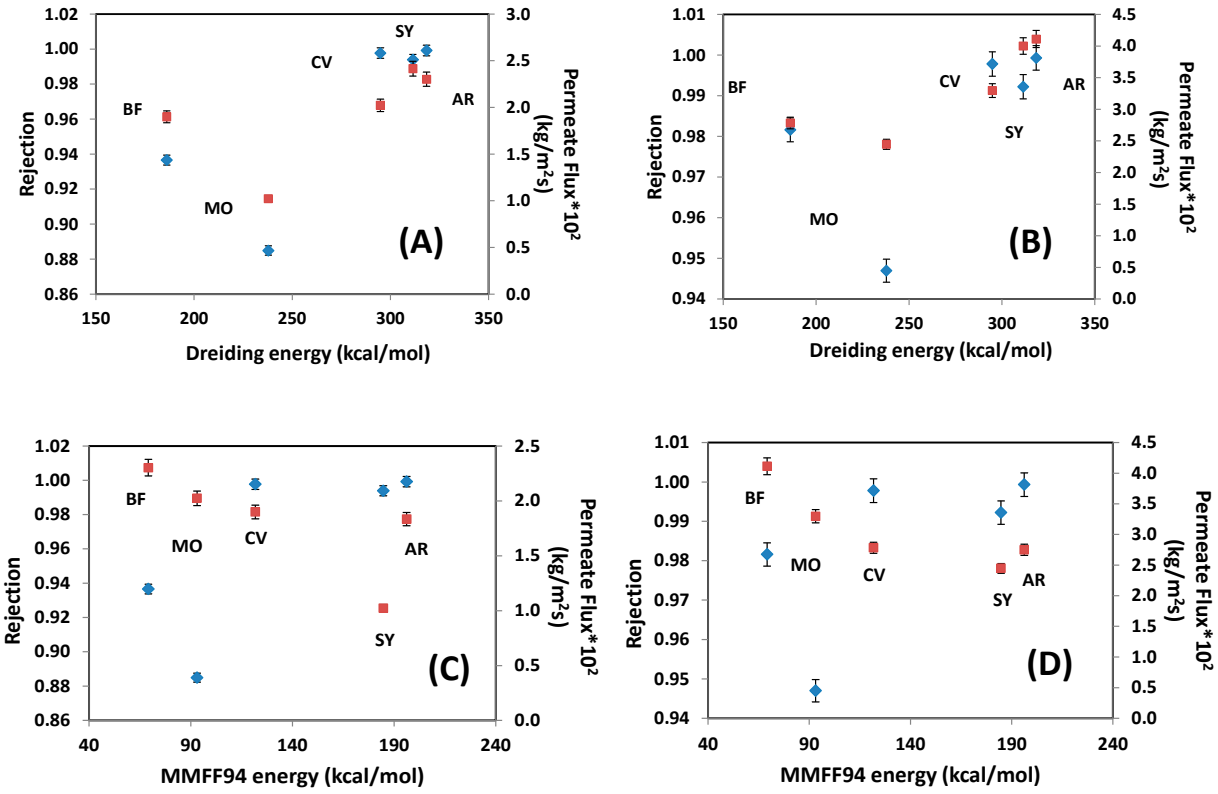


**Figure S1.** Rejection coefficient (♦) and permeate flux (■) variation with dreiding energy (A&B) and with MMFF94 Energy (C&D) for colorants: (MO) Methyl Orange, (BF) Basic Fuchsin, (SY) Sunset Yellow, (AR) Allure Red, (CV) Crystal Violet. Experimental conditions: pH =7, [Dyes] = 50 mg/L and pressure 10 bar (A&C) and 15 bar (B&D).

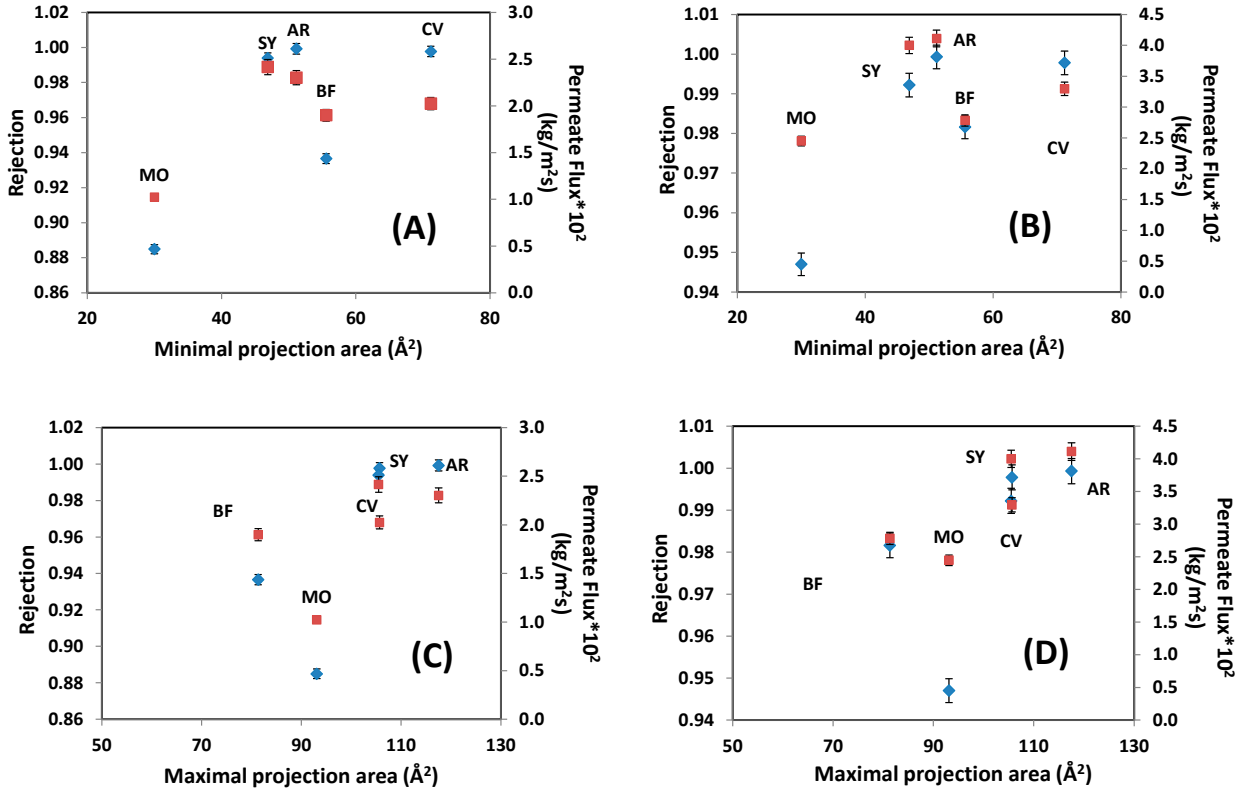


**Figure S2.** Rejection coefficient (♦) and permeate flux (■) variation with minimal projection area (A&B) and with maximal projection area (C&D) for colorants: (MO) Methyl Orange, (BF) Basic Fuchsin, (SY) Sunset Yellow, (AR) Allure Red, (CV) Crystal Violet. Experimental conditions: pH =7, [Dyes] = 50 mg/L and pressure 10 bar (A&C) and 15 bar (B&D).

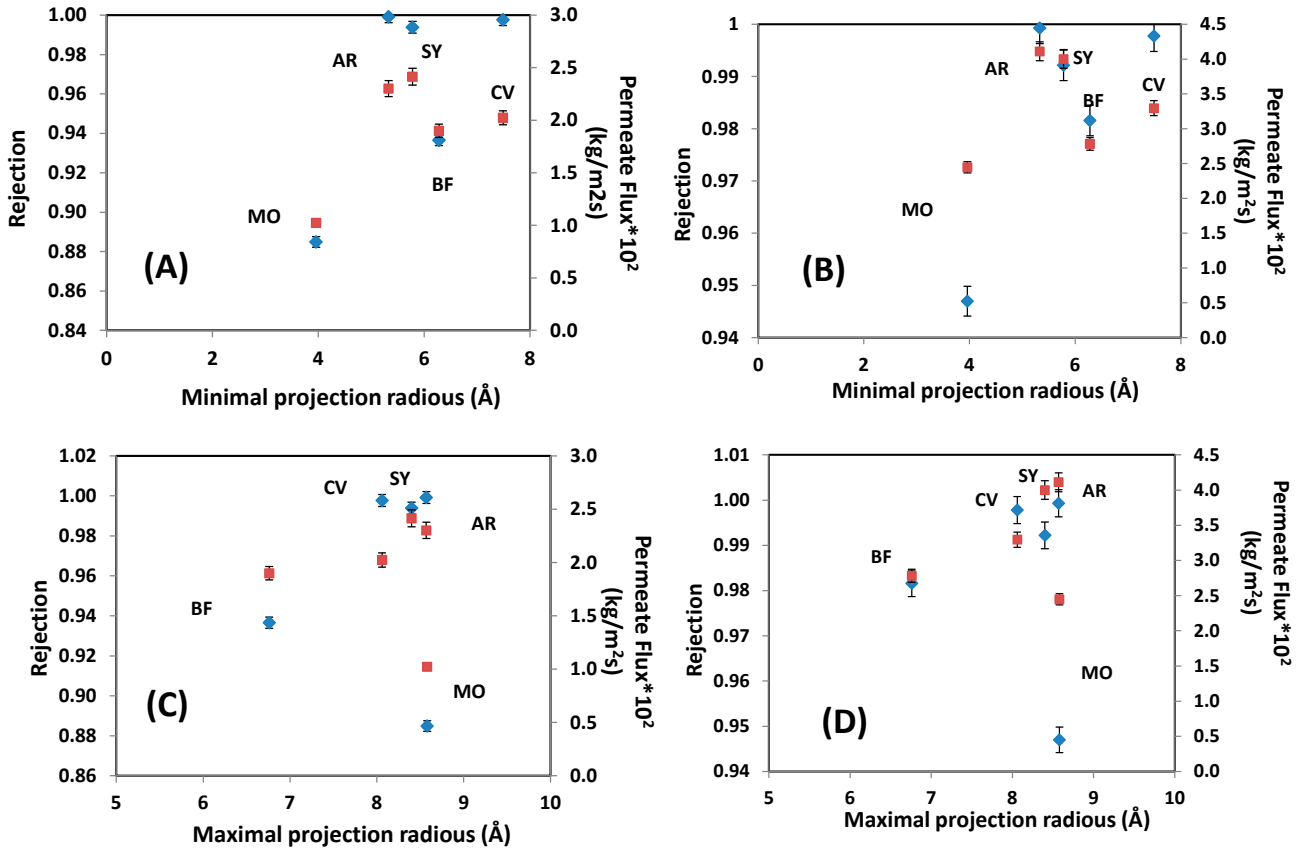


**Figure S3.** Rejection coefficient (♦) and permeate flux (■) variation with minimal projection radious (A&B) and with maximal projection radious (C&D) for colorants: (MO) Methyl Orange, (BF) Basic Fuchsin, (SY) Sunset Yellow, (AR) Allure Red, (CV) Crystal Violet. Experimental conditions: pH =7, [Dyes] = 50 mg/L and pressure 10 bar (A&C) and 15 bar (B&D).

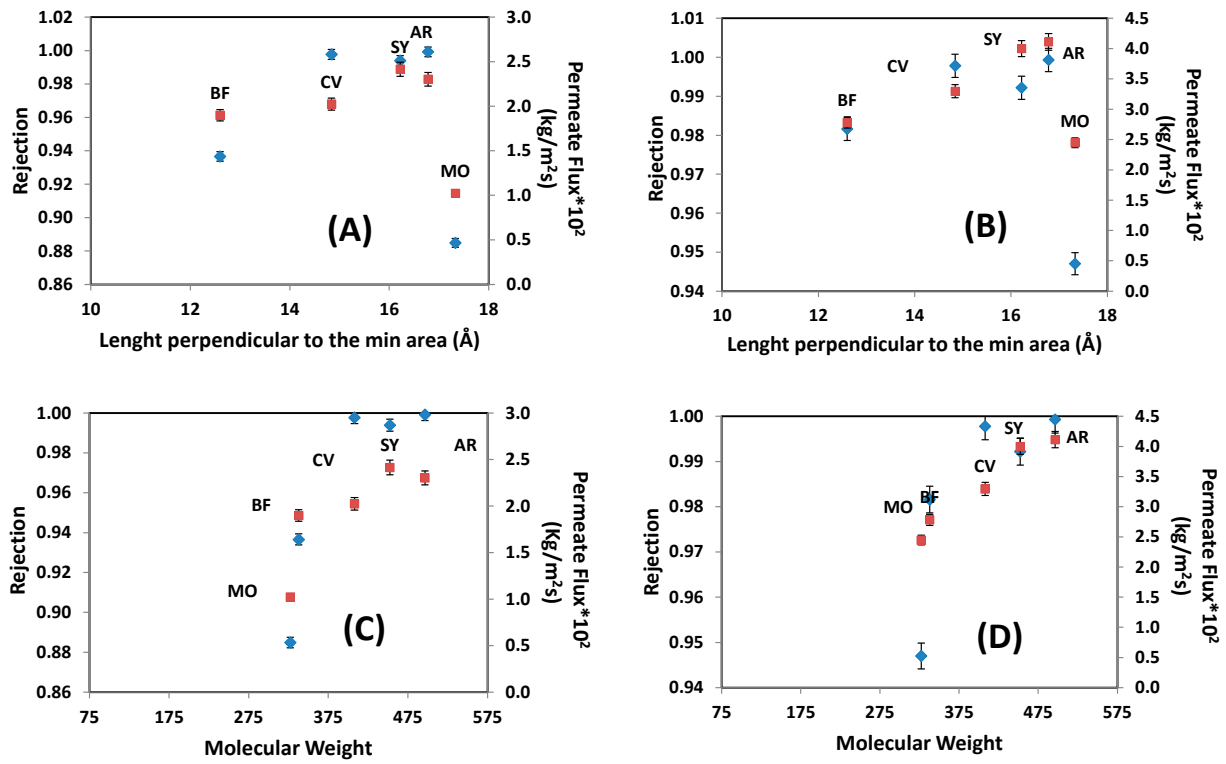


**Figure S4.** Rejection coefficient (♦) and permeate flux (■) variation with length perpendicular to the minimal area (A&B) and with molecular weight (C&D) for colorants: (MO) Methyl Orange, (BF) Basic Fuchsin, (SY) Sunset Yellow, (AR) Allure Red, (CV) Crystal Violet. Experimental conditions: pH =7, [Dyes] = 50 mg/L and pressure 10 bar (A&C) and 15 bar (B&D).