Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Graphene oxide offers precise molecular sieving, structural integrity, microplastic removal, and closed-loop circularity in water-remediating membranes through covalent adaptable network.

*Ria Sen Gupta[#], Samir Mandal[#], Amit Malakar[#], Siddhesh Rege, Sk. Safikul Islam, Ketaki Samnata, Ashok Misra and Suryasarathi Bose**

Department of Materials Engineering, Indian Institute of Science, Bangalore – 560012, India

*sbose@iisc.ac.in , Fax +91-(0)80-2360 0472

# Equal contribution

SUPPORTING INFORMATION:

1. Deconvoluted XPS core spectra of C1s, O1s, F1s and N1s of m-IPN and IPN membrane

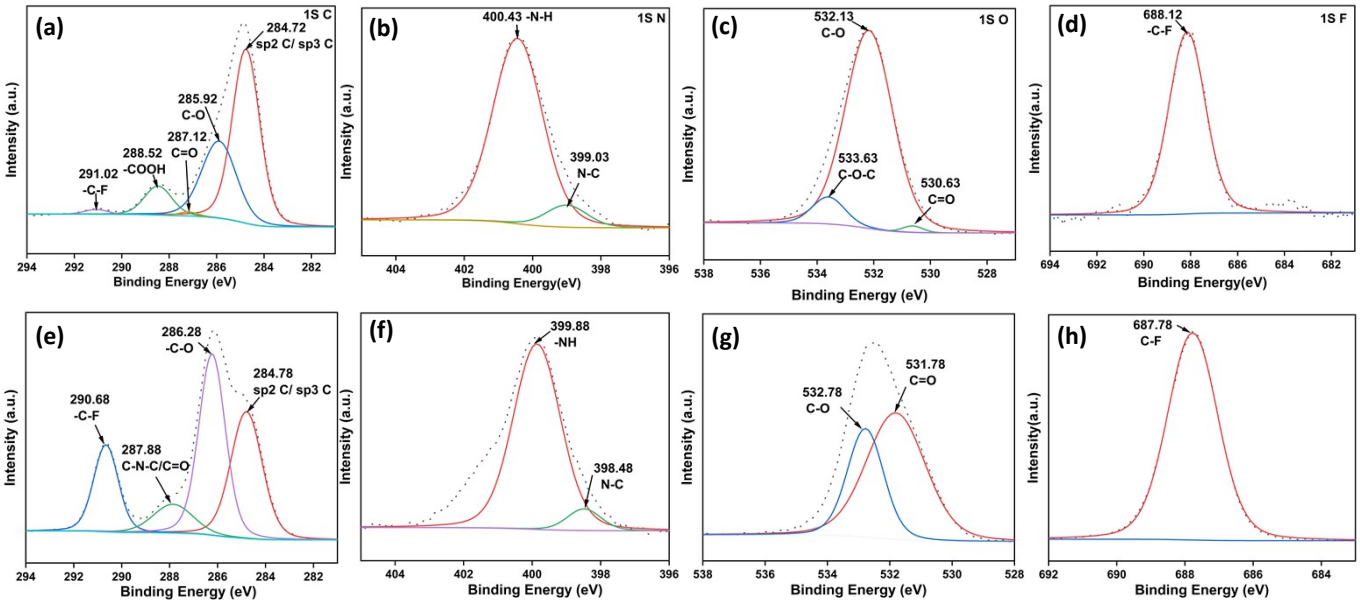


Figure S1. XPS deconvoluted spectra for m-IPN membrane (a) C 1s (b) N 1s (c) O 1s and (d) F 1s and IPN membrane (e) C 1s (f) N 1s (g) O 1s and (h) F 1s

2. AFM line profile of IPN and m-IPN membrane

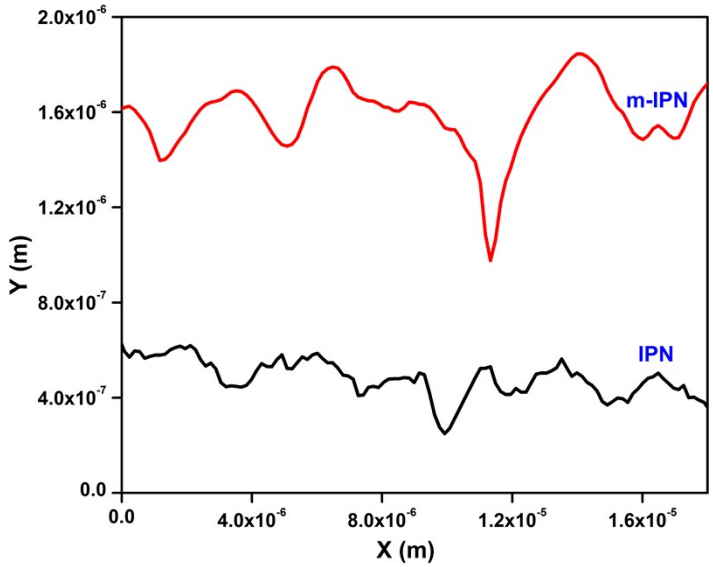


Figure S2. AFM line profile depicting neat IPN and m-IPN membranes.

3. UV-Vis Spectroscopic studies

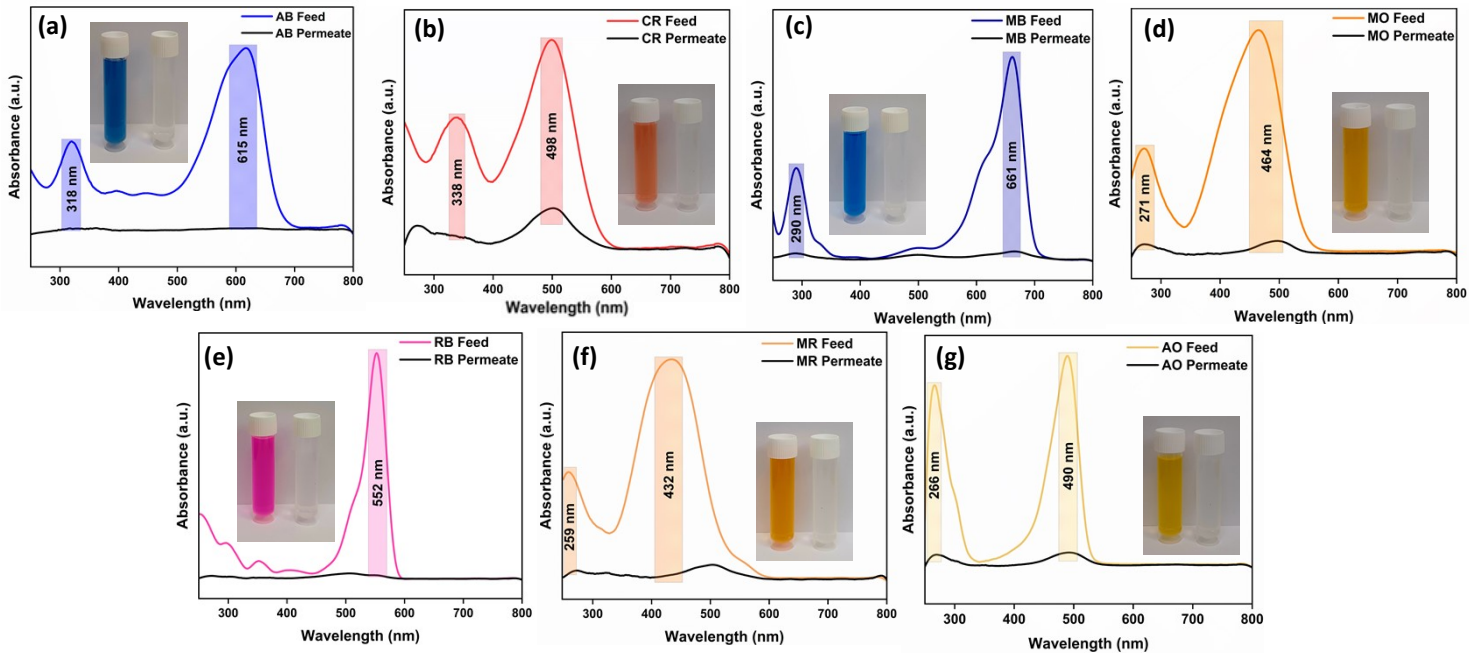


Figure S3. UV-Vis spectra for the feed and permeate solutions of (a) Amido Black (b) Congo Red (c) Methylene Blue (d) Methyl Orange (e) Rhodamine B (f) Methyl Red, and (g) Acridine Orange dyes of 20 ppm

4. Pure Water Flux and XRD of membranes

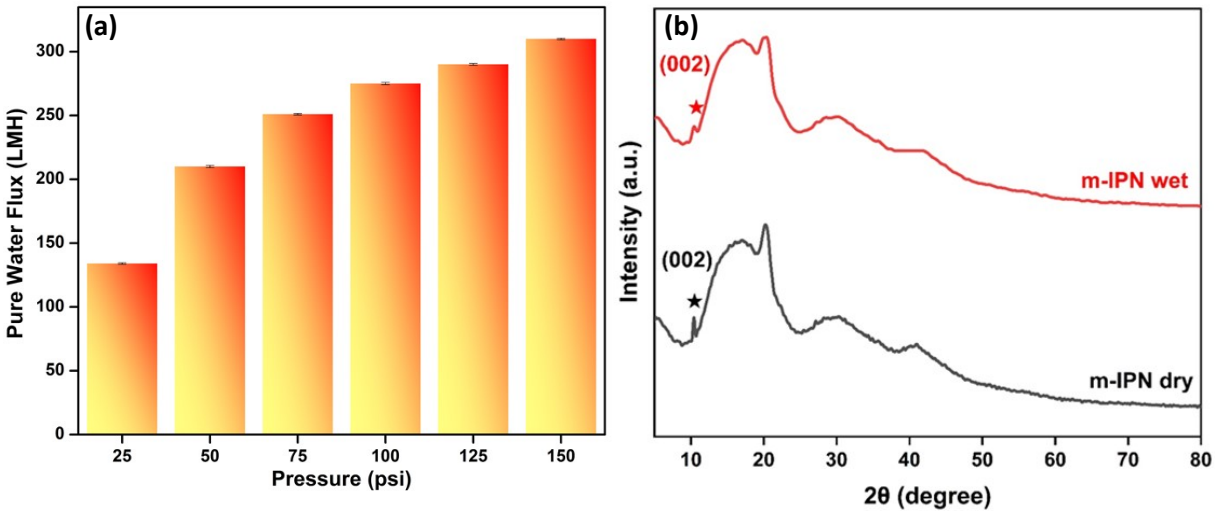


Figure S4. (a) Pure water flux obtained from m-IPN membranes as a function of transmembrane pressure and (b) XRD spectra of dry m-IPN membrane and that of the membrane after dipping it in water for one month.

5. FTIR spectra of neat PVC (unplasticized) powder and PVC pipe powder

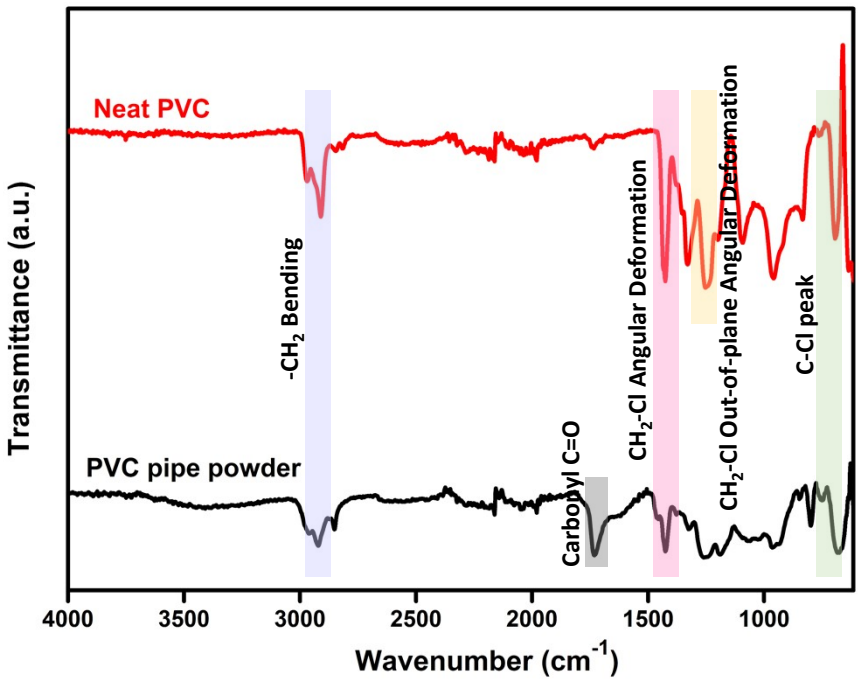


Figure S5. FTIR spectra demonstrating the chemical functionalities of neat unplasticized PVC and PVC powder obtained from the sanitary pipelines.

To have an idea regarding functional groups present in neat PVC and PVC pipe powder FTIR spectra for both were recorded in the wavenumber range 4000 to 615 cm^{-1}. From **Fig. S5**, strong absorption peaks at 2912 cm^{-1} and 2920 cm^{-1} in both spectra were attributed to CH_2 bending. The carbonyl stretching frequency in 1738 cm^{-1} in the case of pipe powder indicated the presence of carbonyl-based additives. The characteristic peak at 1426 cm^{-1} and 1252 cm^{-1} is associated with the angular deformation and out-of-plane angular deformation for the CH-Cl bond. Some additional peaks in the range of 900 cm^{-1} to 1230 cm^{-1} in PVC pipe powder could be ascribed to the addition of plasticizers or other associated additives. The C-Cl stretching resulted in an absorption peak near 690 cm^{-1} in both systems, indicating the presence of PVC.

6. DLS of Feed Microplastic spiked sample and corresponding permeate:

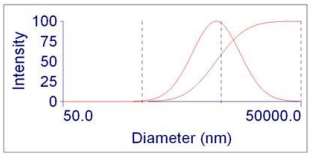
(a)

Measurement Parameters:

Temperature	= 25.0 deg. C	Runs Completed	= 5
Liquid	= Water	Run Duration	= 00:00:30
Viscosity	= 0.890 cP	Total Elapsed Time	= 00:02:30
Ref.Index Fluid	= 1.330	Average Count Rate	= 7.3 kcps
Angle	= 90.00	Ref.Index Real	= 1.533
Wavelength	= 658.0 nm	Ref.Index Imag	= 0.000
Baseline	= Auto (Slope Analysis)	Dust Filter	= Off

PVC s (Combined)

Effective Diameter: 4276.4 nm
Polydispersity: 0.611
Baseline Index: 0.0
Elapsed Time: 00:02:30



Lognormal Distribution

Run	Eff. Diam. (nm)	Half Width (nm)	Polydispersity	Baseline Index
1	1764.5	1130.6	0.411	0.0
2	6629.9	3581.2	0.292	0.0
3	772.3	592.2	0.588	0.0
4	1187.9	887.8	0.559	0.0
5	1086.2	842.1	0.601	0.0
Mean	2288.2	1406.8	0.490	0.0
Std. Error	1097.2	550.3	0.060	0.0
Combined	4276.4	3342.8	0.611	0.0

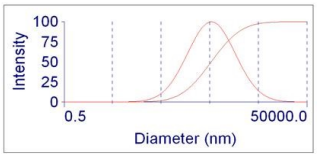
(b)

Measurement Parameters:

Temperature	= 25.0 deg. C	Runs Completed	= 5
Liquid	= Water	Run Duration	= 00:00:30
Viscosity	= 0.890 cP	Total Elapsed Time	= 00:02:30
Ref.Index Fluid	= 1.330	Average Count Rate	= 2.3 kcps
Angle	= 90.00	Ref.Index Real	= 1.533
Wavelength	= 658.0 nm	Ref.Index Imag	= 0.000
Baseline	= Auto (Slope Analysis)	Dust Filter	= Off

m-IPN permeate-Uniform sphere (Combined)

Effective Diameter: 539.8 nm
Polydispersity: 2.553
Baseline Index: 0.0
Elapsed Time: 00:02:30



Lognormal Distribution

Run	Eff. Diam. (nm)	Half Width (nm)	Polydispersity	Baseline Index
1	0.0	0.0	0.000	0.0
2	0.0	0.0	0.000	0.4
3	0.0	0.0	0.000	0.7
4	0.0	0.0	0.000	0.0
5	0.0	0.0	0.000	0.0
Mean	0.0	0.0	0.000	0.2
Std. Error	0.0	0.0	0.000	0.1
Combined	539.8	862.5	2.553	0.0

Figure S6. DLS studies of (a) PVC microplastic spiked water and (b) Permeate obtained after filtration with m-IPN membrane

The DLS studies were performed to get an idea of the size of the microplastics present in the spiked sample. It was observed that the colloidal suspension consisted of particles in the size range of 1000-7000 nm, whereas the permeate solutions had a size range of merely 500 nm, which further corroborated the efficient removal of microplastics via the fabricated m-IPN membranes.