

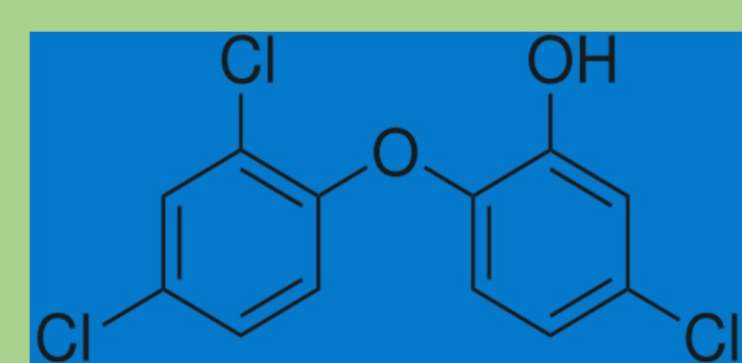


Extraction and Quantification of Triclosan in Wastewater Samples Using Molecularly Imprinted Membrane Adsorbent

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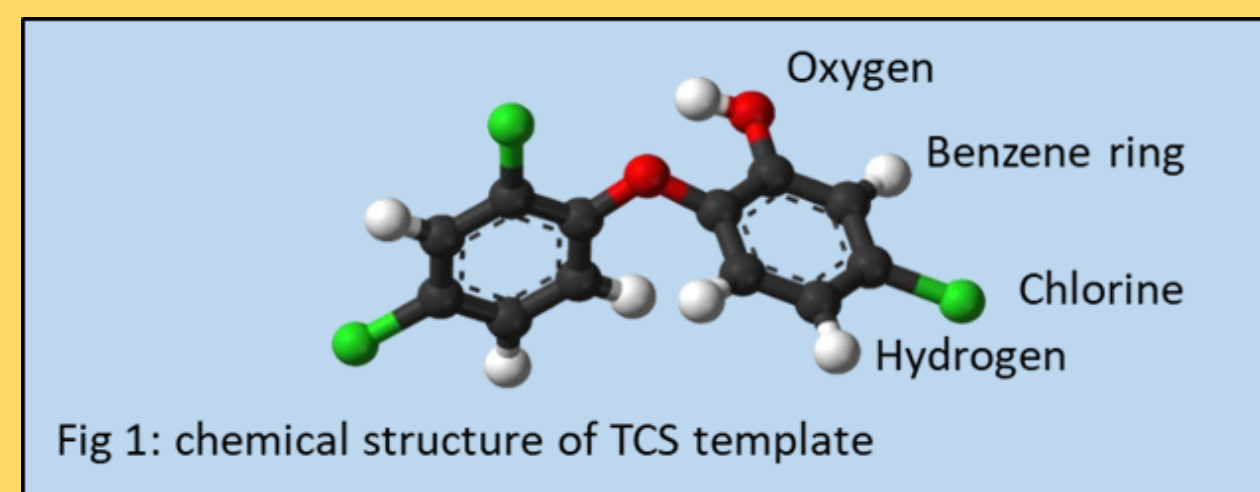
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INTRODUCTION

Triclosan (TCS), ($C_{12}H_7Cl_3O_2$) [Fig 1], remains a lethal antibacterial or antifungal agent present in some consumer products (i.e. toothpaste). This agent can find its way to contaminate natural waters and wastewater treatment plants in South Africa. Given its wide use in personal care products and consumer products, TCS, which is fully retained in WWTP, enters the environment either through treated wastewater (effluent) and/or pharmaceutical personal care products (PPCP)



The MIMs are synthesized and fabricated using polyvinylidene fluoride (PVDF) polymer with selective micro composite particles known as molecularly imprinted polymers (MIPs) via a phase inversion by immersion precipitation technique

Aim: To synthesize molecularly imprinted membranes (MIMs) and investigate their potential to improve the selectivity of PVDF membranes for adsorption of TCS.

Objectives:

- To synthesize and characterise molecularly imprinted membranes (MIMs)
- To improve the adsorption properties and the removal capabilities of the synthesised MIMs against TCS.

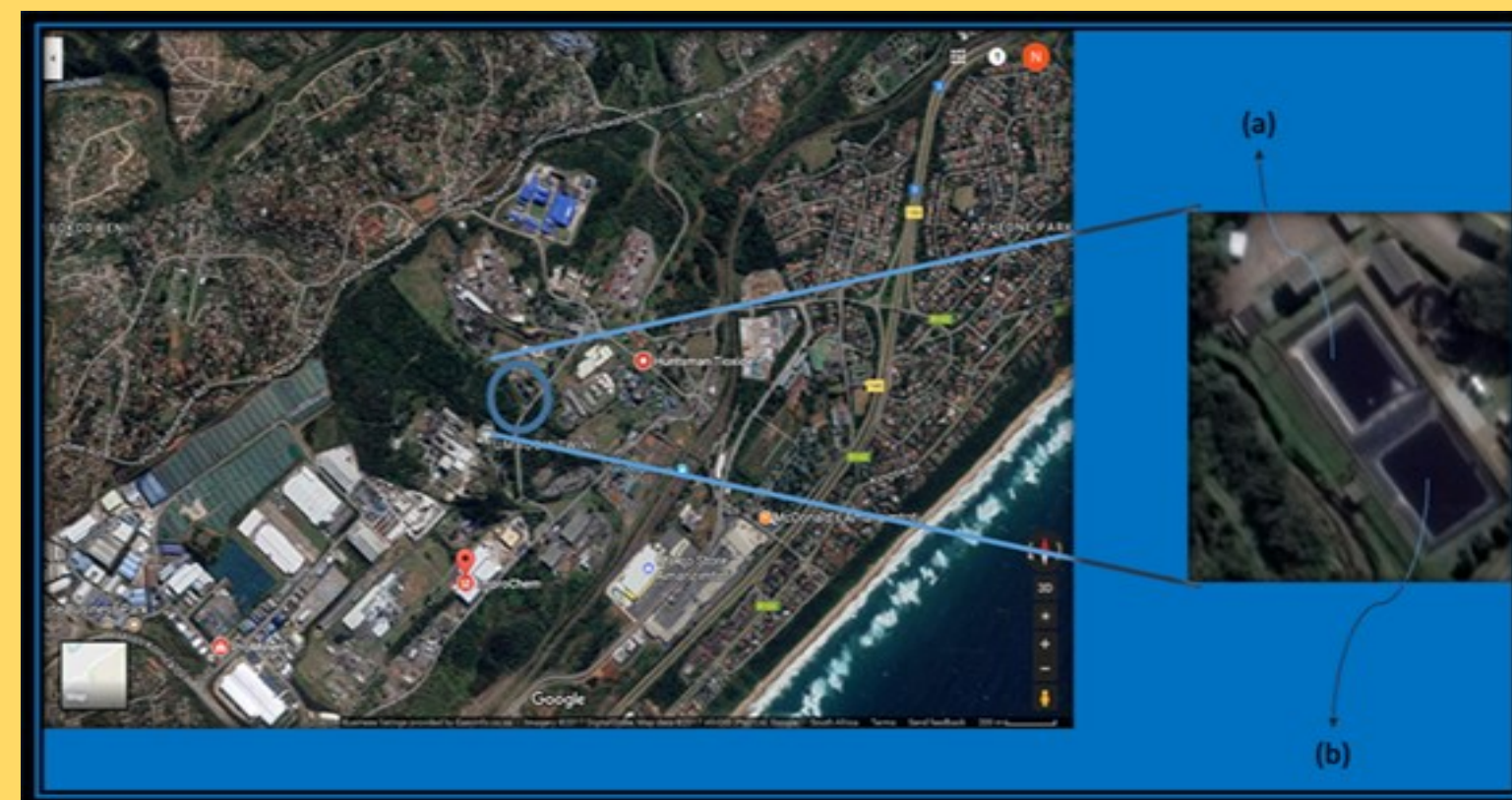


Fig 2: Sampling site and ETP (satellite view): ETP plant (a) ETP process compartment and (b) ETP reservoir compartment

METHODOLOGY

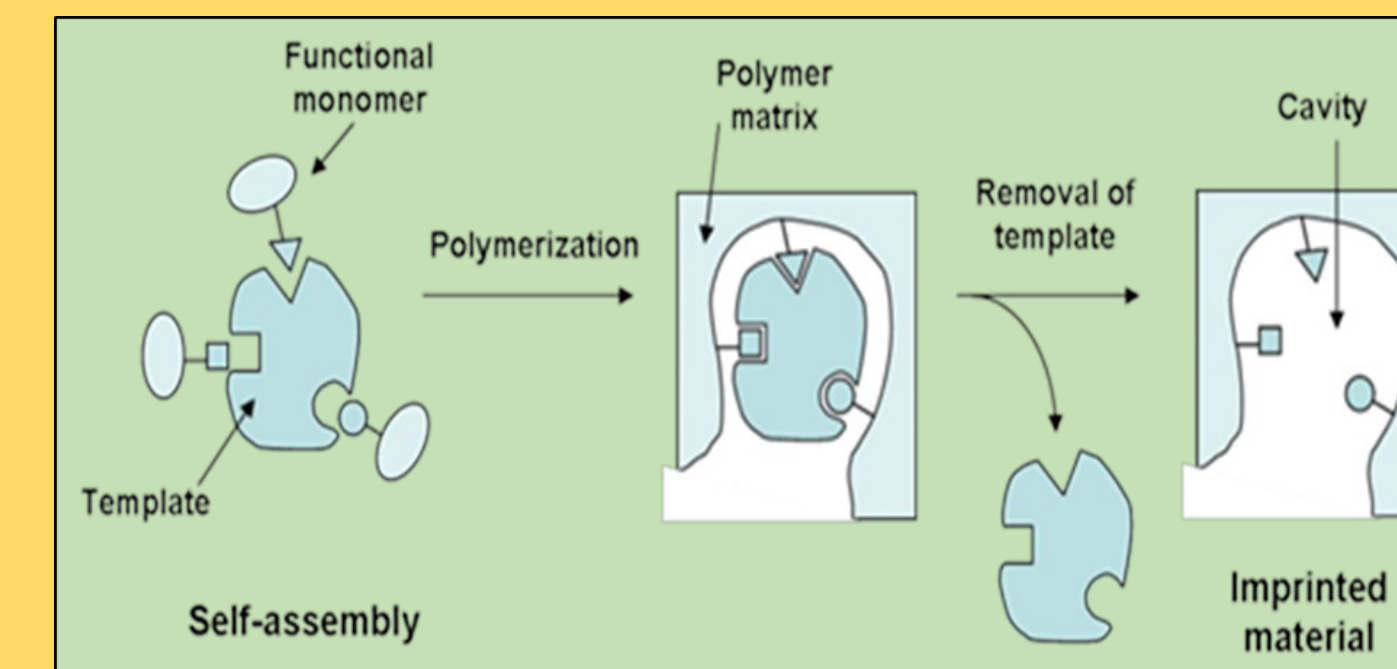


Fig 3: schematic diagram of imprinting by bulk polymerization

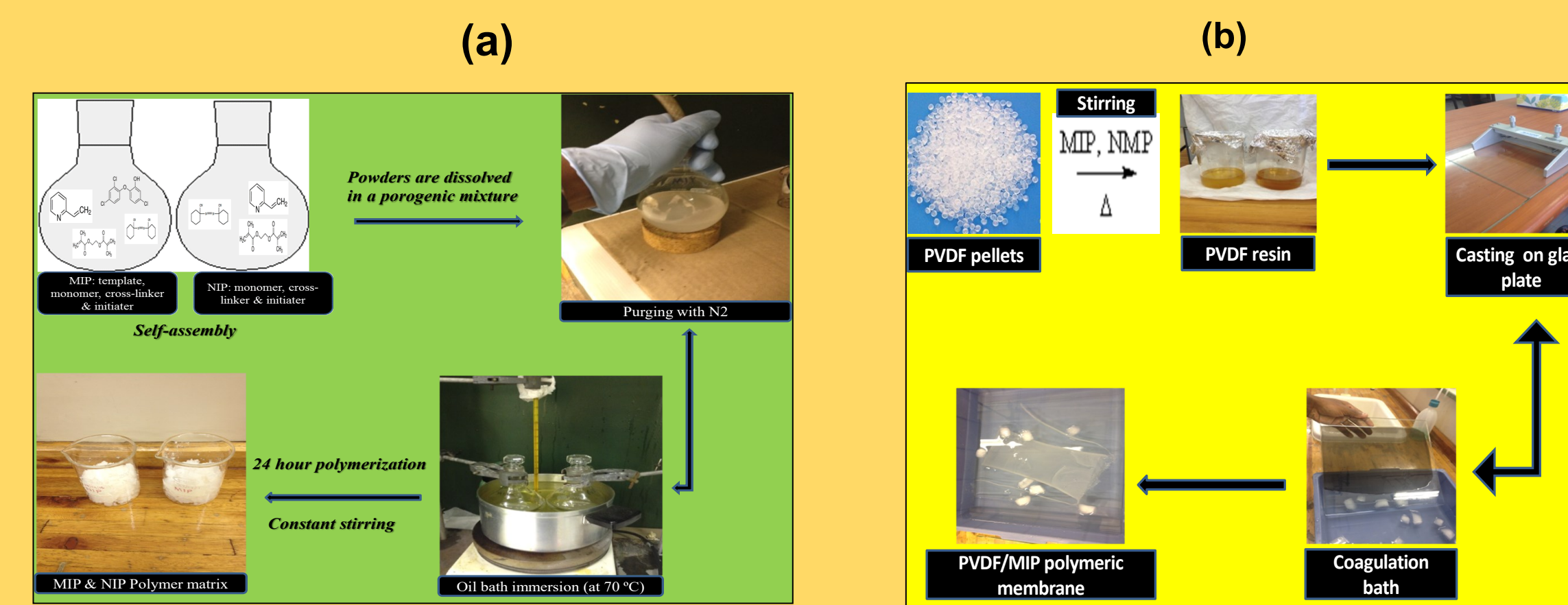


Fig 4: graphical representation of the synthesis of (a) MIPs, and (b) MIMs

RESULTS AND DISCUSSION

Physicochemical parameters on site

- It was vitally important to test the samples for physicochemical properties immediately after sampling. i.e. pH, conductivity, TDS and suspended solids.
- pH of each sample was adjusted to 3.0 after optimisation; thereafter, samples were stored in the refrigerator at 4 °C until further analysis was done.

MIMs removal efficiencies

- Fig 7 graphically displays that MIMs have higher adsorption capabilities for TCS compared to NIMs and bare membrane in almost all monitored days.
- This is attributed by the strong binding sites found on MIP cavities. However, the enrichment of TCS on NIMs and Bare wash off easily on the membrane scaffolds since both are not 'lock and key' as MIMs. Removal efficiencies in WWTPs rely on factors such as compound physicochemical properties.

Table 1: LOD, LOQ, recovery (%) and RSD (%) values (n=3) for the spiked deionised water in the concentration range of 5 to 1000 µg/L

Spiked sample	LOD (µg/L)	LOQ (µg/L)	Recovery (%) ± RSD (%)		
			1000 µg/L	50 µg/L	5 µg/L
Effluent	0.22	0.71			68 ± 10
Deionised water	0.10	0.28	65 ± 5	78 ± 12	112 ± 12

Table 2: Physicochemical parameters of grabbed ETP Dam samples on the monitored days

ETP Dam sample	Parameters					
	pH	Conductivity (mS/m)	Suspended solids (% m/m)	TDS (mg/L)	Salinity (psu)	Dissolved Oxygen (% m/m)
Day 1	8.09	695	410	603	3.94	1.90
Day 2	8.06	744	340	605	3.77	0.38
Day 3	8.12	586	160	598	4.88	0.13
Day 4	7.67	418	112	515	4.13	0.45
Day 5	7.82	482	106	495	3.08	0.65
Day 6	7.54	733	290	674	2.88	0.38
Day 7	7.93	738	80	599	5.18	0.69
Day 8	7.96	1158	82	697	5.08	0.13
Day 9	7.66	1400	120	710	4.93	0.27
Day 10	8.09	835	204	605	3.88	0.22

**Suspended solids (% m/m) results were obtained from the ETP testing laboratory



Fig 5: Dam samples a) before and b) after filtration

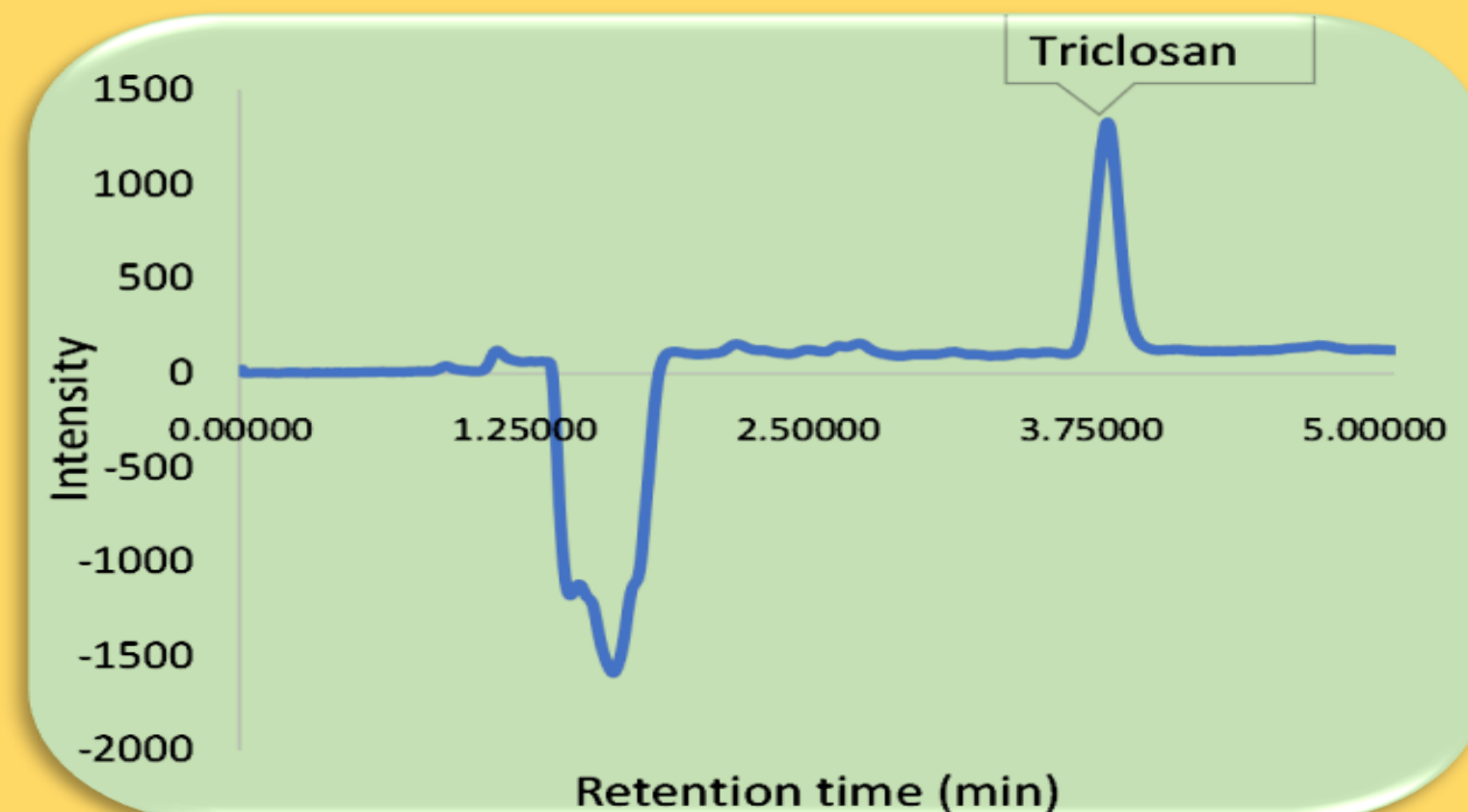


Fig 6: Chromatographic analysis of TCS

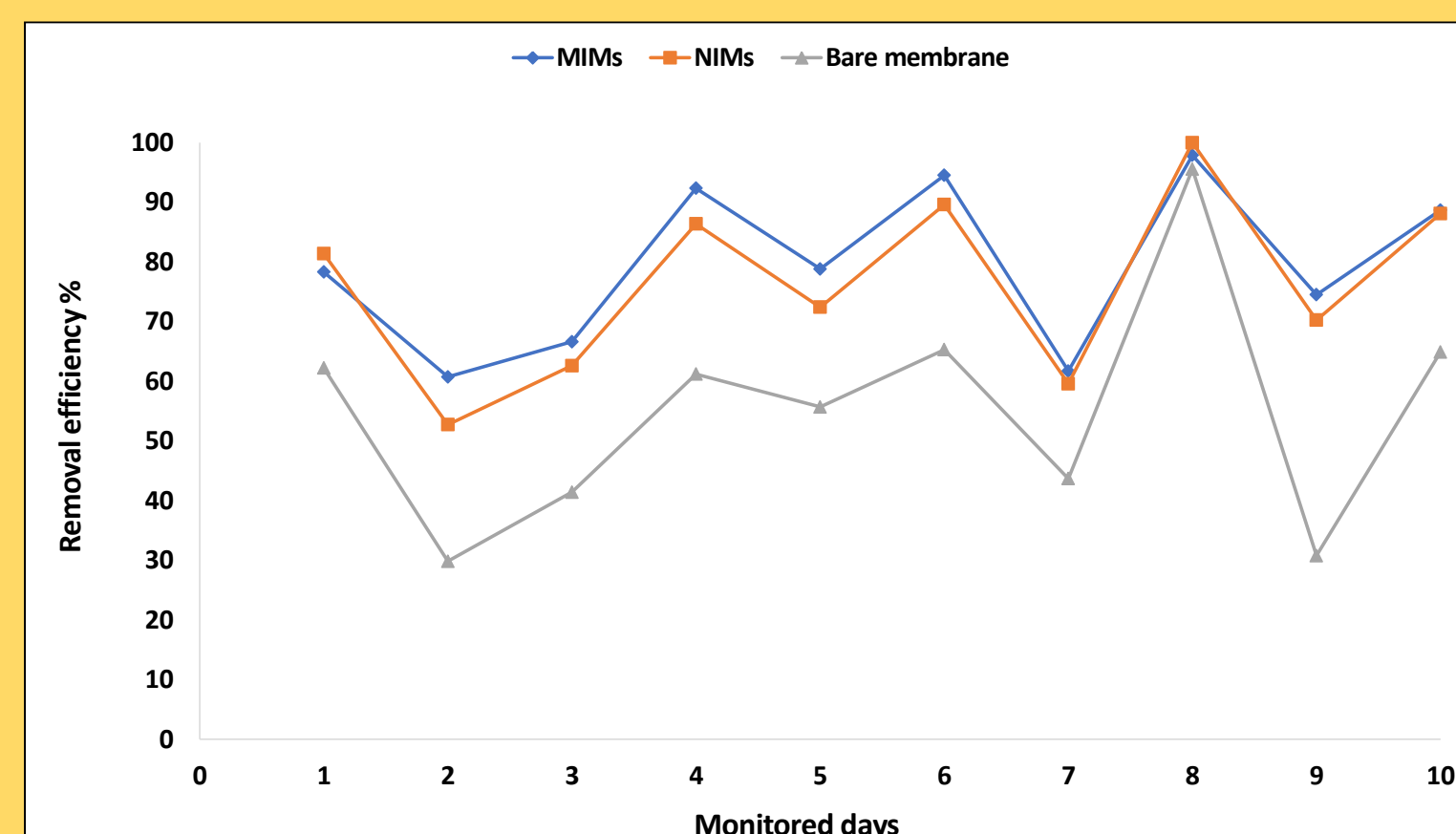


Fig 7: % removal efficiencies by various membranes

Table 3: Recent data on % removal efficiency of TCS from WWTPs

Country, City	% Removal efficiency	Reference
South Africa, Durban	62-100	This study
China, Xiamen	>20	(Sun et al., 2014)
USA, Atlanta	50-100	(Heidler et al., 2006)
Sweden, Goteborg	>90	(Paxeus, 2004)
USA, Washington, DC	58-86	(McAvoy et al., 2002b)
Tokyo, Juliung	45-65	(Sun et al., 2014)

CONCLUSIONS

- MIMs were successfully synthesized.
- This study reduced the effluent discharged to Kingsway Sea by 62-95 % using the MIMs, this was also comparable to global studies. The membrane technology and molecularly imprinted polymer technology relatively gave a good study reflection of what needs to be done to mitigate or counterattack the challenges of POPs in WWTPs.
- South Africa shows the highest removal percentage for this current study [highest being 100%]

ACKNOWLEDGEMENT

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