Tuning small molecule capture/release behaviour in eutectogels

The Brogan Group

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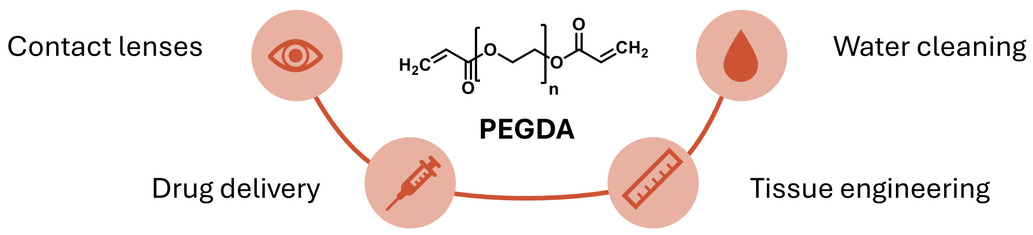
INTRODUCTION

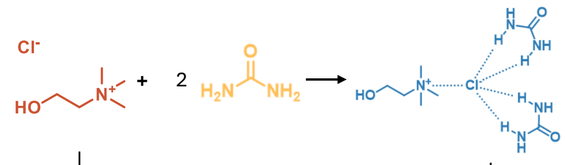
PEGDA-based hydrogels (polyethylene glycol diacrylate water-based gels) are extensively applied in biomedicine and have a broad range of industrial applications.



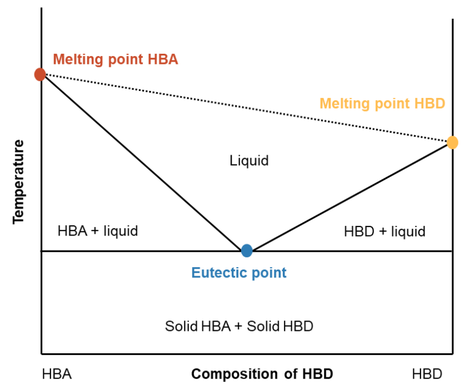
- ✓ Biocompatible and biodegradable
- ✓ Easy functionalisation
- ✓ High loading of hydrophilic drugs
- ✗ Rapid degradation
- ✗ Poor stability
- ✗ Poor mechanical properties

Why use PEGDA-based eutectogels?

Deep eutectic solvents (**DESs**) are mixtures of a hydrogen bond donor (**HBD**) and a hydrogen bond acceptor (**HBA**).



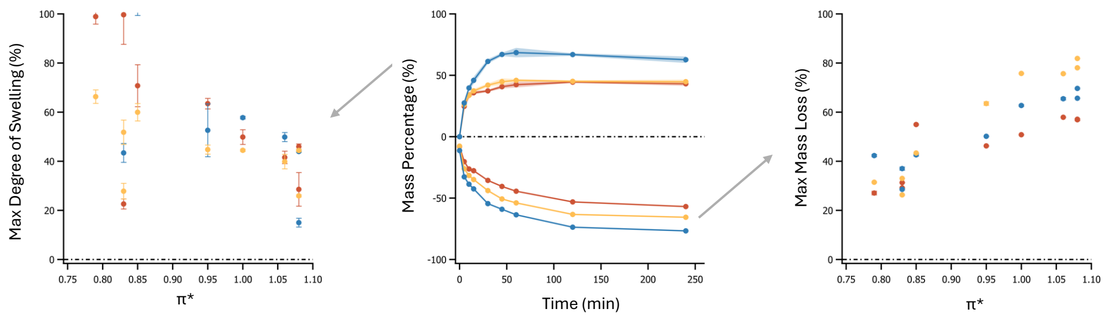
- ✓ High thermal stability
- ✓ Tuneable properties
- ✓ Ease of preparation
- ✓ Low volatility and toxicity
- ✓ Cheap components
- ✓ Biodegradable and biocompatible



SOLVENT LOSS & SWELLING

In order to study how the different DESs affect the capacity of the gel, we use the **degree of swelling** to quantify **water** uptake by the eutectogel, and **solvent loss** to assess the exchange between water and **DES** and the extent of DES release.

More polar DESs (higher π*) exhibited a reduced **degree of swelling** due to increased exchange with water, resulting in greater DES release.

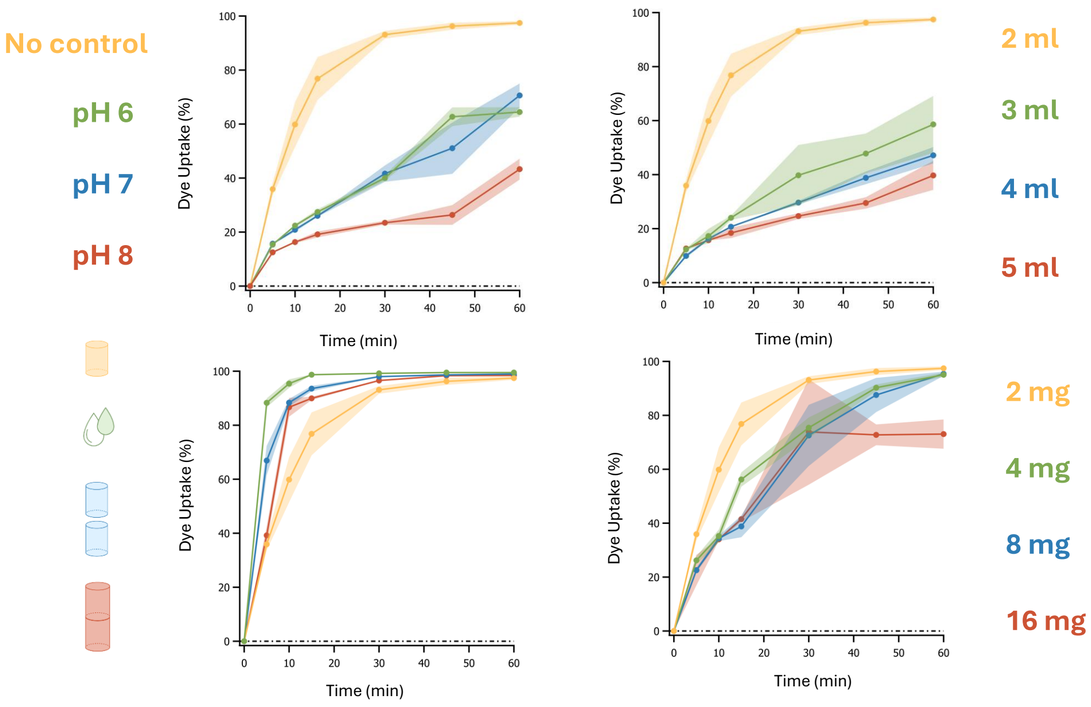


This trend was consistent across different loadings of PEGDA 575 (**20**, **30** and **40** w/w%).

CAPTURE CONTROLS

Dye capture of Cochineal Red was more efficient than **dye release**; therefore, uptake-focused controls were used to investigate factors influencing uptake rate.

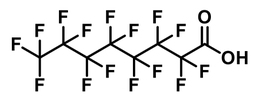
pH control (left) slowed down the process, indicating a pH-driven mechanism in which acidic conditions favour dye uptake. Increased **swelling volume** (right) also reduced the uptake rate as there was more dye present.



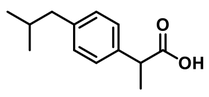
In contrast, increasing the **gel surface area** (left) enhanced uptake, while higher **dye concentrations** (right) slowed down the rate.

CONCLUSIONS & FUTURE WORK

- The **degree of swelling and mass loss** was found to be dependent on the polarity of DESs.
- **Dye release** was found to be more favourable in polar DESs while non-polar DESs favoured **dye capture**.
- Capture scope showed that different molecules can be uptaken faster. Can we use this to **treat wastewater** from a well-known contaminant such as PFAS?
- Can we make dye release better and can we use this for **drug delivery**?



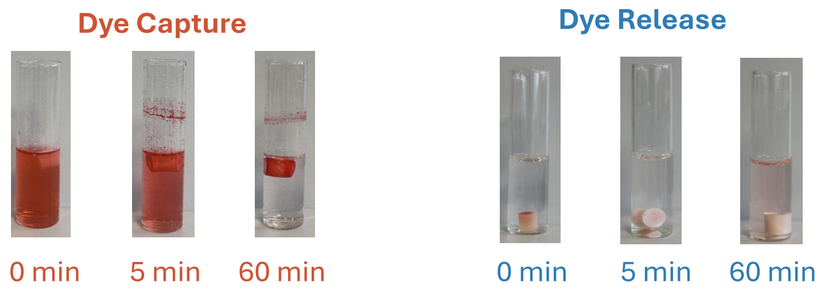
Perfluoro octanoic acid
water treatment



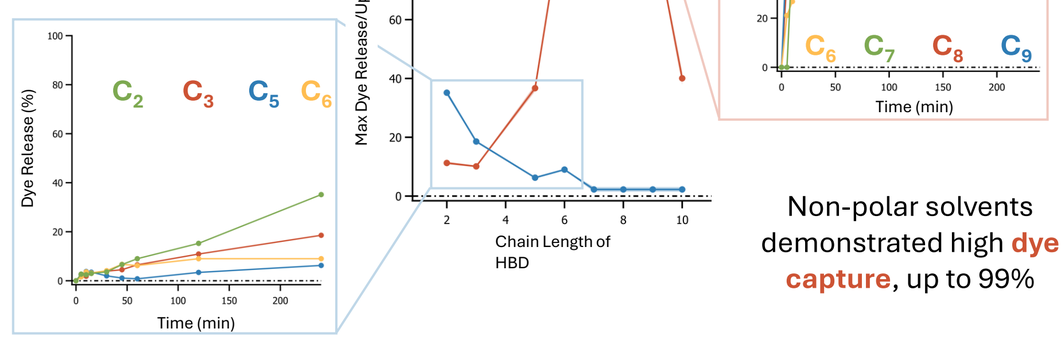
Ibuprofen
drug delivery

DYE CAPTURE AND RELEASE

Understanding how DES composition influences **dye capture** and **dye release** is critical for applications including drug delivery and wastewater treatment.



Polar solvents promoted **dye release** over **dye capture**

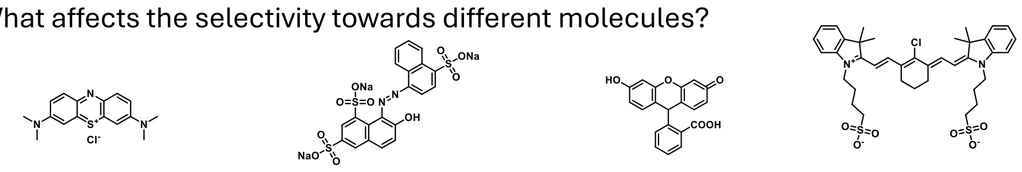


Non-polar solvents demonstrated high **dye capture**, up to 99%

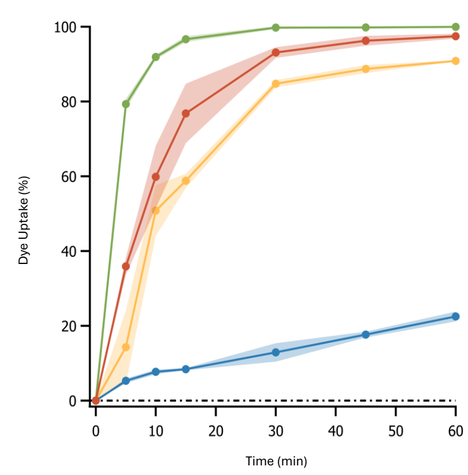
* 20 w/w% of PEGDA 575

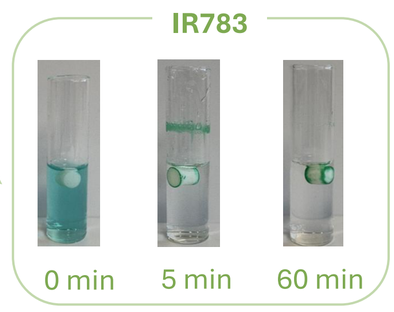
CAPTURE SCOPE

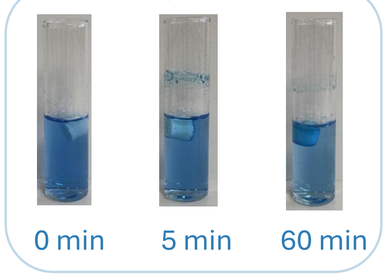
What affects the selectivity towards different molecules?



* 20 w/w% of PEGDA 575







Negatively charged dyes with high log P such as **IR783** were uptaken faster than other positively charged dyes (**Methylene Blue**).

REFERENCES

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