



## Selective heavy metal capture from contaminated water

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# Selective heavy metal capture from contaminated water with covalent organic polymer

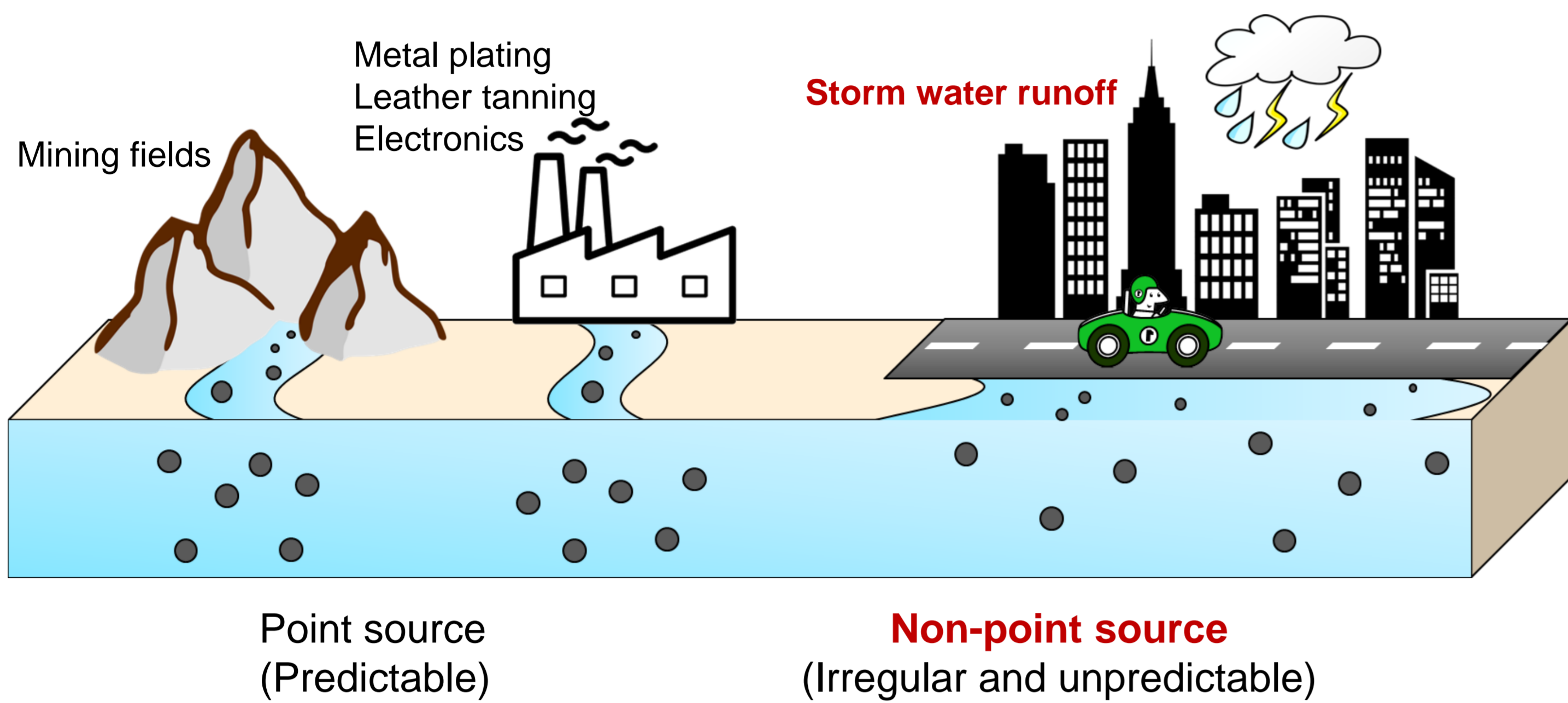


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## 1. Heavy metal contamination

Among various pollutants, **heavy metal ions** have been extensively generated for many years even though their toxicity toward human beings and the environment in general are well known.



## 2. Limitations & Aims of this study

### Limitations of current treatment systems

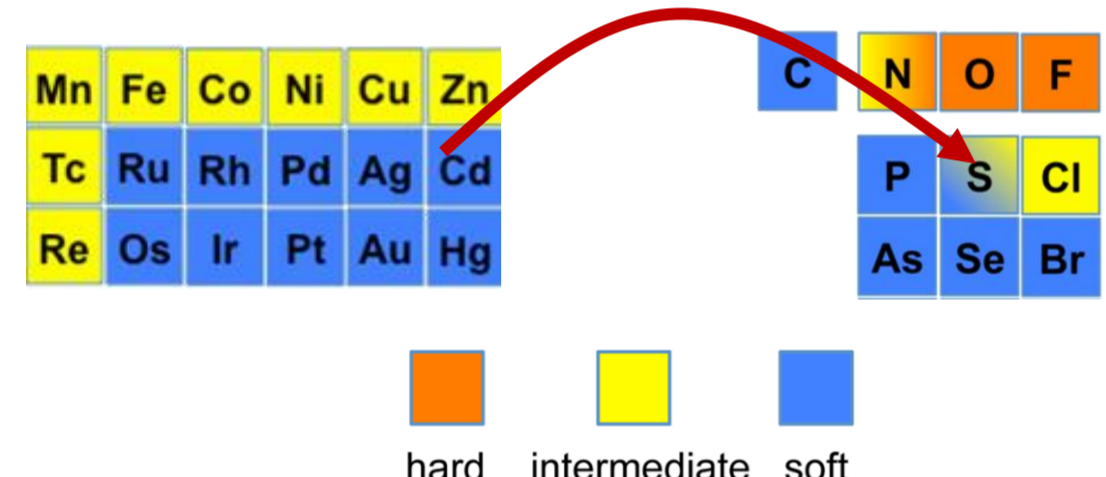
- Lack of adequate space for infrastructure in urban areas
- Cost inefficiency

### Suggesting new sorbent

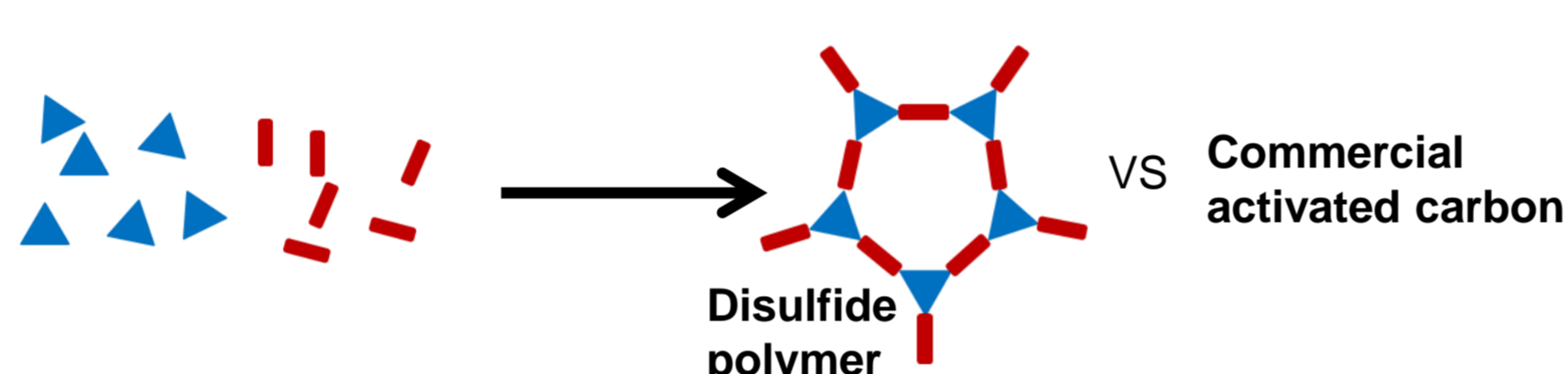
- ✓ High capacity → Facilitate compact treatment system in a city
- ✓ High selectivity → Specifically capture heavy metal in a presence of other cations
- ✓ Fast kinetics → Storm water has short retention time
- ✓ Robust structure from covalent bonding → Avoid to be swept away

## 3. Experimental methods

Principle: Hard Soft Acid Base theory



Phase 1: Design and synthesize stable polymer with sulfur functionality



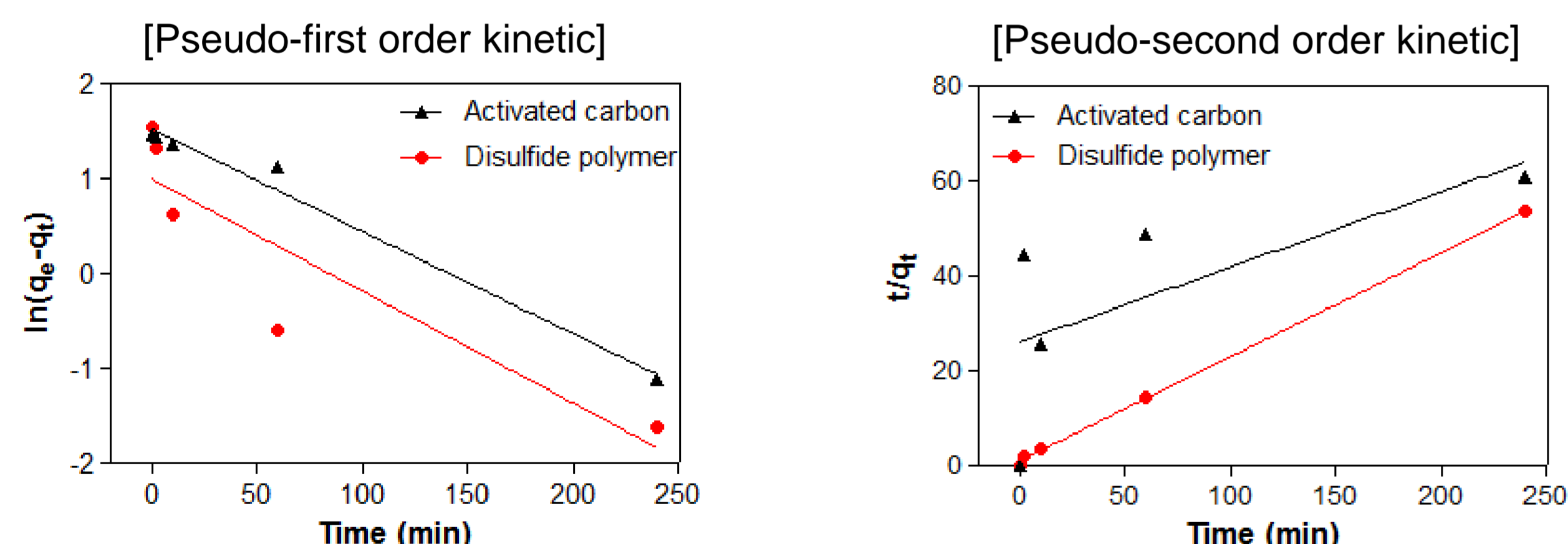
Phase 2: Heavy metal sorption test



1. Pure metal ion test
2. Adding  $\text{Ca}^{2+}$  or  $\text{Mg}^{2+}$  in metal solution
3. Sorption tests in different pH conditions

## 4. Result and Discussion

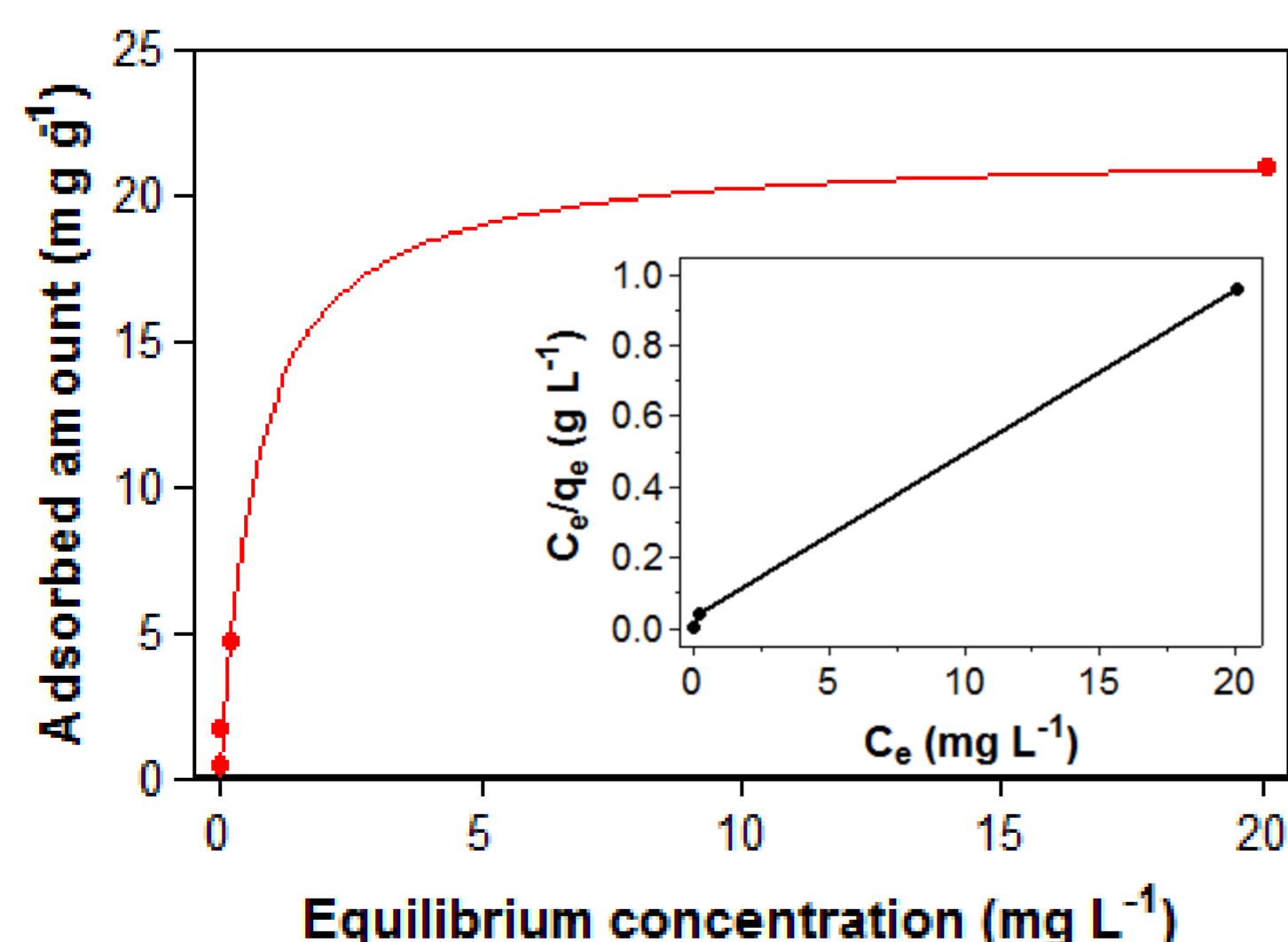
### Sorption kinetics



- ✓ Activated carbon sorption kinetic is suitable with pseudo-first order kinetic model (physisorption) and  $k_1$  is  $0.01 \text{ min}^{-1}$ .
- ✓ Whereas, disulfide polymer correlates to pseudo-second order kinetic model (Chemisorption) and has  $k_2$  of  $13.5 \text{ g mg}^{-1} \text{ min}^{-1}$ .

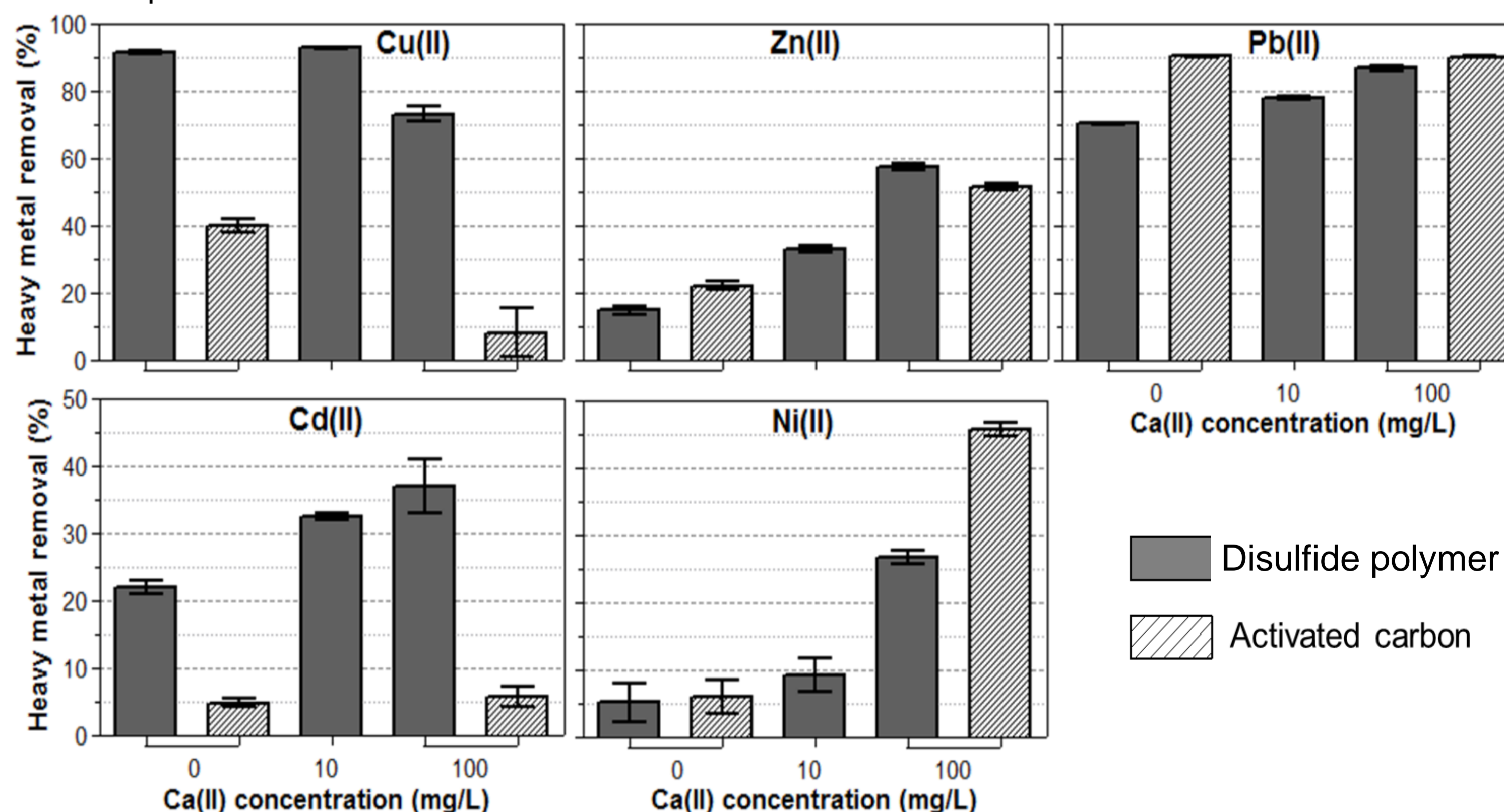
### Sorption capacity

	Disulfide polymer	Activated carbon
Maximum capacity (mg/g)	21.1	11.9
$K_d$ (ml/g)	$9.49 \times 10^5$	$4.28 \times 10^4$
Capacity per area (mg/m <sup>2</sup> )	0.14	0.01



### Selectivity

- ✓ Real wastewater also contains other cations such as  $\text{Ca}(\text{II})$  and this ions compete with heavy metal ions towards sorption sites of sorbent.
- ✓  $\text{Cu}(\text{II})$ ,  $\text{Zn}(\text{II})$ ,  $\text{Pb}(\text{II})$ ,  $\text{Cd}(\text{II})$  sorption test showed that in the presence of  $\text{Ca}(\text{II})$ , disulfide polymer shows higher selective capture ability than activated carbon.  $\text{Ni}(\text{II})$  exhibited opposite result, compared to other metals.



- ✓ Disulfide polymer has 2 times higher sorption capacity and 10 times higher surface area capacity compare to commercial activated carbon.
- ✓ Water-solid partition coefficient shows higher than  $10^5$ , which indicates polymer is an excellent sorbent.

## 4. Conclusion

### Designed porous polymer

- ✓ Facilitate disulfide functionalized polymers by simple reaction & mild condition.
- ✓ Sulfide group gives strong affinity towards heavy metal ions.

### Performance

- ✓ Achieved 99.9% removal of Cd ions.
- ✓ Selectively capturing heavy metal ions in the presence of other cations.

### Application

- ✓ Storm water runoff treatment in urban area.
- ✓ Less turn over rate of column.

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