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Enhanced anaerobic degradation by conductive materials

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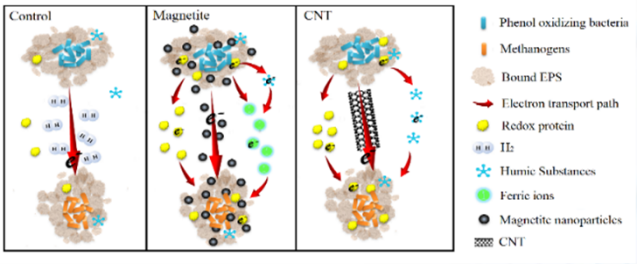
Introduction

- Anaerobic digestion is often interrupted by toxic compounds and its efficiency may be limited by the activity of methanogensis.
- Direct electron transfer could enhance syntrophic methanogensis.
- A strategy to accelerate anaerobic degradation and mitigate toxicity was developed in this project.



Operational procedure

Phase 1: 133 mg/L phenol and glucose
↓
Phase 2: 200mg/L phenol
↓
Phase 3: 400mg/L phenol
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Phase 4: 600mg/L phenol
↓
Phase 5: 800mg/L phenol
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Phase 6: 1000mg/L phenol

Result 1: Stimulated CH_4 production rate

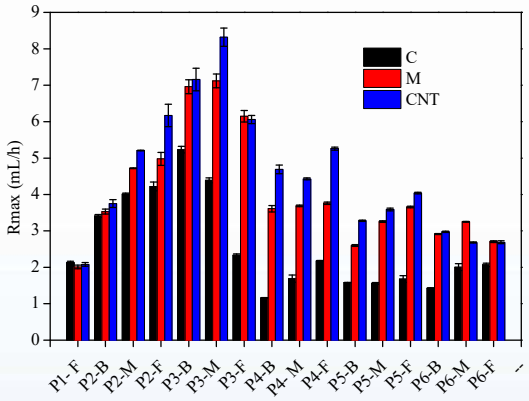

Figure 1. Maximum CH_4 production rate (*Rmax*)
C: Control group, M: Magnetite nanoparticles supplemented group, CNT: Carbon nanotube supplemented group. P1- P6 are the abbreviation of phase 1 to phase 6

Result 2: Enrichment of electroactive methanogens

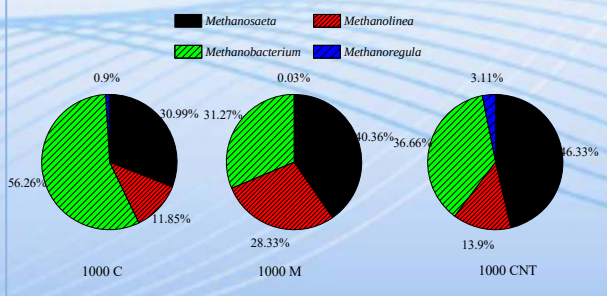

Figure 2. Relative abundance of archaea in phase 6.
1000: 1000 mg/L phenol .

Result 3: Enrichment of functional genera

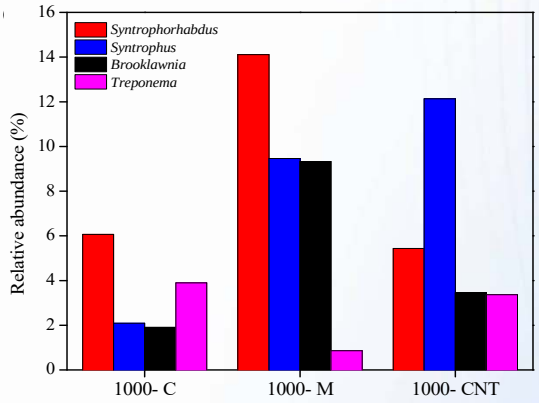

Figure 3. Relative abundance of identified phenol degradation bacteria in phase 6.
1000: 1000 mg/L phenol.

Result 4: Role of EPS in electrons shuttle

Table 1. Quantification of sub-fractions (mg-C/L) of observed organic compounds in EPS.

Sample	High molecular weight protein	Low molecular weight protein	Humic substances	Building blocks
SB-C	7.54	12.27	8.12	4.89
SB-M	4.67	234.82	4.94	3.65
SB-CNT	6.92	105.77	25.20	22.66
LB-C	1.27	7.12	1.10	1.16
LB-M	1.92	24.91	3.02	4.52
LB- CNT	1.64	18.85	1.39	2.19
TB-C	1.45	13.95	0.63	2.52
TB-M	2.41	24.25	1.71	3.56
TB- CNT	0.16	29.25	0.24	0.53

Conclusions

- CMs could act as electron conduit to facilitate interspecies electron transfer.
- CMs altered the EPS constitutions.
- CMs enhanced the growth of functional genera.