

Supporting Information

Research on Treatment of Oily Sludge from Tank Bottom by Ball Milling Combined with Ozone Catalyzed Oxidation

Hong-Shuo Chen, Qi-Ming Zhang, Zi-Jian Yang, Yang-Sheng Liu*

**†College of Environmental Sciences and Engineering, Peking University, Beijing 100871,
People's Republic of China.**

E-mail: yshliu2018@163.com

Content

Table S1. Heavy metal content in oily sludge

Table S2. Particle size distribution of solid from oily sludge

Table S3. Properties of NAO and CAO catalysts

Table S4. Reaction parameters of ozone oxidation and ozone catalytic oxidation processes

Table S5. Analysis and comparison of CO, BO and BOO from oily soil

Figure S1. Catalyst preparation process

Figure S2. Micromorphology of the oily sludge (a) 50× ; (b)200×

Figure S3. Thermal gravimetric analysis of CO, BO and BOO from oily sludge

Table S1. Heavy metal content in oily sludge

Heavy metal category	Measured value/mg•kg ⁻¹	Standard value/mg•kg ⁻¹
Cd	<10	<15
Hg	0	<15
Pb	<150	<1 000
Cr	205	<1 000
As	<50	<75
Cu	115	<1 500
Zn	200	<3 000
Ni	65	<200

Table S2. Particle size distribution of solid from oily sludge

Particle size/μm	Content/wt%
>600	21.47
325-600	14.94
120-325	10.01
45-120	16.56
38-45	9.82
<38	27.20

Table S3. Properties of NAO and CAO catalysts

Item	Surface area/ (m ² •g ⁻¹)	Pore volume/ (cm ³ •g ⁻¹)	Pore diameter/ nm	pH _{pzc}
CAO	1.143	0.004	13.97	11.48
NAO	0.873	0.002	9.46	7.20

Table S4. Reaction parameters of ozone oxidation and ozone catalytic oxidation processes

Item	Reaction rate constant k/ min ⁻¹		Activation energy Ea/ (kJ mol ⁻¹)
	308.15K	318.15K	
COP with CAO	0.074	0.086	12.249
COP with NAO	0.028	0.035	18.188
SOP	0.009	0.021	69.062

Table S5. Analysis and comparison of CO, BO and BOO from oily soil

Items	CO	BO	BOO
SARA analysis/wt%			
Saturates	43.72	50.59	47.25

Aromatics	30.64	38.22	46.36
Resins	13.18	8.25	4.84
Asphaltenes	12.46	2.94	1.55
Elemental content/wt%			
C	81.26	82.37	81.14
H	12.48	14.87	11.58
O	2.88	0.98	4.76
N	0.55	0.31	0.48
S	2.83	1.47	2.04
Density/(g•cm ⁻³)(20°C)	0.9435	0.9218	0.9124
Viscosity/(mm ² •s ⁻¹) (80°C)	57.82	52.17	47.25
pH	7.62	7.58	6.34
Calorific value/(kJ•kg ⁻¹)	43,217	46,654	41,755

Figure S1. Catalyst preparation process

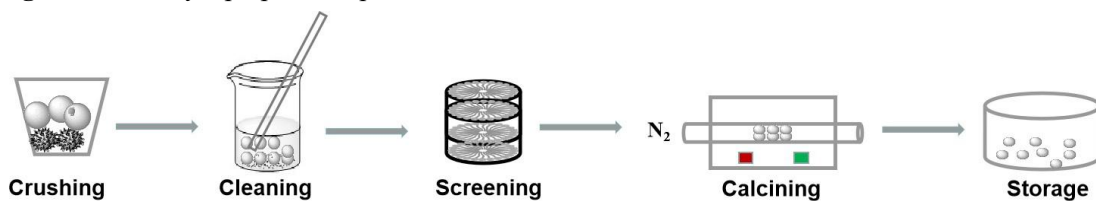


Figure S2. The micromorphology of the oily sludge (a) 50 \times ; (b)200 \times

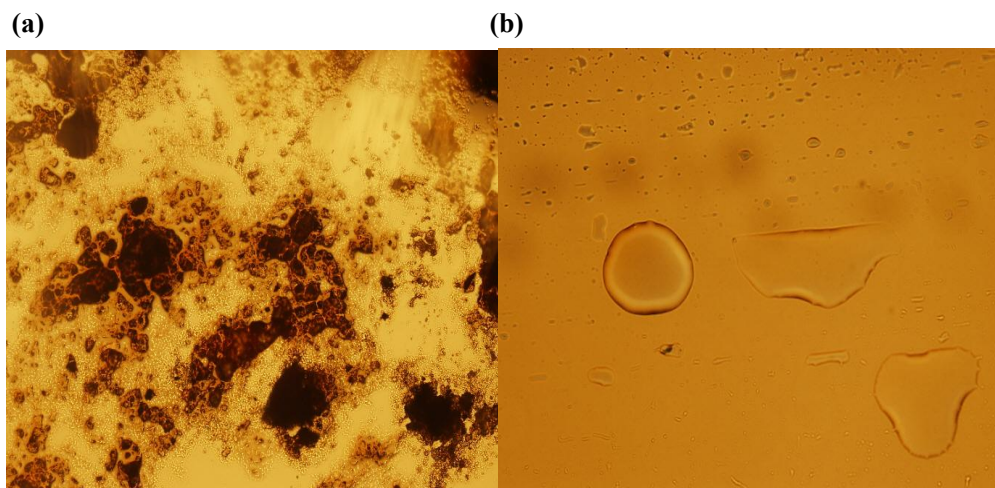


Figure S3. Thermal gravimetric analysis of CO, BO and BOO from oily sludge

