

Supplementary information

Effects of poplar addition on tar formation during the co-pyrolysis of fat coal and poplar at high temperature

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Table S1 Chemical compounds in tar from fat coal, poplar and their blends obtained from GC-MS analysis(%).

Table S2 Band assignments of proton types in ¹H NMR spectra.

Fig. S1 Schematic diagram of self-made tar collecting device.

Table S1 Chemical compounds in tar from fat coal, poplar and their blends obtained from GC-MS analysis(%).

No.	Time/min	Compounds	F tar	FP4 tar	FP8 tar	FP12 tar	FP16 tar	FP32 tar	P tar
1	2.63	Furfural	-	-	-	-	1.01	1.02	1.09
2	2.77	2-Furanmethanol	-	-	-	-	-	-	1.12
3	3.03	m-Xylene	1.10	2.26	1.69	1.94	2.21	1.07	-
4	3.10	n-Butyl ether	1.35	2.99	2.63	4.30	3.14	1.04	1.30
5	3.39	Propanoic acid butyl ester	3.45	6.82	6.10	8.45	6.75	2.28	3.14
6	4.05	2-methyl-Propanoic acid, butyl ester	1.57	1.01	2.33	3.33	1.02	1.03	1.01
7	4.47	Phenol	2.85	4.51	6.37	7.5	5.82	4.83	8.26
8	4.78	Butanoic acid butyl ester	13.55	8.65	13.49	14.33	7.97	4.35	8.76
9	4.87	1,2,4-Trimethylbenzene	1.17	2.10	1.64	1.46	1.98	1.30	-
10	5.31	2-hydroxy-3-methyl-1-one	-	-	-	-	-	-	1.77
11	5.79	2-Methylphenol	4.02	4.93	6.17	8.74	4.95	3.98	2.96
12	6.18	3-Methylphenol	5.73	6.45	8.95	9.06	6.75	4.83	3.92
13	6.46	1-Ethyl-3,5-dimethylbenzene	-	1.02	1.64	1.09	1.28	2.61	8.48
14	7.50	2,4-Dimethylphenol	3.24	3.25	3.22	2.70	3.43	3.32	1.75
15	7.87	3,5-Dimethylphenol	1.60	1.47	1.54	1.25	1.51	1.66	-
16	8.32	2,3-Dimethylhydroquinone	3.42	4.41	4.32	4.02	3.38	4.12	14.83
17	9.27	2-ethyl-5-Methylphenol	1.46	1.15	1.39	1.59	1.22	2.67	-
18	9.37	3-ethyl-5-Methylphenol	1.25	-	-	-	-	-	4.51
19	9.70	4-ethyl-2-Methoxyphenol	-	-	-	-	-	-	4.81
20	9.84	4-methyl-Benzenediol	-	-	-	-	-	-	4.30
21	10.15	2-methyl-Naphthalene	4.91	4.88	3.77	3.74	4.48	4.56	-
22	10.27	2-methoxy-4-Viinyphenol	-	-	-	-	-	-	3.33
23	10.39	2-methyl-Naphthalene	2.24	2.20	1.83	1.73	2.15	2.34	-
24	10.79	2,6-Dimethoxyphenol	-	-	-	-	-	-	2.53
25	11.26	4-Ethylcatechol	-	-	-	-	-	-	2.40
26	11.57	Tetradecane	-	-	-	-	-	-	1.51
27	11.66	2-methoxy-5-(1-propenyl)-Phenol	-	-	-	-	-	-	1.10
28	11.80	1,5-Dimethylnaphthalene	1.81	1.73	1.44	2.49	1.46	2.20	-
29	11.99	1,7-Dimethylnaphthalen	3.45	3.15	2.98	2.36	2.85	3.20	-
30	12.29	1,3-Dimethylnaphthalene	1.78	1.78	1.78	1.94	2.27	3.73	4.64
31	12.45	Biphenylene	-	-	-	-	1.11	1.42	-
32	13.19	1,4,6-Trimethylnaphthalene	1.46	1.31	1.34	1.04	2.04	3.38	-
33	13.33	1-Naphthalenol	-	-	-	-	-	-	1.19
34	14.28	Fluorene	2.13	1.94	1.74	1.32	1.57	2.76	-
35	15.50	5-ethyl-5-Propylundecane	-	-	-	-	-	-	1.58
36	16.75	Anthracene	2.21	1.99	1.89	1.66	1.92	2.28	-
37	18.01	9-Methylantracene	1.49	1.42	1.29	1.04	1.22	1.45	-
38	18.08	1-Methylantracene	2.03	1.78	1.71	1.25	1.63	1.96	-
39	18.28	2-Methylantracene	1.78	1.58	1.44	-	1.16	1.60	-
40	18.81	4-Methylphenanthrene	1.46	1.02	1.14	-	1.05	1.54	-
41	19.45	2,5-Dimethylphenanthrene	2.21	1.99	1.84	-	1.69	2.04	-
42	20.37	Pyrene	1.21	1.06	-	-	1.01	1.09	-
43	21.27	Benzofluorene	1.39	1.32	1.14	-	1.05	1.30	-
44	22.38	o-Terphenyl	2.03	1.93	-	-	1.08	2.04	-
45	23.55	Chrysene	1.74	1.31	-	-	1.03	1.07	-
46	24.51	1-Methylchrysene	1.35	1.26	-	-	1.01	1.04	-
		Others*	17.56	15.33	13.19	11.67	15.80	18.89	9.71

*Tar components with their individual content less than 1.00%.

Table S2 Band assignments of proton types in ^1H NMR spectra.

Proton type	Chemical shift (ppm)	Assignment
H_{ar}	6.3-9.5	Aromatic protons
H_{ar2}	8.3-9.5	Aromatic hydrogens sterically hindered: 'bay', 'fjord' and other geometrically similar zones in angular polycyclic aromatic compounds; aromatic hydrogens in very pericondensed polycyclic aromatic compounds.
H_{ar1}	6.3-8.3	All the other aromatic hydrogens
H_{al}	0.5-4.5	Aliphatic protons
H_{α}	2.1-4.5	Protons of CH , CH_2 or CH_3 in the α position to the aromatic
H_{β}	1.2-2.1	Protons of CH or CH_2 in the β position or further away from the aromatic ring/Protons of CH_3 in the β position of aromatic ring
H_{γ}	0.5-1.2	Protons of CH_3 in the γ position or further away from the aromatic ring

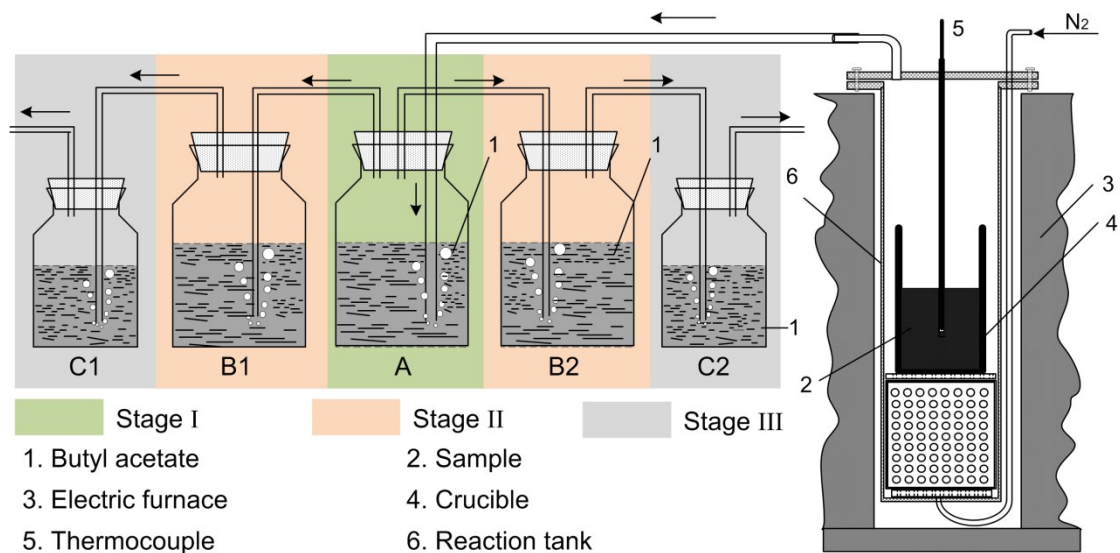


Fig. S1 Schematic diagram of self-made tar collecting device.