Structural Variation of Lignin and Lignin−Carbohydrate Complex in Eucalyptus grandis × E. urophylla during Its Growth Process

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ACS Sustainable Chemistry & Engineering

DOI:
10.1021/acssuschemeng.6b02396

Published: 01/01/2017

Peer reviewed version

Table 1

Quantification of the functional groups (mmol/g) in the lignins of L and PL using a quantitative ^{31}P-NMR method

	Al-OH	S-type OH		G-type OH		H-type OH	COOH	Active sites[c]
		C[a]	NC[b]	C	NC			
L	1.48	0.16	0.47	0.23	0.93	0.68	1.48	2.29
PL	0.24	0.25	0.58	0.21	0.77	3.14	0.61	7.05

[a]C, condensed.
[b]NC, non-condensed.
[c]Active sites means that how much of active sites available for the subsequent chemical modification; Active sites = G-type OH (NC) + H-type OH × 2.

Table 2

The element analysis of lignins

Samples	Elements contents (%)			
	C	H	N	S
L	63.48	5.83	-	-
SAPL-1.0	61.16	6.44	8.37	8.60
SAPL-1.5	58.28	7.63	8.38	11.98
SAPL-2.0	57.50	7.64	10.12	14.10
SAL-1.5	60.84	6.64	5.40	4.39

Table 3

Adsorption capacities of Pb (II) by some lignin-based materials reported in literatures.

Adsorbent	Adsorption capacity (Pb^{2+})	References
Black liquor lignin	89.5	10
Dithiocarbamate functionalized lignin	103.4	17
Alkali glycerol lignin	9.0	18
Ammoniated and sulfonated lignin	53.9	20
Formic lignin	122.3	21
Aminated epoxy-lignin	55.4	42
Porous lignin-based sphere	27.1	43
SAPL-1.5	130.2	Present study

Table 4

Langmuir and Freundlich model fitting parameters for Pb (II) adsorption on SAPL-1.5.

Isotherm model	Parameter	Value
Langmuir model	Q_m (mg/g)	136.9
	K_L (L/mg)	0.2099
	R^2	0.9940
Freundlich model	Q_m (mg/g)	163.2
	K_F (mg/g)(L/mg)$^{1/n}$	45.7752
	n	3.8864
	R^2	0.9677

Table 5

Adsorption kinetics fitting results for Pb (II) on SAPL-1.5 by pseudo-first-order and pseudo-second-order models.

Isotherm models	Parameters	Values
Pseudo-First-Order Model	Q_e (mg/g)	132.3
	k_1 (/min)	0.3047
	R^2	0.7618
Pseudo-Second-Order Model	Q_e (mg/g)	108.7
	$k_2 \times 10^{-2}$ [g/ (mg·min)]	0.1889
	R^2	0.9978